Is Separate Still Unequal? New Evidence on School Segregation and Racial Academic Achievement Gaps

sean f. reardon
Stanford University

Ericka S. Weathers
The Pennsylvania State University

Erin M. Fahle
St. John's University

Heewon Jang
Demetra Kalogrides
Stanford University

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Direct correspondence to sean f. reardon, Stanford University, 520 Galvez Mall, Stanford, CA 94305. Email: sean.reardon@stanford.edu. Some of the data used in this paper was provided by the National Center for Education Statistics (NCES). The research described here was supported by grants from the Spencer Foundation, the William T. Grant Foundation, the Bill and Melinda Gates Foundation and the Overdeck Family Foundation. The opinions expressed here are ours and do not represent views of NCES, the U.S. Department of Education, or any of the aforementioned funding agencies.

Sean F. Reardon (sean.reardon@stanford.edu), Demetra Kalogrides (dkalo@stanford.edu), Heewon Jang (heewonj@stanford.edu), Stanford University, 520 Galvez Mall, Stanford, CA 94305, (650.736.8517).
Ericka S. Weathers (esw71@psu.edu) 300 Rackley Building, University Park, PA 16802, (814.863.3769).
Erin M. Fahle (fahlee@stjohns.edu), St. John's University, 8000 Utopia Parkway, Sullivan Hall 516, Queens, NY 11439 (718.990.6325).

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ABSTRACT

U.S. public schools are highly segregated by both race and class. Prior research shows that the desegregation of Southern schools in the 1960s and 1970s led to significant benefits for black students, including increased educational attainment and higher earnings. We do not know, however, 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 patterns. In this paper we estimate the effects of current-day school segregation on racial achievement gaps. We use 8 years of data from all public school districts in the U.S. We find that racial school segregation is strongly associated with the magnitude of achievement gaps in 3rd grade, and with the rate at which gaps grow from third to eighth grade. The association of racial segregation with achievement gaps is completely accounted for by racial differences in school poverty: racial segregation appears to be harmful because it concentrates minority students in high-poverty schools, which are, on average, less effective than lower-poverty schools. Finally, we conduct exploratory analyses to examine potential mechanisms through which differential enrollment in high-poverty schools leads to inequality. We find that the effects of school poverty do not appear to be explained by differences in the set of measurable teacher or school characteristics available to us.

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INTRODUCTION

Sixty-five years ago, the Supreme Court ruled that state-mandated racial school segregation was unconstitutional. Fifteen years later—now fifty years ago—the desegregation of Southern school districts began in earnest. Those efforts were predicated on the belief that school segregation *per se* contributed to educational inequality in America. Racial achievement gaps declined substantially during the 1970s and 1980s (Reardon, Robinson-Cimpian, and Weathers 2015) providing evidence that desegregation could reduce inequality in educational outcomes. Studies of the effects of the desegregation of Southern school districts during this time show that desegregation had a positive impact on black students and no negative impact on white students (Ashenfelter, Collins, and Yoon 2006; Guryan 2004; Johnson 2019).

However, the desegregation efforts of the late 1960s and early 1970s did not last; public schools today remain highly segregated both by race and class. Moreover, there is little broad or sustained policy interest in creating more integrated schools. The country has retreated from the belief that segregation itself is harmful, quietly settling for an education policy regime that accepts segregated schools as a given and asserts that it is possible to have equally high quality schools in every neighborhood, regardless of racial or economic composition.

This position assumes that segregation today is not harmful in the way that *de jure* segregation was in the South. Legally-mandated segregation may have 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 funding impacts of Southern desegregation appear to be a key reason why desegregation was beneficial for black students (Johnson 2019). In recent decades, court-ordered or legislative school finance reforms have increased funding in low-income school districts, reducing or eliminating between-district funding disparities in many states (Lafortune, Rothstein, and Schanzenbach 2018). Thus, it is not clear that segregation today is attended by the same level of resource inequity as was the case prior to the 1960s. Given both the shift from *de jure* to *de facto* segregation and decrease in school resource inequalities that accompanied *de jure* segregation, we do not know whether—or how—school segregation today leads to unequal educational opportunities.

Our goal is to provide evidence regarding these questions. Using standardized test scores from grades 3-8 in the 2008-09 through 2015-16 school years from nearly all public schools in the U.S., we examine the association between school segregation patterns and racial achievement gaps between white and black students and between white and Hispanic students within school districts, counties, and metropolitan areas in the U.S. We leverage variation in segregation both between places (in cross-sectional models) and within places (in fixed-effects panel models) to identify the nature and magnitude of the associations between segregation, achievement gaps, and the rate at which the achievement gaps change as children progress through school. Finally, we explore the mechanisms through which segregation may operate by testing whether differences in school and teacher characteristics account for the association between segregation and racial achievement gaps. Given the unprecedented scale of our data, our analysis provides the most comprehensive evidence to date regarding the relationship between segregation and academic achievement gaps.

Our models are not intended to provide unbiased causal estimates of the effect of segregation on achievement gaps, as we do not have a clearly exogenous source of variation in segregation with which to identify the effect. School segregation may be correlated with features of communities that lead to large achievement gaps by the time children enter kindergarten; if this is the case the observed association of school segregation and achievement gaps may be provide a biased estimate of the causal effect of segregation. However, we reason that if school segregation affects achievement gaps, we would expect to observe several patterns in the data: 1) school segregation should be positively associated with achievement gaps, after controlling for between-group differences in family background and neighborhood segregation; 2) school segregation should be associated not just with the size of the achievement gap but also with its growth as children progress through school. We examine these associations at multiple levels of geography (i.e. districts, counties, metropolitan areas) and for different group comparisons (i.e. white-black and, white-Hispanic). Evidence that these conditions hold strongly suggests, but not prove, that segregation affects achievement gaps. Given the extent of racial and economic school segregation, knowing if and how segregation affects achievement gaps has broad and important implications for education policy.

A STYLIZED CONCEPTUAL MODEL

We examine racial test score gaps because they reflect racial differences in access to educational opportunities. By "educational opportunities," we mean all experiences in a child's life, from birth onward, that provide opportunities for her to learn, including experiences in children's homes, child care settings, neighborhoods, peer groups, and their schools. This implies that test score gaps may result from unequal opportunities either in or out of school; they are not necessarily the result of differences in school quality, resources, or experiences. Moreover, in saying that test score gaps reflect differences in opportunities, we also mean that they are not the result of innate group differences in cognitive skills or other genetic endowments. While differences in two *individual* children's academic performance may reflect both individual differences and differences in educational opportunities, differences in *average* scores should be understood as reflecting opportunity gaps, given that there are not between-group average differences in genetic endowments or innate academic ability (Nisbett, Aronson, Blair, Dickens, Flynn, Halpern and Turkheimer, 2012; Nisbett 2009; Nisbett 1998).

A study of the relationship between segregation and achievement gaps is therefore a study of the relationship between segregation and the inequality of educational opportunities. To make this clear, consider a stylized model that expresses academic performance (Y_{isd}) of student i in school s in district (or county or metropolitan area) d as a function of student characteristics (denoted by the vector $\mathbf{X}_i$), school characteristics (denoted $\mathbf{Z}_s$), district characteristics (expressed here by a district fixed effect $\mathbf{\Lambda}_d$), and an independent, mean-zero error term e_{isd}:

$$Y_{isd} = \mathbf{X}_i\mathbf{B} + \mathbf{Z}_s\mathbf{\Gamma} + \mathbf{\Lambda}_d + e_{isd}. \tag{1}$$

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 $\bar{\mathbf{X}}_{gd}$ denotes the expected value of $\mathbf{X}$ among students of group g 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 (2), as they are common to white and black students.

If the vector $\mathbf{Z}$ contains a measure of school composition (say, percent of group h in school s, denoted P_s^h), then $\bar{P}_{wd}^h$ is simply the exposure index of white students to group h (the proportion of group h in the average white student's school in district d), and $\bar{P}_{bd}^h$ is the exposure of black students to group h. The achievement gap is a function of $\Delta P_d^h = \bar{P}_{wd}^h - \bar{P}_{bd}^h$, the difference in exposure of whites and blacks to group h. Note that ΔP_d^h is a standard measure of segregation (Reardon and Owens, 2014).

This suggests 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 ΔI_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):

$$\Delta Y_d = \Delta \mathbf{P}_d \mathbf{A} + \Delta \mathbf{X}_d \mathbf{B} + \Delta \mathbf{Z}_d \mathbf{\Gamma} + u_d. \tag{4}$$

This model forms the basis of our analytic strategy in this paper. We are interested $\mathbf{A}$, in the coefficient on racial segregation, and $\mathbf{\Gamma}$, the vector of coefficients on racial differences in school characteristics.

HOW AND WHEN MIGHT SEGREGATION AFFECT ACHIEVEMENT GAPS?

Racial disparities in educational opportunities begin early in children's lives, as a result of large racial differences in average family income. These economic differences yield differences in 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 (Magnuson et al. 2004; Bassok and Galdo 2016; Valentino 2018; Bassok, Finch, Lee, Reardon and Waldfogel 2016). As a result of these differences in educational experiences and opportunities in early childhood, racial achievement gaps are very large when children enter kindergarten (Portilla and Reardon 2016; Bassok at al. 2016).

These achievement gaps may grow throughout K-12 schooling if black and Hispanic students attend lower-quality schools than their white peers. Schools enrolling high proportions of black or Hispanic also typically enroll high proportions of low-income students. Such schools often have less-skilled, less-experienced, and less-qualified teachers than low-poverty schools (Peske and Haycock 2006). In part this is a result of patterns of teacher placement and attrition. Teachers are more likely to leave high-poverty and high-minority schools, constantly leaving them with more novice and uncredentialed teachers (Scafidi, Sjoquist and Stinebrickner 2007; Hanushek, Kain and Rivkin (2004). Thus, when black and Hispanic students are concentrated in high-poverty schools, they may have fewer highly educated, skilled, and experienced teachers than their white peers. This may lead to widening racial achievement gaps during the schooling years (Scafidi et al. 2007), though there is not yet strong or clear evidence relating teacher distribution patterns to the development of achievement gaps.

The concentration of minority students in high-poverty schools may affect educational opportunity gaps and achievement gaps through other mechanisms as well. High-poverty schools have fewer students whose parents have substantial political, social, and economic capital that they can employ to support the school and its students. Thus, there may less potential for beneficial spillover effects on students in such schools. Students in high-poverty schools also have lower average academic skills prior to enrollment; this may lead teachers in such schools to focus their instruction and curricula more on basic skills. There may also be fewer advanced courses and curricular offerings in middle school, and less demand or capacity for gifted/talented programs or other advanced curricula.

Black and Hispanic students also tend to live in racially isolated neighborhoods. Even among households with the same annual income, blacks and Hispanics still reside in lower income neighborhoods than whites (Reardon, Fox and Townsend, 2015). Families residing in disadvantaged neighborhoods may have less access to high-quality preschools, fewer neighbors with high levels of education, social and political capital who can provide role models and support, more exposure to violence and crime (Patillo, 2013), fewer social services (e.g. physical and mental health care), fewer opportunities for extracurricular activities,. All of these factors may shape educational opportunities and cognitive development both in early childhood and during school.

Segregation may also lead to differences in school funding between the schools of white and minority students. In states with weak compensatory school finance systems, poorer school districts may have less funding than richer districts. If minority students are disproportionately concentrated in poorer school districts, their schools will have fewer resources. Even in places where the funding for high- and low-poverty schools is nominally equal, high-poverty schools typically have greater financial needs, given their larger shares of students identified as needing special education services and their often larger shares of English Learner students. Furthermore, wealthier (and often whiter) school districts tend to receive more private donations from school supporting non-profits which can slightly increase per pupil revenue and expenditures, 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 2019).

The above discussion suggests that racial segregation may have consequences for educational achievement not because of the race of one's schoolmates, but because of the link between school racial composition and student poverty rates. Racial segregation may concentrate minority students in high-poverty schools that provide significantly lower levels of educational opportunity than schools serving higher-income students. Racial segregation also concentrates white students in advantaged neighborhoods with better early childhood programs, less crime, more highly educated neighbors, and better public services and supports. As such, segregation in schools and neighborhoods may stratify educational opportunity both prior to school entry and during the schooling years.

PRIOR RESEARCH ON THE EFFECTS OF SCHOOL SEGREGATION

Desegregation, Resources, and Achievement

During the 1960s through 1980s, black students gained increased access to school resources as a result of school desegregation and subsequent enrollment in historically white and well-resourced schools (Johnson 2019). In southern states such as Louisiana, not only did black students gain access to additional school resources through enrolling in traditionally white schools, desegregation was also accompanied by significant changes in the state's school funding system. These changes led to substantial increases in funding for the schools attended by black students (Reber 2010). The expanded access to school resources, such as higher per pupil expenditures and smaller student-to-teacher ratios, for black students improved high school completion rates, educational attainment, socioeconomic status, and health outcomes for blacks (Ashenfelter et al. 2006; Guryan 2004; Johnson 2019; Reber 2010).

The research on the consequences of desegregation in the 1960s and 1970s makes clear that the stratification of educational opportunity (i.e. resources) was an important mechanism linking segregation and educational outcomes prior to the 1970s. It also suggests that the negative effects of segregation can be mitigated by altering the resource contexts of socioeconomically disadvantaged racial minority students. Therefore, if racial disparities in access to resources is the key mechanism through which segregation impacts educational outcomes, we would expect that districts, metropolitan areas, and counties with greater levels of racial disparities in poverty will have larger and widening achievement gaps.

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 score data from 1998 to 2001, Card and Rothstein (2007) find that black-white score gaps were larger in more residentially segregated cities. Net of neighborhood segregation, however, they found that school segregation had no independent association with racial gaps in SAT scores. In contrast, Reardon (2016) finds that school segregation is more predictive of racial achievement gaps than neighborhood segregation in grades three through eight. Reardon (2016) suggests that the discrepancy is a result of the fact that Card and Rothstein (2007) did not fully control for other dimensions of segregation. Moreover, Reardon's data is based on standardized test scores taken by all students, rather than a self-selected sample of SAT takers. Reardon (2016) also found that, among many dimensions of segregation, racial disparities in average school poverty rates were the most powerful correlates of racial achievement gaps. Net of racial disparities in school poverty rates, racial segregation per se was not associated with achievement gaps, suggesting that the mechanisms through which school segregation is related to achievement gaps are driven by the concentration of minority students in high poverty schools, a finding consistent with the discussion of segregation mechanisms above. This is also consistent with Owens' (2016) 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. Note, however, that neither Reardon (2016), Card and Rothstein (2007), nor Owens (2018) examine the association between segregation and the growth of achievement gaps as children progress through school.

Two studies provide some evidence about the effect of racial segregation on achievemnt gaps or other educational disparities. Condron and colleagues (2013) use two-way fixed effects (state and year fixed effects) model to assess the association of within-state school segregation (between schools) on white-black gaps in NAEP scores between 1991 and 2009. They found that higher levels of segregation—as measured by the dissimilarity, black isolation, and black-white exposure indices--were related to larger 4th grade state-level NAEP achievement gaps. Lutz (2011) shows that when school districts were released from court-ordered desegregation plans in the late 1990s or 2000s, black students' dropout rates were higher than in comparable districts not released from desegregation plans. This finding held only in non-Southern districts, however, and is based on a relatively small sample of school districts.

Overall, the existing literature on segregation and student outcomes is thinner than one would like. It shows that desegregation in the mid-to-late 20th century improved black students educational, economic, and social outcome, primarily through the expansion of school resources. Research on the relationship between contemporary levels of segregation and achievement gaps generally shows a clear association between segregation and achievement gaps, but the scope of this research is somewhat limited. It primarily examines segregation at the state or metropolitan area level, rather than the school district level, generally examines the association between segregation and the size—rather than the growth—of achievement gaps, and provides little evidence or no about the mechanisms through which segregation operates.

Measures, Trends, and Variation in Racial Segregation

Much of the work on segregation and academic achievement examines the association between academic achievement and racial composition, rather than segregation. More specifically, researchers often measure the proportion of black or Hispanic students in a school and link this to performance on standardized tests of achievement (Condron et al. 2013; Reardon and Owens 2014). These studies typically find that schools with higher concentrations of racial minority students have lower average achievement than schools with greater proportions of white students (Bankston and Caldas 1996; Benner and Crosnoe 2011; Caldas and Bankston 1998; Mickelson 2001). The limitations in conceptualizing segregation as racial composition are that it confounds segregation patterns with differences in racial composition across place and time and does not account for the possibility that segregation affects academic outcomes through mechanisms other than composition—such as racial disparities in school contexts (Condron et al. 2013; Reardon and Owens 2014).

Studies gauging the association between academic achievement and segregation often use indices of exposure or isolation and evenness or unevenness. Exposure and isolation indices measure the degree to which students are exposed to or isolated from students of a given group. For example, the black-white exposure index is the average share of black students in a typical white student's school or other unit of analysis. Unevenness (or evenness) indices measure the extent to which students are unevenly (or evenly) distributed across schools or other units of analysis. Unevenness measures commonly include the dissimilarity index which represents the share of students of a given race who would have to change schools, districts, etc. to yield equal racial proportions across schools, districts, etc. (Reardon and Owens 2014).

A large number of studies have explored the extent and variation of racial segregation by both measures, leading up to and following *Brown v. Board of Education* (1954). They show that black-white segregation declined with the introduction of desegregation law, although the declines began in earnest after 1968 with the *Green v County School Board of New Kent County* decision (Reardon & 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 would have to change schools in order for all schools to have identical racial enrollments (Reardon & Owens, 2014; Logan, Zhang, & Oakley, 2017). By the early 1980s, segregation had dropped substantially by both isolation and unevenness measures. Only 33% of black students were in schools with 90-100% minority students (Orfield, 2001) and the black-white dissimilarity index similarly dropped to 0.51 (Logan, Zhang, & Oakley, 2017). Hispanic-white segregation was not as thoroughly documented during this period likely because segregation was lower for Hispanic students than black students, and the legal focus was on black-white segregation in the South. However, there is evidence that Hispanic isolation grew from 1968 through the early 1980s (Orfield, 2001).

From the 1980s onward, trends in racial segregation are more stable. Black and Hispanic students are somewhat more racially isolated today compared with the 1980s. In 2016, about 40% of black students and 42% of Latino were in schools with 90-100% minority students, an 8-9 percentage point increase from 1988 (Orfield et al, 2016). Measures of dissimilarity, however, indicate that segregation has either not changed or has declined. For example, Logan et al. (2017) show that the average within-district black-white dissimilarity index remained about the same from 1990 (D=0.47) to 2010 (D=0.46). Fuller and colleagues (2019) show that the average Latino-white within-district dissimilarity index dropped from about 0.65 in 1998 to 0.56 in 2010.

There is less information on racial-economic segregation likely due to (1) the availability of data to explore these trends; and (2) the fact that racial segregation was the legal priority. Fahle et al. (2019) show that from 1999 to 2016 the national black-white difference in exposure to school poverty declined from 0.29 to 0.27 (by about 8%) and the Hispanic-white difference in exposure to school poverty from 0.31 to 0.26 (by about 16%). Within the average district, MSA, and state, the trends are relatively flat; however, there is considerable variation in both average levels and trends in racial differences in exposure to school poverty. In some districts, MSAs and states, all students attend schools with similar poverty rates, while in others black and Hispanic students attend schools with poverty rates that are 40 percentage points higher than white students. Moreover, in states serving large numbers of minority students trends show declines in segregation (similar to the one nationally), while in large districts, with 25 or more schools, there is evidence of increasing segregation.

Overall, racial segregation has declined since 1968, but has remained high since the 1980s with little substantial change. Similarly, trends in racial-economic segregation have been relatively flat since the late 1990s, although there is key variation in these trends among places. The high and largely stable levels of racial and racial-economic segregation in the U.S. mean that, if segregation contributes to unequal educational opportunity, then reducing segregation may be an effective and necessary part of any comprehensive approach to eliminating racial achievement gaps.

DATA

Achievement Data

Our analysis relies on the construction of reliable and comparable measures of racial achievement gaps within school districts, counties and metropolitan areas. Our measures of racial achievement gaps come from the Stanford Education Data Archive (SEDA) V3.0 (Reardon et al. 2019).[1] SEDA is built using the National Center for Education Statistics' ED*Facts* data, which includes district-level counts of students scoring in each of several academic proficiency levels (often labeled something like "Below Basic," "Basic," "Proficient," and "Advanced") on every state's accountability assessments. These data are disaggregated by race (white, black, Hispanic), grade (grades 3-8), test subject (math and ELA), and year (school years 2008-09 through 2015-16). SEDA uses this data, along with the National Assessment of Educational Progress (NAEP) data, to provide mean test scores on a common scale for each racial group (white, black, Hispanic), in each school district, county, and metropolitan area, in grades 3-8, from the 2009 through 2016 years in math and ELA.

There are 403 metropolitan areas,[2] 3,142 counties (and county-equivalents) and roughly 13,200 school districts serving grades 3-8 in the United States. Our analytic sample for the white-black achievement gap models contains 5,755 school districts, 2,067 counties, and 389 metropolitan areas. For the white-Hispanic achievement gap models, the samples include 7,800 school districts, 2,544 counties, and 390 metropolitan areas. Although the analytic sample includes estimated achievement gaps from

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[1] We use a private version of the SEDA data, which does not censor any estimates due to sample size or add noise to any estimates.

[2] Note: The Census defines 388 metropolitan areas in the U.S., but some large metropolitan areas are subdivided into "divisions." We count each divisions as a unique metropolitan area in our analyses. This yields 403 metropolitan areas.

only about half of all public school districts in the U.S., the excluded districts enroll relatively few minority students. Almost all black (96%) and Hispanic (96%) public school students in grades 3-8 in the U.S. are enrolled in districts included in the analytic sample. That almost all minority students are enrolled in only 50-60% of school districts simply reflects the spatial concentration of minority students in the United States. The metropolitan area analytic sample includes 93% of black and 91% of Hispanic public school students in grades 3-8 that attend public schools in metropolitan areas; the county analytic sample includes 96% of black and 98% of Hispanic public school students in grades 3-8.

Segregation Measures

We construct segregation measures from the Common Core of Data (CCD) universe surveys for years 2009-2016[3] and the ED*Facts* data, described above. The CCD Public Elementary/Secondary School Universe is an annual survey of all public elementary and secondary schools in the United States. The data include basic descriptive information on schools and school districts, including staff and enrollment counts. We use school-x-year-x-grade racial composition data from the CCD to compute our key segregation measures. Because school-x-year-x-grade free/reduced-price lunch data are not included in the CCD, we instead use school-x-year-x-grade counts of the number of students that are economically disadvantaged from the ED*Facts* data. States' definitions of economic disadvantage differ but the modal definition is based on whether students qualify for free or reduced priced lunches. For districts, counties and metropolitan areas, and in each year and grade, we compute the proportion of students that are black, Hispanic, and black or Hispanic and the proportion of students that are economically disadvantaged in the average white, black and Hispanic student's school. We compute racial differences between corresponding measures to construct racial disparities in exposure to poor and minority schoolmates within each district, county, or metropolitan area in each grade and year. In the cross-sectional models,

[3] CCD universe surveys and finance files are available for download at https://nces.ed.gov/ccd/ccddata.asp.

we use an unweighted average of these measures across grades and years within each geographic unit.

We also construct corresponding residential segregation measures, the minority-white gaps in exposure to poor and minority neighbors. We use census tracts to approximate neighborhoods, and use tract-level data from the American Community Survey (ACS), downloaded from the National Historical Geographic Information System (NHGIS) web portal (https://www.nhgis.org/). Data for districts and counties are available as 5-year pooled samples, from which we use the samples from 2006-2010 through 2012-2016. Data for metropolitan areas are available in one year samples; we use the annual estimates for metropolitan areas from 2010-2016. We average the segregation measures over all the available years to obtain a single measure for each geographical unit.

Local Contextual Characteristics

We also use a series on covariate and control variables from the ACS, CCD, and Civil Rights Data Collection (CRDC) data. The control variables used in our models include the proportion of students in the unit-year-grade that are black, Hispanic and economically disadvantaged, and average school size. These measures are all taken from the CCD with the exception of the proportion of economically disadvantaged students which comes from ED*Facts*. We also use controls for average socioeconomic status in the unit as well as black-white and Hispanic-white differences in socioeconomic status, which we compute from the ACS data. The socioeconomic status (SES) composite is the first principal component of the following variables: the log of median family income, the proportion of adults with a bachelor's degree, the poverty rate, the unemployment rate, the SNAP receipt rate, and the single female-headed household rate. In constructing these measures, we use the ACS-reported margins of error to create empirical Bayes shrunken versions of these measures. Units with less precise SES measures are shrunken more to the mean, reducing bias in our estimates. We construct the principal components analysis using school district data from the full population estimates in the 2008-2012 ACS, and then use the factor weights from this when constructing the SES composites in other years, racial groups, and geographic units. This ensures comparability of the SES measure across years and populations. As an additional control, we create an analogous version of the SES composite using data from the 2000 Census, so that we have two measures of average family SES in each place, using Census and ACS data from 2000-2016.

Our models also include a set of measures hypothesized to mediate the associations between segregation and achievement gaps. We measure racial differences in peers' 3rd grade test scores using average school test scores computed from the ED*Facts* data. Within each unit we compute the average 3rd grade test score in schools attended by white, black and Hispanic students, and the difference between these two. Using CCD data, we compute the student to teacher ratio in the average white, black and Hispanic student's school within the unit; we use the black-white and Hispanic-white differences in these ratios to measure racial differences in class size. We also use CCD data to compute total per pupil expenditures in the average white, black and Hispanic student's district within counties and metropolitan areas. We then compute the logged white-black and white-Hispanic ratios of expenditures to measure racial differences in district funding. Note that the CCD only collects data on district expenditures and not on school expenditures, so we are unable to compute a comparable within-district difference in school expenditures measure. Three other mediator variables we use in our models are computed from the CRDC data. We compute the proportion of novice (first or second year) teachers and chronically absent teachers (10+ days per year) in the average white, black and Hispanic students' schools and then take the black-white and Hispanic-white differences in these measures. Schools also report whether they offer gifted programs in the CRDC. We compute the proportion of white, black and Hispanic students in each unit that attend schools that offer gifted programs and then take the white-black and white-Hispanic differences.

The measures discussed above are included in cross-sectional models. The measures are available by year but we average them across years to get a single value for each unit. For the ACS measures we use the average of the 2007-2011 and 2012-2016 values (i.e., we average values from two ACS samples that include non-overlapping survey years) for districts and counties; we use the average of the 2011 and 2016 values for metropolitan areas. For comparability with the ACS measures, we use the 2011 and 2016 averages for the CCD measures as well. Since the CRDC data are not available in every year we average over the 3 years that are available (2011-12, 2013-14, and 2015-16).

Because the panel models are identified from within unit variation across grades and years, they include a more parsimonious set of controls that vary across units, years and grades. These include racial composition, proportion economically disadvantaged, and average school size.

METHODS

A Stylized Model

Consider a modified version of the stylized model described above, on that expresses academic performance (Y_{tisd}) at time t of student i in school s in district (or county or metropolitan area) d as a function of the accumulated effects of potentially time-varying student, school, and district characteristics, plus a student fixed effect and an independent, mean-zero error term e_{tisd}:

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

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 and expression for the white-black achievement gap at time T:

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

Given the model of achievement described in (5), the white-black gap at time T in district d is a function of a) the accumulation of white-black differences in individual characteristics (for example, white-black differences in family income trajectories over their lives); 2) the accumulation of white-black differences in average school characteristics (for example, white-black differences in the total amount of segregation in the district from kindergarten through grade T); and 3) white-black differences in the average student fixed effects. Note that the accumulated district characteristics do not enter into (2), as 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 address this, we can difference Equation 6 with respect to time:

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

where $\delta\Delta Y_{td} = \Delta Y_{td} - \Delta Y_{(t-1)d}$ is the change in the white-black achievement gap during period T. Under this model, the change the achievement gap during grade T is a function of between-group differences individual and school characteristics during grade T. Note that the temporal difference eliminates both the white-black difference in fixed effects from the model and all values of the covariates prior to time T.

In practice we may lack time-specific measures of some individual and school characteristics, however, which may lead to bias in estimates of $\mathbf{\Gamma}$. To partially address this, we include district-grade and district-year fixed effects in these models, as well as lagged measures of the achievement gap:

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

To the extent that $\Delta\mathbf{X}_{td}$, for example, does not vary within a district, net of grade and year fixed effects, the estimates of $\mathbf{\Gamma}$ will not be biased by the omission of $\Delta\mathbf{X}_{td}$ from the model.

Empirical Models

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 and family characteristics.

Given the structure of the SEDA data (multiple observations nested within units), we fit these models as hierarchical linear models. The data are structured so that there are up to 96 grade-year-subject observations per district (we have data for up to 6 grades, 8 years, and 2 subjects per unit); and two observations (one for white and one for either black or Hispanic students, as relevant) per grade-cohort-subject. We treat the two groups' observations as nested within grade-year-subject cells, and grade-year-subject cells as nested within units. 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:

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

$$\begin{aligned}
\alpha_{0gcbd} &= \beta_{00d} + \beta_{01d}(grade - 3) + \beta_{02d}(cohort - 2007) + \beta_{03d}(math - 0.5) + r_{0d} \\
\alpha_{1gcbd} &= \beta_{10d} + \beta_{11d}(grade - 3) + \beta_{12d}(cohort - 2007) + \beta_{13d}(math - 0.5)
\end{aligned}$$

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

$$e_{sgcbd} \sim N\left(0, Var\left(\hat{Y}_{sgcbd}\right)\right); r_{0d} \sim N(0, \sigma^2); \mathbf{U}_d \sim MVN\left(0, \boldsymbol{\tau}^{\mathbf{2}}\right). \tag{9}$$

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 unit d (district, county, metro); $white$ is an binary variable indicating whether an observation refers to white students; and p_{sgcbd} is the proportion of white students in unit d (among black and white or Hispanic and white students only, as relevant). The coefficients α_{0gcbd} and α_{2gcbd} describe, respectively, the average test score (among white and black or Hispanic students) and the difference in average scores between white and black or Hispanic students in grade g, cohort c, and subject b in unit d. In the second level of the model, $grade$ is a continuous variable indicating the tested grade (ranging from 3 to 8), centered at 5.5; $cohort$, defined as $year - grade$, is a continuous variable indicating the year students entered first grade, centered at 2007; $math$ is an indicator equal to one if the subject is math; and $\mathbf{X}$ is a vector of (year-, grade-, and subject-invariant) covariates consisting of the segregation measures and controls described before. The $u_{..d}$ 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-unit error term with mean 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, given by the squared standard error of $\hat{Y}_{sgcbd}$. We fit the model using maximum likelihood using the HLM v7 program.

The parameters of our interest are the coefficients in the vectors $\mathbf{\Gamma}_{\mathbf{100}}$ and $\mathbf{\Gamma}_{\mathbf{110}}$ that correspond to the measures of segregation included in $\mathbf{X}$, as they describe the cross-district relationship between a variety of segregation measures and achievement gaps and their growth across grades; they are of the form shown in Equations (6) and (7) above. 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.

An alternate approach is to use 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 models of the form below:

$$\delta\Delta \mathrm{Y}_{sgybd} = \sum_{j=1}^{2} \alpha_j \Delta Y_{s(g-j)(y-j)bd} + \mathbf{X}_{sgyd}\mathbf{B} + \Delta\mathbf{Z}_{sgyd}\mathbf{\Gamma} + \eta_{gd} + \lambda_{yd} + math_{bd} + u_{sgybd}, \tag{10}$$

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 unit d (district, county, metro) and $\Delta Y_{s(g-j)(y-j)bd}$ is the gap for the same cohort of students j grades/years earlier. 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 unit-grade-year-subject,. $\mathbf{X}$ is a vector of grade-year-unit gyd controls (including percent black, Hispanic, and ECD, and average school size; $\Delta\mathbf{Z}$ is a vector of segregation measures (including one or more of the following: black-white difference in exposure to black students for white-black gap, Hispanic-white difference in exposure to Hispanic students for white-Hispanic gap; $math_{bd}$ is a vector of an indicator variable whether the test score belongs to math; η_{gd} is a vector of unit-by-grade fixed effects; λ_{yd} is a vector of unit-by-year fixed effects; and u_{sgybd} is a normally-distributed error term. The parameter of interest here is $\mathbf{\Gamma}$, as it represents the association between the segregation measure(s) and the change in the achievement gap.

RESULTS

Descriptive statistics: *Cross-sectional model samples.*

Descriptive statistics for our cross-sectional model samples are shown in Table 1. We have six analytic samples, corresponding to the 3 aggregations (district, county, metro) and 2 racial group comparisons (white-black and white-Hispanic). The white-black analytic samples include 868,702 observations from 5,755 school districts; 293,014 observations from 2,067 counties; and 56,880 observations from 389 metropolitan areas. The white-Hispanic analytic samples include 1,160,564 observations from 7,800 school districts; 351,238 observations from 2,544 counties, and 56,476 observations from 390 metropolitan areas.

[Table 1 about here]

The average white-black achievement gap (in grade 5.5) ranges from 0.504 standard deviation units in school districts to 0.667 standard deviation units in metropolitan areas. In approximate grade levels, these are gaps indicate that white students score an average of 1.5 to 2 grade levels higher than black students in the average district, county and metropolitan area. For all three aggregations, the standard deviation of the mean achievement gap is about 0.2 across units, suggesting substantial variation across districts, counties, and metros. For example, it implies that there are districts where the gaps are reasonably small (less than a 10^{th} of a standard deviation, or a third of a grade level) and others where they are close to 1 standard deviation or three grade levels.

The average white-Hispanic achievement gap is slightly smaller, ranging from 0.360 to 0.489 standard deviations across the three aggregations. On average, white students score higher on average than Hispanic students by about 1 to 1.5 grade levels. Again, there is substantial variation in these gaps among units, similar in magnitude to that of the black-white gap (standard deviation of the mean achievement gap is approximately 0.2 at all aggregations).

The average per-grade growth in the white-black achievement gap between third and eighth grades is small in comparison the average achievement gap, ranging from nearly zero in the average district to 0.010 standard deviations per grade in the average metropolitan area. Importantly, there is variation around this mean growth rate (SD = 0.02), such that there are places where gaps are closing slightly and places where they are widening slightly from third to eighth grade. The average per-grade growth in the white-Hispanic achievement gap is also small relative to the size of the average gap, however, we see that gaps are narrowing during school in the average district, county, and metropolitan area. The standard deviations of these growth rates are approximately 0.02 for all units, suggesting that there is variability between places in whether gaps narrow or widen during school years.

We report four measures of school segregation: black- or Hispanic-white differences in exposure to poor schoolmates, in exposure to minority schoolmates, in exposure to black students, and in exposure to Hispanic schoolmates. In the average district, county, and metropolitan area, black students attend schools with more economically disadvantaged peers, more black students, and more Hispanic students, than do their white counterparts. A similar pattern is found for Hispanic-white measures of school segregation. Both achievement gaps and segregation measures are larger on average in metropolitan areas relative to school districts. School districts tend to be more homogenous and have fewer schools, restricting the between-school sorting and between-school differences in opportunities to learn relative to larger aggregations (e.g., metropolitan areas).

Descriptive statistics: Panel model samples.

Table 2 provides descriptive statistics for the panel models samples. Again, we have six analytic samples corresponding to the three aggregations (district, county, metropolitan area) and two racial group comparisons (white-black, white-Hispanic). These samples are smaller than those used in the cross-sectional model because the panel model samples are restricted to unit-grade-year observations for which we observe both white and black/Hispanic achievement and the 1- and 2-year lagged versions of both of these; many districts and counties with very small black or Hispanic populations lack measures of the group's mean achievement in many years and grades, making them unusable in the panel models. The black-white samples include 80,612 observations from 3,029 districts, 40,546 observations from 1,357 counties, and 10,781 observations from 375 metropolitan areas. The Hispanic-white samples include 99,042 observations from 4,804 districts, 38,663 observations from 1,551 counties, and 10,384 observations from 387 metropolitan areas. In this table we show both the between-unit variance and the within-unit variance in each measure. Our modeling strategy relies on the within-unit variation, so we focus on that here.

[Table 2 about here]

The outcome used in the panel models is the within-cohort grade-to-grade change in minority-white achievement gaps. For black-white gaps, the average within-cohort grade-to-grade gap change in achievement is near zero (ranging from -0.001 in the average district to 0.009 in the average metropolitan area). The standard deviations of changes in the gap within units (0.22 in districts, 0.17 in counties, and 0.12 in metropolitan areas) suggest that changes in the average achievement gaps vary across grades and years. For the white-Hispanic within-cohort grade-to-grade gap changes, the average change is -0.012 in districts, -0.011 in counties, and -0.009 in metropolitan areas. Again, the within-unit standard deviations are large (0.277 in districts, 0.175 in counties, and 0.109 in metropolitan areas). Interestingly, for both black-white and Hispanic-white changes in achievement, the amount of variation within units is very similar to the amount of variation between units. It is likely, however, that some of the within-unit variation in segregation levels is measurement error or reflects volatility in the measures in small school districts, where the movement a few students among schools can sharply change measured segregation levels.

We include the same four measures of school segregation in the panel models. The average district, county, and metropolitan area in our panel samples have slightly higher average segregation than those included in our cross-sectional models. However, the same trend is apparent: black and Hispanic students are exposed to larger proportions of poor and minority schoolmates than their white peers. Again, our modeling strategy relies on the fact that these measures vary within unit. The within-unit standard deviations of the difference in exposure to minorities (black + Hispanic) and the difference in exposure to poor schoolmates are about 0.03 for all units and both racial group comparisons. Unlike with changes in achievement, there is notably less variation within units in segregation relative to between units particularly for the larger aggregations.

Bivariate Associations

The bivariate associations between achievement and school segregation measures are shown in Table 3. Two key patterns are apparent. Differences in exposure to minority schoolmates are modestly positively associated with both gaps and the rate at which the gaps grow in districts, counties and metropolitan areas. The correlations between black-white differences in exposure to minority schoolmates and white-black achievement gaps are 0.31 among school districts and 0.54 among counties and metropolitan areas. These associations between the white-black gap and black-white differences in exposure to minority schoolmates are shown visually in Figure 1. The correlations between Hispanic-white differences in exposure to minority schoolmates and white-Hispanic achievement gaps are even higher (0.37 among school districts, 0.52 among counties, and 0.65 among metropolitan areas). Correlations between racial differences in exposure to minority schoolmates and gap growth range from 0.25 to 0.40 across all geographic units and samples, with higher correlations again observed in the Hispanic-white samples (Table 3, Figures 1 and A1).

[Table 3 about here]

[Figure 1 about here]

That said, differences in exposure to poor schoolmates are even more strongly associated with gaps and similarly associated with growth in the gaps. Correlations with racial achievement gaps range from 0.42 to 0.75 and correlations with average gap growth rates range from 0.32 to 0.49, across the samples. Figure 2 provides a scatter plot of both white-black achievement gaps and the rate at which the gap grows against racial differences in exposure to poor schoolmates (Figure A2 provides the same plots for white-Hispanic achievement gaps and gap growth). The strong correlation with average gaps is apparent. Notably, there are no places where racial differences in exposure to poor schoolmates is modest or high and achievement gaps are low. In comparison to Figure 1, there is a tighter clustering of the scatter in Figure 2 and a steeper gradient on differences in exposure to school poverty than on differences in exposure to minority schoolmates.

[Figure 2 about here]

Simply put, places with larger racial differences in exposure to poor and minority schoolmates—more racial and racial-economic school segregation--tend to be places with larger racial achievement gaps and somewhat larger growth in racial achievement gaps. Importantly, while the two segregation measures are highly correlated (0.82 to 0.93), they are not identical, especially among school districts (see Figure 3). These bivariate associations suggest 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, a concern we address in the next section.

[Figure 3 about here]

Racial segregation predicts achievement gaps

In the cross-sectional models, racial differences in exposure to minority students is strongly, positively associated with white-black and white-Hispanic achievement gaps in grade 3 (Table 4, columns B1 and H1). These associations remain strong even after controlling for racial differences in socioeconomic status (SES), overall SES, and racial composition (Table 4, columns B2 and H2) and controlling for residential segregation (Table 4, columns B3 and H3). In models B3 and H3, both school segregation and residential segregation predict the average gap in grade 3; the coefficient on school segregation is about twice as large as that on residential segregation. In these models, the estimates imply that, net of racial socioeconomic differences and residential segregation, a difference of 0.10 in racial school segregation (measured as the black or Hispanic-white difference exposure to minority schoolmates) is associated with a 0.05 or 0.07 SD difference in the white-black or white-Hispanic grade 3 achievement gap, respectively.

[Table 4 about here]

The association between 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. In 5 of the 6 models, school segregation is a significant predictor of gap growth (it is not significant in the white-black metropolitan area models, though the estimate is somewhat imprecise). After controlling for residential segregation the coefficient on school segregation is not significant in the district models.

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 for lagged achievement gaps, proportions of racial and economic composition, among others (Table 4, columns B5 and H5), the estimated coefficients range from 0.10 to 0.31. These coefficients are not statistically significant in the models for metropolitan statistical areas, but they are also much less precise (given the much smaller sample size); we cannot rule out meaningfully large coefficients or coefficients of 0. The panel models leverage only variation within grades, across years and within years, across grades (i.e., they include unit-grade and unit-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 Hispanic-white achievement gaps grow more in grades and years when a district or county is more racially segregated, relative to the average. Relative to the average grade or year, we estimate that a 0.10 increase in the difference in exposure to minority schoolmates would correspond to a 0.016 to 0.031 standard deviation/year differences in the white-black and the white-Hispanic gap growth rates, respectively, within a school district.

Racial segregation operates through differences in exposure to poverty.

Once we account for racial differences in school poverty (Table 5), however, racial composition differences among schools are no longer positively and significantly associated with the grade 3 achievement gap (5 of 6 coefficients are insignificant) or gap growth (all 6 coefficients are either negative or indistinguishable from 0). Differences in exposure to school poverty, however, are strongly associated with gaps in grade 3 and modestly associated with gap growth, net of racial differences in exposure to minority schoolmates in the district and county models (B6, H6). Again, the panel models suggest that the association between segregation and rate at which racial achievement gaps increase is larger than indicated by the cross-sectional models (B8, H8). 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 (B9, H9). Note that this is true despite very high correlation (0.82 to 0.93) between differences in exposure to minority and poor schoolmates. Therefore, these models strongly suggest that, while racial segregation matters, it matters primarily because it leads to differences in exposure to poor schoolmates. For completeness, we show this pattern holds even when controlling for racial differences in exposure to minority and poor neighbors (B7, H7). This is consistently true, except in the metro models where there is low statistical power.

[Table 5 about here]

Do 'peer effects' explain the link between segregation and widening achievement gap?

Table 6 investigates whether the association of segregation and achievement gaps is related to students' peers' characteristics. Models B9 and H9 and panel models B11 and H11 include separate measures of differences in exposure to black students and in exposure to Hispanic students in place of differences in exposure to minority (black plus Hispanic) schoolmates. Shown at the bottom of each model is the *p*-value from the test that the coefficients on the differences in black and Hispanic exposure are the same; in each case, we fail to reject this hypothesis, meaning there is no evidence that segregation operates specifically through differential exposure to black or Hispanic schoolmates.

[Table 6 about here]

Models B10, B12, H10, and H12 include a measure of the difference in schoolmates' prior academic performance as a predictor of the growth rate of the gaps. The coefficients here are negative, which is opposite what we would expect if having lower-achieving peers led to less-challenging, less-effective instruction. Instead, the coefficients indicate that achievement gaps narrow, on average, in districts and counties when black or Hispanic students attend schools with lower-achieving peers. The inclusion of peers' prior achievement changes the coefficient on differences in school poverty modestly in the cross-sectional models (increases it by 50% or more, generally). There is no evidence that differences in peers' prior performance is part of the mechanism through which segregation leads to larger achievement gaps.

How do observable differences in school characteristics relate to segregation?

Thus far, our model results suggest that racial segregation predominantly affects racial achievement gaps through differences in exposure to school poverty. We estimate a series of exploratory cross-sectional models to test whether differences in proxy measures of school quality can explain the association between differences in exposure to school poverty and achievement gaps and gap growth. Table 7 provides correlations among the segregation measures and measures of differences in school resources and peer characteristics. Differences in classmates' average test scores, in exposure to novice school teachers, and in 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 at all aggregations. Differences in exposure to chronically absent teachers is positively associated with the four segregation measures in the district samples, but not consistently in the county or metropolitan area samples. This suggests that in places that have higher levels of racial and racial-economic segregation, there are larger racial differences in these school quality measures. In contrast, when significant (primarily in the district sample) differences in student-teacher ratios are weakly negatively associated with segregation. In the county and metro samples, racial differences in district per pupil expenditures are also negatively associated with segregation. These suggest that class size and funding disparities are actually smaller in more racially segregated places, on average. This is likely a result of compensatory funding policies, like Title I, that provide additional funds to high poverty schools and districts, and states' efforts to provide more resources for disadvantaged districts.

[Table 7 about here]

While we observed significant correlations between these factors and the segregation measures, adding minority-white differences in exposure to novice teachers, in exposure to chronically absent teachers, in school offerings of gifted programs, and in schools student-teacher ratios to the models has essentially no effect on the size of coefficient on minority-white differences in exposure to poor schoolmates (Table 8, Appendix Tables A1-A5). Similarly, the association between gap growth and minority-white differences in exposure to poor schoolmates remains similar across all models, regardless of aggregation and racial group. In other words, differences in observed measures of school quality do not explain the association between differences in exposure to poor schoolmates and achievement gaps or gap growth. Notably, however, these are not an exhaustive list school resources, so we cannot definitively rule out school resources as contributing to the association between racial-economic segregation and achievement gaps.

[Table 8 about here]

One addition finding from these models is relevant. In models B18 and H18, minority-white differences in exposure to minority neighbors is a significant predictor of the average gap in third grade.

This is true at the district and county level for both white-black and white-Hispanic gaps (see Appendix Tables A1-A5). This suggests that neighborhood segregation—particularly exposure to minorities—may play a role in shaping early achievement gaps. However, it is not a significant predictor of growth, indicating that school segregation is more impactful for how gaps change during school years, as predicted.

DISCUSSION

In the landmark *Brown v. Board of Education 1954* case, the Supreme Court ruled that state-mandated racial school segregation was unconstitutional. This ruling was predicated on the belief that school segregation led to unequal educational opportunities in America. While the U.S. saw a marked decline in racial school segregation following court-ordered desegregation efforts, schools remain highly racially and economic segregated. Moreover, the public and policymakers have also retreated from the position that segregation in and of itself is harmful and should be reduced. Instead, policy discussions focus on the goal of providing high quality schooling to all students within a system that is highly segregated by both race and class.

Perhaps this is appropriate. There is reason to wonder whether racial school segregation still leads to differential educational opportunities. Prior to the desegregation of schools in the 1960s and 1970s, racial segregation was accompanied by very large differences in school funding. That funding inequality declined sharply following the desegregation of schools, and has declined further or been eliminated in many states in recent decades as a result of school finance reforms. At the same time, accountability efforts have drawn increased attention to racial disparities in educational outcomes and are designed to incentivize states to focus attention on low-achieving schools. Moreover, the segregation of schools in the South prior to the 1954 *Brown* decision was mandated by law. As the Court argued in *Brown*, this gave the unequal treatment of black and white students an official imprimatur that, in itself, caused psychological harm to black children. In the absence of *de jure* segregation and the stark funding inequalities that accompanied segregation two generations ago, does segregation still matter?

The answer is yes. Using scores from hundreds of millions of tests taken in the last decade by students in thousands of school districts, we find a very strong link between racial school segregation and academic achievement gaps. More segregated school systems have larger achievement gaps, on average, and their gaps grow faster during elementary and middle schools than in less segregated ones. Indeed, every school district in the U.S. where segregation is even moderately high has a large achievement gap, and the association between racial school segregation and achievement gaps remains strong even after accounting for racial differences in socioeconomic status and residential segregation.

Why is this? We find that the association between racial school segregation and achievement gaps appears to operate entirely through differences in exposure to poor schoolmates. Once we control for racial differences in school poverty, racial segregation is no longer predictive of achievement gaps or the growth in the gaps. Instead, it is the difference in school poverty that matters. This implies that high-poverty schools provide, on average, lower educational opportunity than low-poverty schools. Racial segregation matters, therefore, because it concentrates black and Hispanic students in high-poverty schools, not because of the racial composition of their schools, per se. To make this concrete, consider the New York City and Fulton County, GA school districts, two of the most racially segregated districts in the country. In both districts black students attend schools where the average proportion of minority students is more than 50 percentage points higher than in their white peers' schools. And in both places the average white-black family socioeconomic disparity is roughly the same (about 2.75 standard deviations of the national district distribution). But in Fulton County, racial-economic segregation 30 percentage points higher than in New York: the black-white difference in school poverty rates is 22 percentage points in New York, compared to 52 points in Fulton County. Correspondingly, the white-black achievement gap is one third of a standard deviation larger in Fulton (1.1 standard deviations) than in New York City (0.77 standard deviations).

Our analyses are less conclusive, 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. We find this to be the case: in more segregated school districts, counties, and metropolitan areas, white students are more likely to be concentrated in schools with more experienced teachers and more gifted and talented programs, for example. We do not find that these differences are associated with achievement gaps or the growth in achievement gaps, however. That said, our measures of school resources and teacher skills are rather weak proxies for school quality, so we cannot say for sure whether differences in school resources, teacher skills, or curricula are part of the reason why segregation leads to larger achievement gaps.

Another possibility is that racial 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' or students' expectations of their performance, or differences in norms around academic achievement. We find no evidence that this is the case. Although segregation is almost always accompanied by large differences in the academic performance of minority and white students' schoolmates, these differences are not associated with achievement gaps. In fact, we find that achievement gaps tend to narrow slightly from grade 3 to 8, on average, in school systems where minority students' schoolmates have lower prior scores than white students' schoolmates. So called "peer effects" do not appear to explain the link between segregation and widening achievement gaps.

In sum, our analyses provide evidence that racial school segregation is closely linked to racial inequality in academic performance. This implies that segregation creates unequal educational opportunities. Although our analyses do not identify the specific mechanisms through which segregation leads to inequality, they make it clear that the mechanism is linked to differences in schools' *poverty rates*, not differences in schools' *racial composition*.

One response to this finding is to say that we should focus on reducing economic segregation among schools, rather than racial segregation *per se*. Indeed, our results imply that racial segregation would not produce unequal outcomes so long as white and minority students attended schools with equal socioeconomic composition. But such a configuration is not mathematically possible given the large racial differences in family socioeconomic conditions in most districts, counties, and metropolitan areas in the U.S. In other words, it is not currently possible to have both high racial segregation and no racial difference in school poverty rates. This is empirically evident in Figure 3 above. Racial segregation is almost invariably accompanied by large racial differences in school poverty rates.

A different response to this finding would be to leave schools' racial and socioeconomic composition unchanged and focus resources on improving high-poverty schools. This has been the intent of many school improvement efforts over the last few decades. And while there are examples of highly-effective high-poverty schools, it is not clear we know how to do so systematically in the context of high levels of segregation. As Figure 2 shows, we have no example of a school district where minority students disproportionately attend high poverty schools that does not have a large racial achievement gap. If it were possible to create equal educational opportunity under conditions of segregation and economic inequality, some community—among the thousands of districts in the country—would have done so. None have. Separate is still unequal.

If we are serious about reducing racial inequality in educational opportunity, then, we must address racial segregation among schools. This we do know how to do, or at least we once did.

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TABLES

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

	Districts		Counties		Metropolitan Areas	
	Mean	SD	Mean	SD	Mean	SD
Sample in Models Predicting White-Black Achievement Gaps						
White-Black Gap, Mean Achievement	0.504	0.213	0.528	0.211	0.667	0.201
White-Black Gap, Achievement Growth Across Grades	-0.001	0.019	0.004	0.021	0.010	0.020
Black-White Gap in Exposure to Poor Schoolmates	0.027	0.056	0.075	0.104	0.180	0.119
Black-White Gap in Exposure to Minority (Black+Hispanic) Schoolmates	0.034	0.072	0.104	0.132	0.234	0.166
Black-White Gap in Exposure to Black Schoolmates	0.027	0.069	0.080	0.119	0.179	0.164
Black-White Gap in Exposure to Hispanic Schoolmates	0.008	0.033	0.024	0.052	0.056	0.073
Black-White Differences in Exposure to Poor Neighbors	0.020	0.037	0.042	0.046	0.084	0.048
Black-White Differences in Exposure to Minority Neighbors	0.036	0.073	0.108	0.131	0.238	0.165
Proportion Black	0.135	0.196	0.161	0.207	0.149	0.142
Proportion Hispanic	0.162	0.205	0.124	0.161	0.182	0.195
Standardized EB SES Composite (2007-11 & 2012-16 ACS Average)	0.143	0.988	-0.159	0.659	-0.294	0.574
White-Black Difference in Standardized EB SES Composite (2007-11 & 2012-16 ACS Average)	2.014	0.689	2.322	0.652	2.881	0.602
White-Black Difference in Standardized SES Composite (From 2000 Census)	1.289	1.345	2.250	1.701	3.321	1.566
N, Units	5755		2067		389	
N, Observations	868702		293014		56880	
Sample in Models Predicting White-Hispanic Achievement Gaps						
White-Hispanic Gap, Mean Achievement	0.360	0.203	0.365	0.206	0.489	0.199
White-Hispanic Gap, Achievement Growth Across Grades	-0.015	0.020	-0.011	0.020	-0.008	0.019
Hispanic-White Gap in Exposure to Poor Schoolmates	0.021	0.052	0.056	0.089	0.154	0.116
Hispanic-White Gap in Exposure to Minority (Black+Hispanic) Schoolmates	0.024	0.056	0.076	0.102	0.187	0.131
Hispanic-White Gap in Exposure to Black Schoolmates	0.006	0.027	0.025	0.053	0.067	0.069
Hispanic-White Gap in Exposure to Hispanic Schoolmates	0.018	0.046	0.051	0.081	0.120	0.114
Hispanic-White Differences in Exposure to Poor Neighbors	0.012	0.026	0.024	0.033	0.057	0.037
Hispanic-White Differences in Exposure to Minority Neighbors	0.026	0.057	0.081	0.103	0.190	0.131
Proportion Black	0.092	0.164	0.120	0.182	0.149	0.142
Proportion Hispanic	0.177	0.217	0.139	0.180	0.182	0.195
Standardized EB SES Composite (2007-11 & 2012-16 ACS Average)	0.214	0.920	-0.073	0.635	-0.294	0.574
White-Hispanic Difference in Standardized EB SES Composite (2007-11 & 2012-16 ACS Average	1.164	0.363	1.293	0.386	1.690	0.515
White-Hispanic Difference in Standardized SES Composite (From 2000 Census)	0.858	1.194	1.327	1.551	2.302	1.315
N, Units	7800		2544		390	
N, Observations	1160564		351238		56476	

Note: Summary statistics calculated using one observation per unit (district, county, metropolitan area).

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

	Districts			Counties			Metropolitan Areas		
	Mean	Overall SD	Within Unit SD	Mean	Overall SD	Within Unit SD	Mean	Overall SD	Within Unit SD
Sample in Models Predicting White-Black Achievement Gaps									
Change in Achievement Gap Relative to Prior Year	-0.001	0.221	0.218	0.002	0.167	0.165	0.009	0.119	0.117
Black-White Gap in Exposure to Poor Schoolmates	0.048	0.081	0.032	0.104	0.118	0.032	0.187	0.120	0.032
Black-White Gap in Exposure to Minority (Black+Hispanic) Schoolmates	0.067	0.105	0.036	0.149	0.147	0.034	0.251	0.160	0.028
Black-White Gap in Exposure to Black Schoolmates	0.057	0.104	0.032	0.123	0.139	0.031	0.199	0.161	0.024
Black-White Gap in Exposure to Hispanic Schoolmates	0.010	0.040	0.014	0.026	0.055	0.011	0.052	0.072	0.013
Proportion Black	0.252	0.198	0.023	0.254	0.205	0.018	0.181	0.150	0.008
Proportion Hispanic	0.171	0.199	0.022	0.115	0.139	0.016	0.158	0.171	0.013
Proportion Economically Disadvantaged	0.570	0.217	0.061	0.579	0.179	0.060	0.522	0.122	0.035
Average School Size	172	116	70	137	79	47	128	54	39
N, Units		3029			1357			375	
N, Observations		80612			40546			10781	
Sample in Models Predicting White-Hispanic Achievement Gaps									
Change in Achievement Gap Relative to Prior Year	-0.012	0.281	0.277	-0.011	0.177	0.175	-0.009	0.110	0.109
Hispanic-White Gap in Exposure to Poor Schoolmates	0.039	0.075	0.031	0.091	0.107	0.030	0.153	0.115	0.032
Hispanic-White Gap in Exposure to Minority (Black+Hispanic) Schoolmates	0.042	0.077	0.031	0.114	0.116	0.030	0.184	0.130	0.029
Hispanic-White Gap in Exposure to Black Schoolmates	0.010	0.035	0.012	0.035	0.058	0.014	0.068	0.069	0.015
Hispanic-White Gap in Exposure to Hispanic Schoolmates	0.032	0.065	0.027	0.079	0.094	0.026	0.116	0.111	0.025
Proportion Black	0.126	0.174	0.017	0.140	0.172	0.011	0.165	0.149	0.008
Proportion Hispanic	0.275	0.211	0.039	0.206	0.188	0.023	0.186	0.193	0.014
Proportion Economically Disadvantaged	0.536	0.222	0.067	0.540	0.164	0.048	0.524	0.126	0.033
Average School Size	155	118	70	126	77	45	128	55	40
N, Units		4804			1551			387	
N, Observations		99042			38663			10384	

Note: Summary statistics are calculated using all observations for all units (district, county, metropolitan area).

Table 3. Correlations Among Achievement Gap Measures and Segregation Measures

Districts

	Average Test Score Gap	Gap Growth Rate	Difference in Exposure to Minority Schoolmates	Difference in Exposure to Poor Schoolmates
Average Test Score Gap		0.062	0.371	0.442
Gap Growth Rate	0.202		0.309	0.324
Difference in Exposure to Minority Schoolmates	0.313	0.279		0.89
Difference in Exposure to Poor Schoolmates	0.417	0.412	0.82	

Counties

	Average Test Score Gap	Gap Growth Rate	Difference in Exposure to Minority Schoolmates	Difference in Exposure to Poor Schoolmates
Average Test Score Gap		0.235	0.520	0.597
Gap Growth Rate	0.304		0.398	0.458
Difference in Exposure to Minority Schoolmates	0.543	0.395		0.92
Difference in Exposure to Poor Schoolmates	0.630	0.487	0.86	

Metropolitan Areas

	Average Test Score Gap	Gap Growth Rate	Difference in Exposure to Minority Schoolmates	Difference in Exposure to Poor Schoolmates
Average Test Score Gap		0.179	0.649	0.751
Gap Growth Rate	0.203		0.364	0.381
Difference in Exposure to Minority Schoolmates	0.541	0.253		0.93
Difference in Exposure to Poor Schoolmates	0.659	0.315	0.88	

Note: In each panel, white-black correlations are shown below the diagonal; white-Hispanic correlations are above the diagonal.

Table 4. Achievement Gaps and Differences in Exposure to Minority Schoolmates

	White-Black Gap Models					White-Hispanic Gap Models				
	Cross-Sectional Models			Panel Models		Cross-Sectional Models			Panel Models	
	B1	B2	B3	B4	B5	H1	H2	H3	H4	H5
Districts										
Coefficients on Grade 3 Gap										
Minority-White Differences in Exposure to Minority Schoolmates	0.874 ***	0.610 ***	0.487 ***			1.239 ***	0.851 ***	0.721 ***		
	(0.038)	(0.034)	(0.040)			(0.041)	(0.039)	(0.045)		
Minority-White Differences in Exposure to Minority Neighbors			0.217 ***					0.247 ***		
			(0.035)					(0.044)		
Coefficients on Growth of Gap										
Minority-White Differences in Exposure to Minority Schoolmates	0.015 ***	0.010 *	0.007	0.037	0.158 ***	0.036 ***	0.018 **	0.005	0.154 **	0.313 ***
	(0.004)	(0.005)	(0.006)	(0.045)	(0.039)	(0.005)	(0.006)	(0.007)	(0.051)	(0.044)
Minority-White Differences in Exposure to Minority Neighbors			0.004					0.022 **		
			(0.005)					(0.007)		
N (Districts)	5,755	5,755	5,752	3,176	3,176	7,800	7,800	7,788	3,176	3,176
Counties										
Coefficients on Grade 3 Gap										
Minority-White Differences in Exposure to Minority Schoolmates	0.799 ***	0.497 ***	0.330 ***			0.910 ***	0.524 ***	0.389 ***		
	(0.030)	(0.032)	(0.044)			(0.035)	(0.039)	(0.055)		
Minority-White Differences in Exposure to Minority Neighbors			0.217 ***					0.245 **		
			(0.052)					(0.070)		
Coefficients on Growth of Gap										
Minority-White Differences in Exposure to Minority Schoolmates	0.023 ***	0.022 ***	0.016 *	-0.023	0.103 *	0.045 ***	0.026 ***	0.022 *	-0.025	0.160 **
	(0.004)	(0.005)	(0.007)	(0.054)	(0.046)	(0.005)	(0.006)	(0.009)	(0.059)	(0.051)
Minority-White Differences in Exposure to Minority Neighbors			0.007					0.003		
			(0.008)					(0.011)		
N (Counties)	2,067	2,067	2,072	1,421	1,421	2,544	2,544	2,549	1,421	1,421
Metropolitan Areas										
Coefficients on Grade 3 Gap										
Minority-White Differences in Exposure to Minority Schoolmates	0.640 ***	0.262 ***	0.148			0.903 ***	0.350 ***	0.590 ***		
	(0.051)	(0.060)	(0.109)			(0.060)	(0.068)	(0.136)		
Minority-White Differences in Exposure to Minority Neighbors			0.120					-0.267		
			(0.126)					(0.186)		
Coefficients on Growth of Gap										
Minority-White Differences in Exposure to Minority Schoolmates	0.011 *	0.010	0.022	0.009	0.125	0.041 ***	0.025 **	0.040 *	0.015	0.169
	(0.006)	(0.008)	(0.015)	(0.109)	(0.096)	(0.007)	(0.009)	(0.019)	(0.110)	(0.099)
Minority-White Differences in Exposure to Minority Neighbors			-0.014					-0.028		
			(0.018)					(0.026)		
N (Metropolitan Areas)	389	389	388	382	382	390	390	389	382	382
Controls Included?	-	X	X	-	X	-	X	X	-	X

Note: All models also include measures of grade (centered on grade 3), cohort (centered on 2012) and math (centered on .5). Control variables in cross-sectional models include: the overall standardized SES composite, white-black or white-Hispanic differences in SES, proportion black, and proportion Hispanic. Control variables in panel models include: 1 and 2 year lags of the gaps, proportion black, proportion Hispanic, proportion economically disadvantaged, average school size, proportion of students attending charter schools, and the black-white, Hispanic-white and free lunch-non free lunch gap in charter school attendance.
* p<.05; ** p<.01; *** p<.001.

Table 5. Achievement Gaps and Differences in Exposure to Poor Schoolmates

	White-Black Gap Models					White-Hispanic Gap Models				
	Cross-Sectional Models			Panel Models		Cross-Sectional Models			Panel Models	
	B2	B6	B7	B5	B8	H2	H6	H7	H5	H8
Districts										
Coefficients on Grade 3 Gap										
Minority-White Differences in Exposure to	0.610 ***	0.013	-0.077			0.851 ***	0.041	-0.022		
Minority Schoolmates	(0.034)	(0.059)	(0.064)			(0.039)	(0.079)	(0.079)		
Minority-White Differences in Exposure to		0.924 ***	0.893 ***				0.998 ***	0.975 ***		
Poor Schoolmates		(0.075)	(0.075)				(0.084)	(0.085)		
Minority-White Differences in Exposure to			0.175 ***					0.194 ***		
Minority Neighbors			(0.041)					(0.052)		
Minority-White Differences in Exposure to			0.054					-0.099		
Poor Neighbors			(0.088)					(0.113)		
Coefficients on Growth of Gap										
Minority-White Differences in Exposure to	0.010 *	-0.018 *	-0.020 *	0.158 ***	-0.023	0.018 **	-0.009	-0.013	0.313 ***	0.160 **
Minority Schoolmates	(0.005)	(0.008)	(0.009)	(0.039)	(0.050)	(0.006)	(0.012)	(0.012)	(0.044)	(0.059)
Minority-White Differences in Exposure to		0.044 ***	0.043 ***		0.304 ***		0.032 *	0.021		0.211 ***
Poor Schoolmates		(0.011)	(0.011)		(0.052)		(0.013)	(0.013)		(0.056)
Minority-White Differences in Exposure to			0.000					0.014		
Minority Neighbors			(0.006)					(0.009)		
Minority-White Differences in Exposure to			0.009					0.024		
Poor Neighbors			(0.015)					(0.019)		
N (Districts)	5,755			3,176		7,800			4,957	
Counties										
Coefficients on Grade 3 Gap										
Minority-White Differences in Exposure to	0.465 ***	0.140 *	0.042			0.527 ***	0.073	0.018		
Minority Schoolmates	(0.030)	(0.055)	(0.065)			(0.037)	(0.064)	(0.071)		
Minority-White Differences in Exposure to		0.507 ***	0.477 ***				0.644 ***	0.630 ***		
Poor Schoolmates		(0.071)	(0.075)				(0.075)	(0.079)		
Minority-White Differences in Exposure to			0.169 ***					0.150		
Minority Neighbors			(0.058)					(0.080)		
Minority-White Differences in Exposure to			0.063					-0.112		
Poor Neighbors			(0.121)					(0.157)		
Coefficients on Growth of Gap										
Minority-White Differences in Exposure to	0.021 ***	-0.015	-0.016	0.103 *	-0.029	0.024 ***	0.001	0.003	0.160 **	0.075
Minority Schoolmates	(0.004)	(0.008)	(0.010)	(0.046)	(0.056)	(0.006)	(0.010)	(0.012)	(0.051)	(0.063)
Minority-White Differences in Exposure to		0.055 ***	0.052 ***		0.221 ***		0.031 **	0.031 *		0.131 *
Poor Schoolmates		(0.011)	(0.011)		(0.052)		(0.012)	(0.012)		(0.058)
Minority-White Differences in Exposure to			-0.001					-0.002		
Minority Neighbors			(0.009)					(0.013)		
Minority-White Differences in Exposure to			0.021					0.000		
Poor Neighbors			(0.020)					(0.026)		
N (Counties)	2,067			1,421		2,544			1,598	
Metropolitan Areas										
Coefficients on Grade 3 Gap										
Minority-White Differences in Exposure to	0.238 ***	-0.159	-0.243			0.423 ***	-0.052	0.096		
Minority Schoolmates	(0.053)	(0.094)	(0.130)			(0.062)	(0.122)	(0.165)		
Minority-White Differences in Exposure to		0.630 ***	0.578 ***				0.666 ***	0.667 ***		
Poor Schoolmates		(0.124)	(0.127)				(0.152)	(0.153)		
Minority-White Differences in Exposure to			0.030					-0.158		
Minority Neighbors			(0.128)					(0.171)		
Minority-White Differences in Exposure to			0.470					-0.282		
Poor Neighbors			(0.263)					(0.306)		
Coefficients on Growth of Gap										
Minority-White Differences in Exposure to	0.013	0.002	0.010	0.125	0.034	0.022 **	0.020	0.036	0.169	0.120
Minority Schoolmates	(0.007)	(0.013)	(0.019)	(0.096)	(0.122)	(0.008)	(0.017)	(0.023)	(0.099)	(0.132)
Minority-White Differences in Exposure to		0.019	0.018		0.144		0.003	-0.003		0.070
Poor Schoolmates		(0.018)	(0.018)		(0.119)		(0.021)	(0.021)		(0.125)
Minority-White Differences in Exposure to			-0.018					-0.040		
Minority Neighbors			(0.019)					(0.024)		
Minority-White Differences in Exposure to			0.026					0.070		
Poor Neighbors			(0.040)					(0.045)		
N (Metropolitan Areas)	389			382		390			388	
Controls Included?	X	X	X	X	X	X	X	X	X	X

Note: All models also include measures of grade (centered on grade 3), cohort (centered on 2012) and math (centered on .5). Control variables in cross-sectional models include: the overall standardized SES composite, white-black or white-Hispanic differences in SES, proportion black, and proportion Hispanic. Control variables in panel models include: 1 and 2 year lags of the gaps, proportion black, proportion Hispanic, proportion economically disadvantaged, average school size, proportion of students attending charter schools, and the black-white, Hispanic-white and free lunch-non free lunch gap in charter school attendance.

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

Table 6. Achievement Gaps, Differences in Exposure to Poor Schoolmates, and Peer Characteristics

	White-Black Gap Models						White-Hispanic Gap Models					
	Cross-Sectional Models			Panel Models			Cross-Sectional Models			Panel Models		
	B6	B9	B10	B5	B11	B12	H6	H9	H10	H5	H11	H12
Districts												
Coefficients on Grade 3 Gap												
Minority-White Differences in	0.013		0.013				0.041		0.039			
Exposure to Minority Schoolmates	(0.059)		(0.059)				(0.079)		(0.079)			
Minority-White Differences in		0.015						0.078				
Exposure to Black Schoolmates		(0.059)						(0.096)				
Minority-White Differences in		0.069						0.007				
Exposure to Hispanic Schoolmates		(0.104)						(0.090)				
Minority-White Differences in	0.924 ***	0.908 ***	0.923 ***				0.998 ***	1.015 ***	0.999 ***			
Exposure to Poor Schoolmates	(0.075)	(0.079)	(0.075)				(0.084)	(0.087)	(0.084)			
Coefficients on Growth of Gap												
Minority-White Differences in	-0.018 *		-0.014	-0.023		-0.009	-0.009		-0.003	0.160 **		0.160 **
Exposure to Minority Schoolmates	(0.008)		(0.008)	(0.050)		(0.050)	(0.012)		(0.012)	(0.059)		(0.060)
Minority-White Differences in		-0.019 *			-0.026			-0.004			0.155	
Exposure to Black Schoolmates		(0.008)			(0.050)			(0.015)			(0.086)	
Minority-White Differences in		-0.031 *			-0.000			-0.013			0.163 *	
Exposure to Hispanic Schoolmates		(0.015)			(0.099)			(0.013)			(0.065)	
Minority-White Differences in	0.044 ***	0.048 ***	0.059 ***	0.304 ***	0.302 ***	0.309 ***	0.032 *	0.034 **	0.055 ***	0.211 ***	0.210 ***	0.225 ***
Exposure to Poor Schoolmates	(0.011)	(0.011)	(0.012)	(0.052)	(0.052)	(0.052)	(0.013)	(0.013)	(0.014)	(0.056)	(0.056)	(0.056)
Minority-White Differences in			-0.012 **			-0.038 **			-0.018 ***			-0.016
Exposure to Classmates Average Test			(0.005)			(0.012)			(0.005)			(0.013)
P-Value: Exposure to Blacks = Exposure to Hispanic		0.545			0.785			0.471			0.934	
N (Districts)	5,755	5,755	5,755	3,176	3,176	3,176	7,800	7,800	7,800	4,957	4,957	4,957
Counties												
Coefficients on Grade 3 Gap												
Minority-White Differences in	0.140 *		0.140 *				0.073		0.073			
Exposure to Minority Schoolmates	(0.055)		(0.055)				(0.064)		(0.064)			
Minority-White Differences in		0.161 **						0.024				
Exposure to Black Schoolmates		(0.056)						(0.085)				
Minority-White Differences in		0.005						0.101				
Exposure to Hispanic Schoolmates		(0.091)						(0.073)				
Minority-White Differences in	0.507 ***	0.517 ***	0.506 ***				0.644 ***	0.638 ***	0.645 ***			
Exposure to Poor Schoolmates	(0.071)	(0.071)	(0.070)				(0.075)	(0.075)	(0.075)			
Coefficients on Growth of Gap												
Minority-White Differences in	-0.015		-0.006	-0.029		-0.015	0.001		0.005	0.075		0.081
Exposure to Minority Schoolmates	(0.008)		(0.008)	(0.056)		(0.056)	(0.010)		(0.010)	(0.063)		(0.064)
Minority-White Differences in		-0.016			-0.033			0.014			0.173	
Exposure to Black Schoolmates		(0.008)			(0.057)			(0.014)			(0.100)	
Minority-White Differences in		-0.005			0.002			-0.006			0.036	
Exposure to Hispanic Schoolmates		(0.014)			(0.117)			(0.011)			(0.070)	
Minority-White Differences in	0.055 ***	0.054 ***	0.079 ***	0.221 ***	0.220 ***	0.226 ***	0.031 **	0.033 **	0.054 ***	0.131 *	0.132 *	0.139 *
Exposure to Poor Schoolmates	(0.011)	(0.011)	(0.012)	(0.052)	(0.052)	(0.052)	(0.012)	(0.012)	(0.013)	(0.058)	(0.058)	(0.058)
Minority-White Differences in			-0.025 ***			-0.028 *			-0.021 ***			-0.026
Exposure to Classmates Average Test			(0.005)			(0.013)			(0.006)			(0.016)
P-Value: Exposure to Blacks = Exposure to Hispanic		0.180			0.766			0.347			0.206	
N (Counties)	2,067	2,067	2,067	1,421	1,421	1,421	2,544	2,544	2,544	1,598	1,598	1,598
Metropolitan Areas												
Coefficients on Grade 3 Gap												
Minority-White Differences in	-0.159		-0.161				-0.052		-0.052			
Exposure to Minority Schoolmates	(0.094)		(0.094)				(0.122)		(0.122)			
Minority-White Differences in		-0.152						-0.092				
Exposure to Black Schoolmates		(0.098)						(0.151)				
Minority-White Differences in		-0.181						-0.027				
Exposure to Hispanic Schoolmates		(0.127)						(0.136)				
Minority-White Differences in	0.630 ***	0.630 ***	0.630 ***				0.666 ***	0.655 ***	0.665 ***			
Exposure to Poor Schoolmates	(0.124)	(0.124)	(0.124)				(0.152)	(0.154)	(0.152)			
Coefficients on Growth of Gap												
Minority-White Differences in	0.002		0.007	0.034		0.040	0.020		0.022	0.120		0.150
Exposure to Minority Schoolmates	(0.013)		(0.013)	(0.122)		(0.122)	(0.017)		(0.017)	(0.132)		(0.132)
Minority-White Differences in		0.000			0.045			0.048 *			0.038	
Exposure to Black Schoolmates		(0.014)			(0.125)			(0.021)			(0.173)	
Minority-White Differences in		0.006			-0.036			0.001			0.172	
Exposure to Hispanic Schoolmates		(0.018)			(0.220)			(0.018)			(0.150)	
Minority-White Differences in	0.019	0.019	0.035	0.144	0.149	0.146	0.003	0.011	0.006	0.070	0.066	0.106
Exposure to Poor Schoolmates	(0.018)	(0.018)	(0.019)	(0.119)	(0.119)	(0.119)	(0.021)	(0.021)	(0.023)	(0.125)	(0.125)	(0.125)
Minority-White Differences in			-0.016			-0.015			-0.004			-0.095 ***
Exposure to Classmates Average Test			(0.009)			(0.026)			(0.010)			(0.028)
P-Value: Exposure to Blacks = Exposure to Hispanic		0.923			0.700			0.045			0.468	
N (Metropolitan Areas)	389	389	389	382	382	382	390	390	390	388	388	388
Controls Included?	X	X	X	X	X	X	X	X	X	X	X	X

Note: All models also include measures of grade (centered on grade 3), cohort (centered on 2012) and math (centered on .5). Control variables in cross-sectional models include: the overall standardized SES composite, white-black or white-Hispanic differences in SES, proportion black, and proportion Hispanic. Control variables in panel models include: 1 and 2 year lags of the gaps, proportion black, proportion Hispanic, proportion economically disadvantaged, average school size, proportion of students attending charter schools, and the black-white, Hispanic-white and free lunch-non free lunch gap in charter school attendance. The p-values provided in the table are for a test of whether the coefficient on the difference in exposure to black students is significantly different from that on the difference in exposure to Hispanic students. * p<.05; ** p<.01; *** p<.001

Table 7. 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
Districts				
Minority-White Differences in Exposure to Poor Schoolmates	1.000 ***	0.817 ***	1.000 ***	0.894 ***
Minority-White Differences in Exposure to Minority Schoolmates	0.817 ***	1.000 ***	0.894 ***	1.000 ***
Minority-White Differences in Exposure to Black Schoolmates	0.693 ***	0.879 ***	0.397 ***	0.613 ***
Minority-White Differences in Exposure to Hispanic Schoolmates	0.653 ***	0.509 ***	0.882 ***	0.911 ***
Minority-White Differences in Exposure to Poor Neighbors	0.431 ***	0.430 ***	0.483 ***	0.468 ***
Minority-White Differences in Exposure to Minority Neighbors	0.517 ***	0.592 ***	0.599 ***	0.614 ***
White-Minority Differences in Classmates' Average Test Scores	0.777 ***	0.720 ***	0.796 ***	0.739 ***
Minority-White Differences in Exposure to Novice Teachers	0.368 ***	0.409 ***	0.307 ***	0.307 ***
Minority-White Differences in Exposure to Chronically Absent Teachers	0.090 ***	0.064 ***	0.149 ***	0.121 ***
Minority-White Differences in Schools' Student/Teacher Ratios	-0.062 ***	-0.066 ***	-0.120 ***	-0.109 ***
White-Minority Differences in Schools' Offerings of Gifted Programs	0.132 ***	0.149 ***	0.021	0.009
Counties				
Minority-White Differences in Exposure to Poor Schoolmates	1.000 ***	0.861 ***	1.000 ***	0.916 ***
Minority-White Differences in Exposure to Minority Schoolmates	0.861 ***	1.000 ***	0.916 ***	1.000 ***
Minority-White Differences in Exposure to Black Schoolmates	0.697 ***	0.868 ***	0.219 ***	0.368 ***
Minority-White Differences in Exposure to Hispanic Schoolmates	0.559 ***	0.480 ***	0.878 ***	0.908 ***
Minority-White Differences in Exposure to Poor Neighbors	0.636 ***	0.636 ***	0.661 ***	0.628 ***
Minority-White Differences in Exposure to Minority Neighbors	0.728 ***	0.808 ***	0.769 ***	0.811 ***
White-Minority Differences in Classmates' Average Test Scores	0.827 ***	0.784 ***	0.811 ***	0.738 ***
Minority-White Differences in Exposure to Novice Teachers	0.369 ***	0.403 ***	0.352 ***	0.391 ***
Minority-White Differences in Exposure to Chronically Absent Teachers	0.014	0.012	0.098 ***	0.087 ***
Minority-White Differences in Schools' Student/Teacher Ratios	-0.008	-0.030	-0.003	-0.017
White-Minority Differences in Schools' Offerings of Gifted Programs	0.176 ***	0.199 ***	0.136 ***	0.139 ***
White-Minority Differences in Log of Districts' Per Pupil Expenditures	-0.311 ***	-0.327 ***	-0.153 ***	-0.113 ***
Metros				
Minority-White Differences in Exposure to Poor Schoolmates	1.000 ***	0.876 ***	1.000 ***	0.926 ***
Minority-White Differences in Exposure to Minority Schoolmates	0.876 ***	1.000 ***	0.926 ***	1.000 ***
Minority-White Differences in Exposure to Black Schoolmates	0.728 ***	0.881 ***	0.040	0.252 ***
Minority-White Differences in Exposure to Hispanic Schoolmates	0.326 ***	0.166 **	0.915 ***	0.884 ***
Minority-White Differences in Exposure to Poor Neighbors	0.680 ***	0.725 ***	0.688 ***	0.718 ***
Minority-White Differences in Exposure to Minority Neighbors	0.797 ***	0.925 ***	0.844 ***	0.909 ***
White-Minority Differences in Classmates' Average Test Scores	0.882 ***	0.838 ***	0.893 ***	0.857 ***
Minority-White Differences in Exposure to Novice Teachers	0.351 ***	0.380 ***	0.412 ***	0.441 ***
Minority-White Differences in Exposure to Chronically Absent Teachers	-0.088	-0.117 *	0.003	-0.018
Minority-White Differences in Schools' Student/Teacher Ratios	-0.030	0.006	0.089	0.127 *
White-Minority Differences in Schools' Offerings of Gifted Programs	0.255 ***	0.299 ***	0.171 **	0.207 ***
White-Minority Differences in Log of Districts' Per Pupil Expenditures	-0.469 ***	-0.535 ***	-0.212 ***	-0.285 ***

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

Table 8. Regression Coefficients, White-Black School Resource Disparities and Achievement Gaps, School Districts

	White-Black Cross-Sectional Models, School Districts					
	B13	B14	B15	B16	B17	B18
Coefficients on Grade 3 Gap						
Minority-White Difference in Exposure to Minority Schoolmates	0.002 (0.060)	0.016 (0.059)	0.013 (0.059)	0.013 (0.059)	-0.077 (0.064)	-0.082 (0.062)
Minority-White Difference in Exposure to Poor Schoolmates	0.920 *** (0.075)	0.915 *** (0.075)	0.925 *** (0.075)	0.925 *** (0.075)	0.893 *** (0.075)	0.877 *** (0.076)
Minority-White Difference in Exposure to Novice Teachers	0.155 (0.160)					0.179 (0.165)
Minority-White Difference in Exposure to Chronically Absent Teachers		0.222 * (0.102)				0.254 * (0.105)
Minority-White Difference in Schools' Offerings of Gifted Programs			-0.011 (0.056)			-0.013 (0.057)
Minority-White Difference in Schools' Student/Teacher Ratios				-0.000 (0.001)		0.000 (0.001)
Minority-White Difference in Exposure to Minority Neighbors					0.175 *** (0.041)	0.171 *** (0.040)
Minority-White Difference in Exposure to Poor Neighbors					0.054 (0.088)	0.053 (0.088)
Coefficients on Growth of Gap						
Minority-White Difference in Exposure to Minority Schoolmates	-0.020 * (0.008)	-0.018 * (0.008)	-0.018 * (0.008)	-0.018 * (0.008)	-0.020 * (0.009)	-0.018 * (0.009)
Minority-White Difference in Exposure to Poor Schoolmates	0.043 *** (0.011)	0.044 *** (0.011)	0.044 *** (0.011)	0.044 *** (0.011)	0.043 *** (0.011)	0.059 *** (0.012)
Minority-White Difference in Exposure to Novice Teachers	0.028 (0.024)					0.035 (0.024)
Minority-White Difference in Exposure to Chronically Absent Teachers		0.005 (0.015)				0.015 (0.016)
Minority-White Difference in Schools' Offerings of Gifted Programs			0.004 (0.008)			0.002 (0.008)
Minority-White Difference in Schools' Student/Teacher Ratios				-0.000 (0.000)		0.000 (0.000)
Minority-White Difference in Exposure to Minority Neighbors					0.000 (0.006)	0.002 (0.006)
Minority-White Difference in Exposure to Poor Neighbors					0.009 (0.015)	0.010 (0.014)
N (Districts)	5,755	5,755	5,755	5,755	5,752	5,752
Controls Included?	X	X	X	X	X	X

Note: All models also include measures of grade (centered on grade 3), cohort (centered on 2012) and math (centered on .5). Control variables in cross-sectional models include: overall standardized EB SES composite, white-black or white-Hispanic differences in EB SES, proportion black, and proportion Hispanic. Control variables in panel models include: 1 and 2 year lags of the gaps, proportion black, proportion Hispanic, proportion economically disadvantaged, and average school size. * p<.05; ** p<.01; *** p<.001.

FIGURES

Figure 1. Association between Differences in Exposure to Minority Schoolmates and Achievement Gaps and Gap Growth Rates, White-Black Gaps

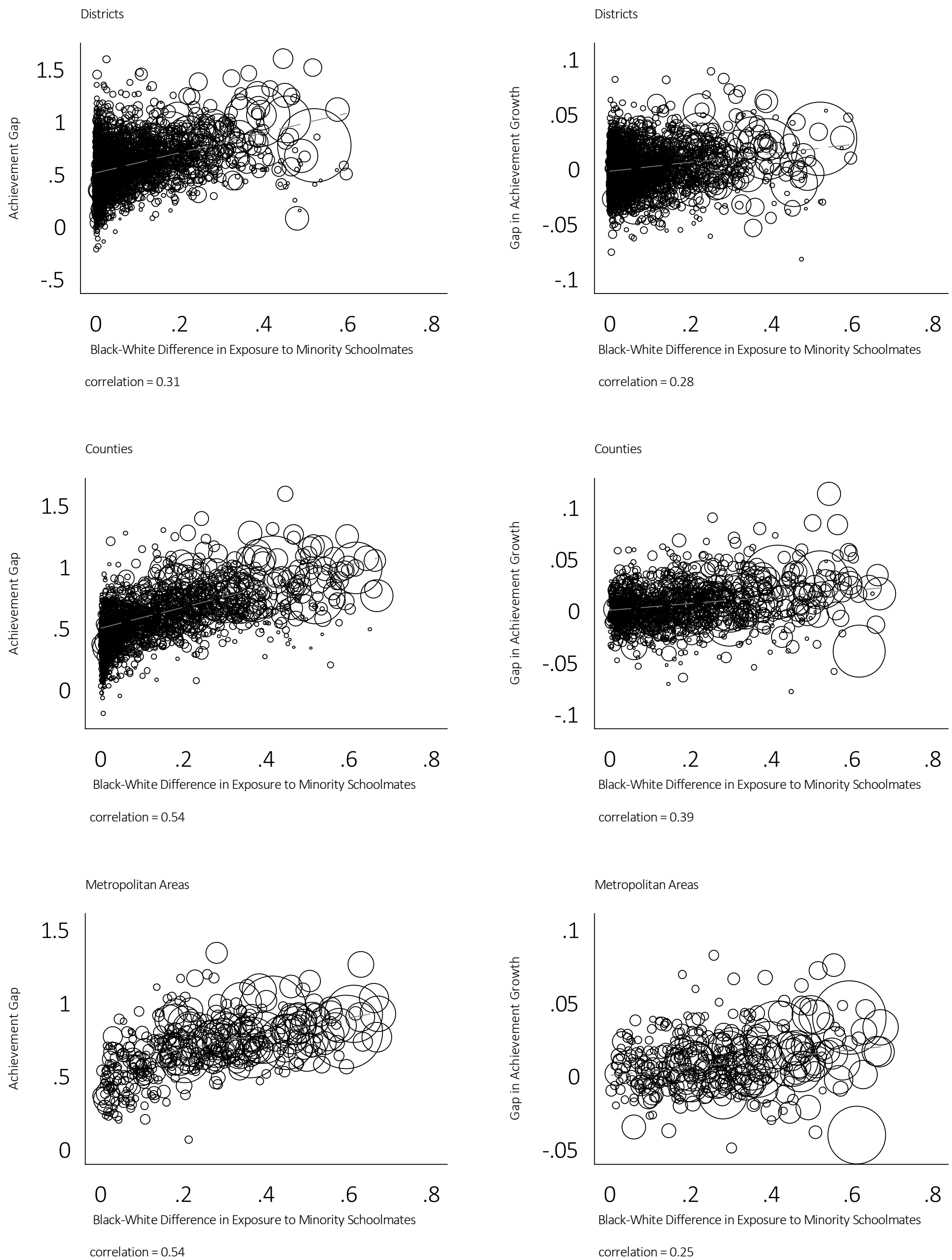


Figure 2. Association between Differences in Exposure to Poor Schoolmates and Achievement Gaps and Gap Growth Rates, White-Black Gaps

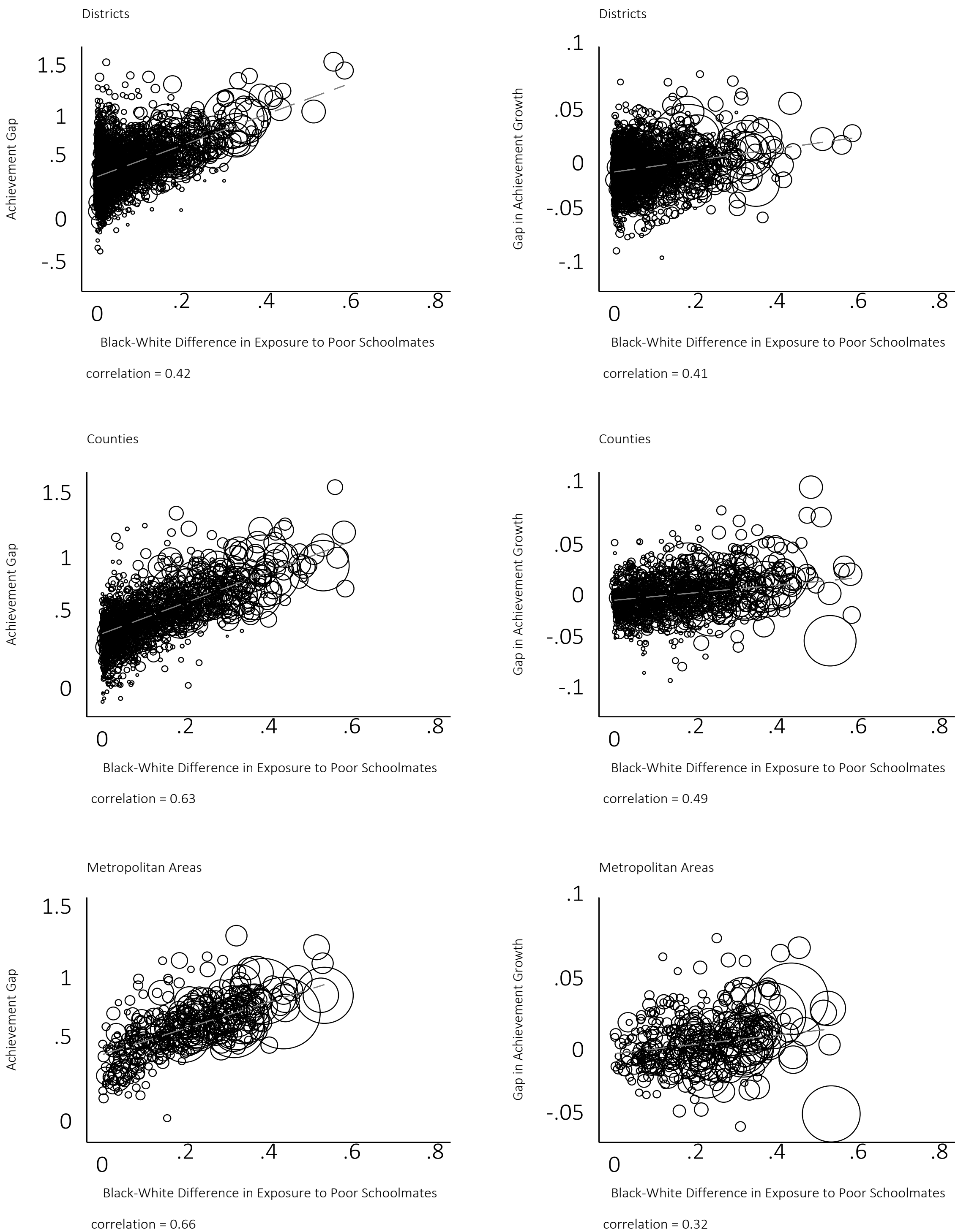
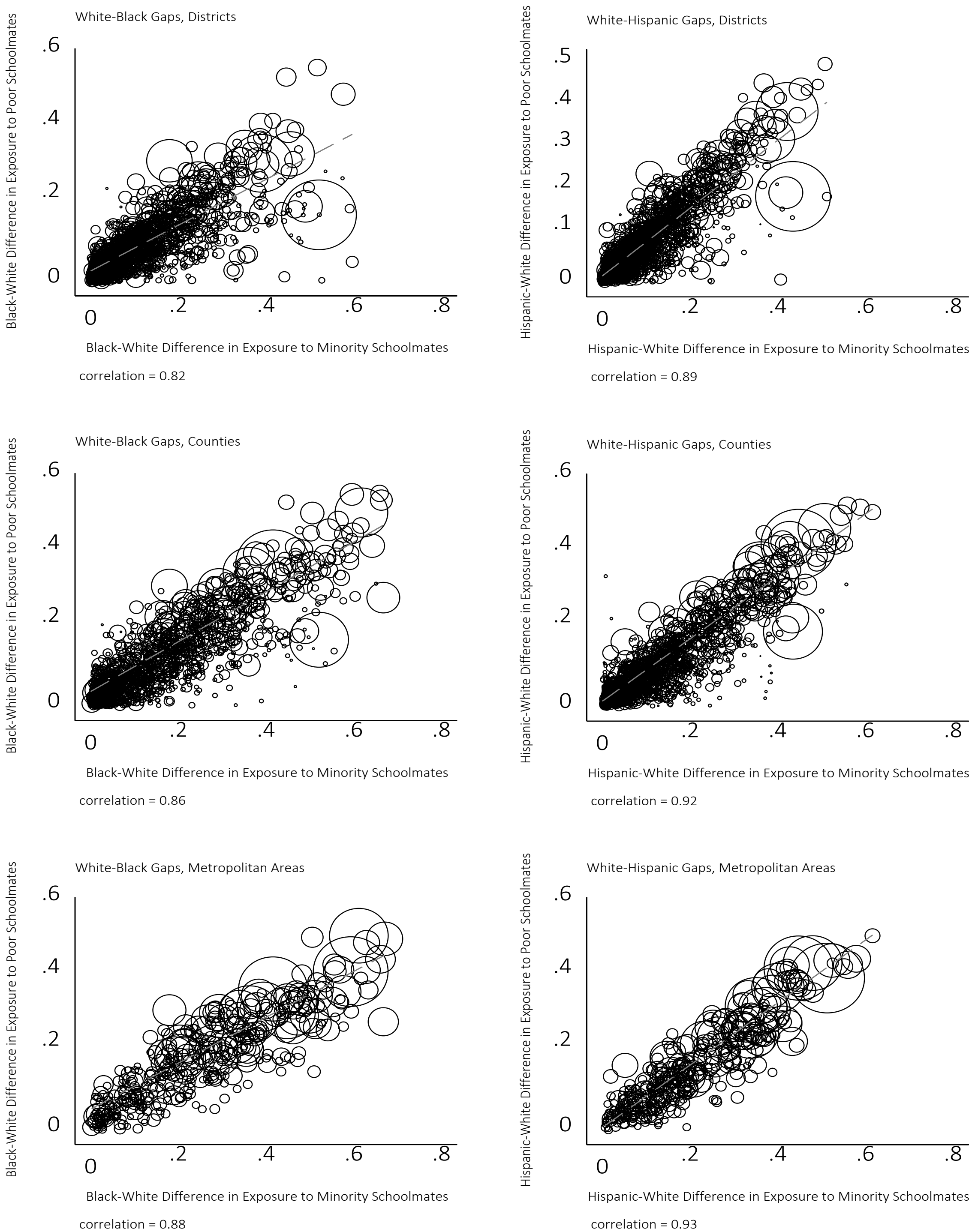


Figure 3. Association between Racial Segregation and Differences in Exposure to Poor Schoolmates



APPENDIX TABLES

Table A1. Regression Coefficients, White-Black School Resource Disparities and Achievement Gaps, Counties

	White-Black Cross-Sectional Models, Counties						
	B13	B14	B15	B16	B18	B17	B19
Coefficients on Grade 3 Gap							
Minority-White Difference in Exposure to	0.120 *	0.141 *	0.139 *	0.140 *	0.146 **	0.042	0.025
Minority Schoolmates	(0.055)	(0.055)	(0.055)	(0.055)	(0.055)	(0.065)	(0.067)
Minority-White Difference in Exposure to	0.499 ***	0.506 ***	0.506 ***	0.507 ***	0.512 ***	0.477 ***	0.473 ***
Poor Schoolmates	(0.071)	(0.071)	(0.071)	(0.071)	(0.071)	(0.075)	(0.078)
Minority-White Difference in Exposure to	0.301 *						0.303 *
Novice Teachers	(0.130)						(0.135)
Minority-White Difference in Exposure to		-0.026					-0.021
Chronically Absent Teachers		(0.070)					(0.074)
Minority-White Difference in Schools'			0.006				-0.004
Offerings of Gifted Programs			(0.035)				(0.041)
Minority-White Difference in Schools'				-0.000			0.000
Student/Teacher Ratios				(0.000)			(0.000)
Minority-White Difference in Districts'					0.045		0.039
Per Pupil Expenditures					(0.055)		(0.054)
Minority-White Difference in Exposure to						0.169 ***	0.171 **
Minority Neighbors						(0.058)	(0.059)
Minority-White Difference in Exposure to						0.063	0.068
Poor Neighbors						(0.121)	(0.123)
Coefficients on Growth of Gap							
Minority-White Difference in Exposure to	-0.013	-0.014	-0.014	-0.015	-0.018 *	-0.016	-0.012
Minority Schoolmates	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.010)	(0.010)
Minority-White Difference in Exposure to	0.055 ***	0.055 ***	0.055 ***	0.055 ***	0.052 ***	0.052 ***	0.074 ***
Poor Schoolmates	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.013)
Minority-White Difference in Exposure to	-0.027						-0.015
Novice Teachers	(0.019)						(0.022)
Minority-White Difference in Exposure to		-0.003					-0.001
Chronically Absent Teachers		(0.011)					(0.011)
Minority-White Difference in Schools'			-0.004				-0.003
Offerings of Gifted Programs			(0.005)				(0.006)
Minority-White Difference in Schools'				-0.000			0.000 ***
Student/Teacher Ratios				(0.000)			(0.000)
Minority-White Difference in Districts'					-0.025 **		-0.020
Per Pupil Expenditures					(0.009)		(0.010)
Minority-White Difference in Exposure to						-0.001	0.005
Minority Neighbors						(0.009)	(0.009)
Minority-White Difference in Exposure to						0.021	0.021
Poor Neighbors						(0.020)	(0.019)
N (Counties)	2,067	2,067	2,067	2,067	2,067	2,072	2,072
Controls Included?	X	X	X	X	X	X	X

Note: All models also include measures of grade (centered on grade 3), cohort (centered on 2012) and math (centered on .5). Control variables include: overall standardized SES composite, white-black or white-Hispanic difference in SES, proportion black, and proportion Hispanic. * p<.05; ** p<.01; *** p<.001.

Table A2. Regression Coefficients, White-Black School Resource Disparities and Achievement Gaps, Metropolitan Areas

	White-Black Cross-Sectional Models, Metropolitan Areas						
	B13	B14	B15	B16	B18	B17	B19
Coefficients on Grade 3 Gap							
Minority-White Difference in Exposure to	-0.180	-0.161	-0.162	-0.160	-0.215 *	-0.243	-0.335 *
Minority Schoolmates	(0.094)	(0.093)	(0.094)	(0.094)	(0.096)	(0.130)	(0.132)
Minority-White Difference in Exposure to	0.623 ***	0.638 ***	0.628 ***	0.631 ***	0.617 ***	0.578 ***	0.566 ***
Poor Schoolmates	(0.124)	(0.124)	(0.124)	(0.125)	(0.123)	(0.127)	(0.126)
Minority-White Difference in Exposure to	0.345						0.412
Novice Teachers	(0.225)						(0.228)
Minority-White Difference in Exposure to		0.165					0.203
Chronically Absent Teachers		(0.109)					(0.109)
Minority-White Difference in Schools'			0.014				0.025
Offerings of Gifted Programs			(0.049)				(0.049)
Minority-White Difference in Schools'				0.000			-0.001
Student/Teacher Ratios				(0.004)			(0.004)
Minority-White Difference in Districts'					-0.201 *		-0.210 *
Per Pupil Expenditures					(0.088)		(0.087)
Minority-White Difference in Exposure to						0.030	0.042
Minority Neighbors						(0.128)	(0.127)
Minority-White Difference in Exposure to						0.470	0.422
Poor Neighbors						(0.263)	(0.260)
Coefficients on Growth of Gap							
Minority-White Difference in Exposure to	0.001	0.002	0.001	0.004	-0.003	0.010	0.008
Minority Schoolmates	(0.013)	(0.013)	(0.013)	(0.013)	(0.014)	(0.019)	(0.019)
Minority-White Difference in Exposure to	0.019	0.019	0.019	0.016	0.017	0.018	0.025
Poor Schoolmates	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.020)
Minority-White Difference in Exposure to	0.011						0.024
Novice Teachers	(0.032)						(0.032)
Minority-White Difference in Exposure to		0.001					0.005
Chronically Absent Teachers		(0.016)					(0.015)
Minority-White Difference in Schools'			0.000				0.005
Offerings of Gifted Programs			(0.007)				(0.007)
Minority-White Difference in Schools'				-0.001			-0.001
Student/Teacher Ratios				(0.001)			(0.001)
Minority-White Difference in Districts'					-0.016		-0.014
Per Pupil Expenditures					(0.012)		(0.012)
Minority-White Difference in Exposure to						-0.018	-0.016
Minority Neighbors						(0.019)	(0.019)
Minority-White Difference in Exposure to						0.026	0.030
Poor Neighbors						(0.040)	(0.039)
N(Metropolitan Areas)	389	389	389	389	389		
Controls Included?	X	X	X	X	X	X	X

Note: All models also include measures of grade (centered on grade 3), cohort (centered on 2012) and math (centered on .5). Control variables include: overall standardized SES composite, white-black or white-Hispanic difference in SES, proportion black, and proportion Hispanic. * p<.05; ** p<.01; *** p<.001.

Table A3. Regression Coefficients, White-Hispanic School Resource Disparities and Achievement Gaps, School Districts

	White-Hispanic Cross-Sectional Models, School Districts					
	H13	H14	H15	H16	H17	H18
Coefficients on Grade 3 Gap						
Minority-White Difference in Exposure to Minority Schoolmates	0.046	0.045	0.041	0.040	-0.022	-0.012
	(0.079)	(0.079)	(0.079)	(0.079)	(0.079)	(0.079)
Minority-White Difference in Exposure to Poor Schoolmates	1.005 ***	0.985 ***	0.997 ***	0.996 ***	0.975 ***	0.956 ***
	(0.085)	(0.085)	(0.084)	(0.084)	(0.085)	(0.085)
Minority-White Difference in Exposure to Novice Teachers	-0.168					-0.160
	(0.175)					(0.181)
Minority-White Difference in Exposure to Chronically Absent Teachers		0.194				0.291 *
		(0.117)				(0.121)
Minority-White Difference in Schools' Offerings of Gifted Programs			0.006			0.087
			(0.059)			(0.062)
Minority-White Difference in Schools' Student/Teacher Ratios				-0.000		0.000
				(0.001)		(0.001)
Minority-White Difference in Exposure to Minority Neighbors					0.194 ***	0.197 ***
					(0.052)	(0.052)
Minority-White Difference in Exposure to Poor Neighbors					-0.099	-0.100
					(0.113)	(0.113)
Coefficients on Growth of Gap						
Minority-White Difference in Exposure to Minority Schoolmates	-0.010	-0.008	-0.009	-0.008	-0.013	-0.009
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)
Minority-White Difference in Exposure to Poor Schoolmates	0.031 *	0.031 *	0.032 *	0.032 *	0.021	0.041 **
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.014)
Minority-White Difference in Exposure to Novice Teachers	0.023					0.026
	(0.028)					(0.029)
Minority-White Difference in Exposure to Chronically Absent Teachers		0.005				0.003
		(0.019)				(0.020)
Minority-White Difference in Schools' Offerings of Gifted Programs			0.003			-0.002
			(0.009)			(0.010)
Minority-White Difference in Schools' Student/Teacher Ratios				0.000		0.000
				(0.000)		(0.000)
Minority-White Difference in Exposure to Minority Neighbors					0.014	0.016
					(0.009)	(0.009)
Minority-White Difference in Exposure to Poor Neighbors					0.024	0.024
					(0.019)	(0.019)
N (Districts)	7,800	7,800	7,800	7,800	7,788	7,788
Controls Included?	X	X	X	X	X	X

Note: All models also include measures of grade (centered on grade 3), cohort (centered on 2012) and math (centered on .5). Control variables include: overall standardized SES composite, white-black or white-Hispanic difference in SES, proportion black, and proportion Hispanic. * p<.05; ** p<.01; *** p<.001.

Table A4. Regression Coefficients, White-Hispanic School Resource Disparities and Achievement Gaps, Counties

	White-Hispanic Cross-Sectional Models, Counties						
	H13	H14	H15	H16	H18	H17	H19
Coefficients on Grade 3 Gap							
Minority-White Difference in Exposure to	0.074	0.073	0.073	0.074	0.076	0.018	0.018
Minority Schoolmates	(0.065)	(0.064)	(0.064)	(0.064)	(0.064)	(0.071)	(0.072)
Minority-White Difference in Exposure to	0.644 ***	0.643 ***	0.645 ***	0.644 ***	0.633 ***	0.630 ***	0.619 ***
Poor Schoolmates	(0.075)	(0.075)	(0.075)	(0.075)	(0.076)	(0.079)	(0.079)
Minority-White Difference in Exposure to	-0.011						0.007
Novice Teachers	(0.142)						(0.142)
Minority-White Difference in Exposure to		0.032					0.029
Chronically Absent Teachers		(0.079)					(0.079)
Minority-White Difference in Schools'			-0.003				-0.011
Offerings of Gifted Programs			(0.042)				(0.042)
Minority-White Difference in Schools'				0.000			0.000
Student/Teacher Ratios				(0.000)			(0.000)
Minority-White Difference in Districts'					-0.073		-0.084
Per Pupil Expenditures					(0.055)		(0.055)
Minority-White Difference in Exposure to						0.150	0.160 *
Minority Neighbors						(0.080)	(0.080)
Minority-White Difference in Exposure to						-0.112	-0.136
Poor Neighbors						(0.157)	(0.157)
Coefficients on Growth of Gap							
Minority-White Difference in Exposure to	0.001	0.001	0.001	0.001	0.001	0.003	0.006
Minority Schoolmates	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.012)	(0.012)
Minority-White Difference in Exposure to	0.031 **	0.031 **	0.031 **	0.031 **	0.031 **	0.031 *	0.054 ***
Poor Schoolmates	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.014)
Minority-White Difference in Exposure to	-0.003						-0.001
Novice Teachers	(0.023)						(0.023)
Minority-White Difference in Exposure to		-0.005					-0.005
Chronically Absent Teachers		(0.012)					(0.012)
Minority-White Difference in Schools'			0.005				0.005
Offerings of Gifted Programs			(0.007)				(0.006)
Minority-White Difference in Schools'				-0.000			0.000
Student/Teacher Ratios				(0.000)			(0.000)
Minority-White Difference in Districts'					-0.002		-0.002
Per Pupil Expenditures					(0.009)		(0.009)
Minority-White Difference in Exposure to						-0.002	0.000
Minority Neighbors						(0.013)	(0.013)
Minority-White Difference in Exposure to						0.000	0.002
Poor Neighbors						(0.026)	(0.025)
N (Counties)	2,544	2,544	2,544	2,544	2,544	2,549	2,549
Controls Included?	X	X	X	X	X	X	X

Note: All models also include measures of grade (centered on grade 3), cohort (centered on 2012) and math (centered on .5). Control variables include: overall standardized SES composite, white-black or white-Hispanic difference in SES, proportion black, and proportion Hispanic. * p<.05; ** p<.01; *** p<.001.

Table A5. Regression Coefficients, White-Hispanic School Resource Disparities and Achievement Gaps, Metropolitan Areas

	White-Hispanic Cross-Sectional Models, Metropolitan Areas						
	H13	H14	H15	H16	H18	H17	H19
Coefficients on Grade 3 Gap							
Minority-White Difference in Exposure to	-0.048	-0.056	-0.043	-0.065	-0.080	0.096	0.041
Minority Schoolmates	(0.123)	(0.121)	(0.122)	(0.122)	(0.123)	(0.165)	(0.196)
Minority-White Difference in Exposure to	0.666 ***	0.671 ***	0.663 ***	0.673 ***	0.671 ***	0.667 ***	0.685 ***
Poor Schoolmates	(0.152)	(0.152)	(0.152)	(0.152)	(0.152)	(0.153)	(0.192)
Minority-White Difference in Exposure to	-0.061						0.010
Novice Teachers	(0.251)						(0.331)
Minority-White Difference in Exposure to		0.159					0.149
Chronically Absent Teachers		(0.142)					(0.170)
Minority-White Difference in Schools'			-0.040				-0.043
Offerings of Gifted Programs			(0.065)				(0.085)
Minority-White Difference in Schools'				0.003			0.004
Student/Teacher Ratios				(0.004)			(0.003)
Minority-White Difference in Districts'					-0.112		-0.123
Per Pupil Expenditures					(0.109)		(0.149)
Minority-White Difference in Exposure to						-0.158	-0.128
Minority Neighbors						(0.171)	(0.202)
Minority-White Difference in Exposure to						-0.282	-0.310
Poor Neighbors						(0.306)	(0.372)
Coefficients on Growth of Gap							
Minority-White Difference in Exposure to	0.003	0.003	0.003	0.000	0.003	0.036	0.032
Minority Schoolmates	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.023)	(0.025)
Minority-White Difference in Exposure to	0.022	0.020	0.020	0.024	0.016	-0.003	-0.005
Poor Schoolmates	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.021)	(0.023)
Minority-White Difference in Exposure to	-0.016						-0.004
Novice Teachers	(0.034)						(0.036)
Minority-White Difference in Exposure to		0.010					0.013
Chronically Absent Teachers		(0.020)					(0.017)
Minority-White Difference in Schools'			0.001				0.005
Offerings of Gifted Programs			(0.009)				(0.011)
Minority-White Difference in Schools'				-0.001			-0.001 *
Student/Teacher Ratios				(0.000)			(0.000)
Minority-White Difference in Districts'					-0.022		-0.015
Per Pupil Expenditures					(0.015)		(0.017)
Minority-White Difference in Exposure to						-0.040	-0.034
Minority Neighbors						(0.024)	(0.028)
Minority-White Difference in Exposure to						0.070	0.066
Poor Neighbors						(0.045)	(0.047)
N(Metropolitan Areas)	390	390	390	390	390	389	389
Controls Included?	X	X	X	X	X	X	X

Note: All models also include measures of grade (centered on grade 3), cohort (centered on 2012) and math (centered on .5). Control variables include: overall standardized SES composite, white-black or white-Hispanic difference in SES, proportion black, and proportion Hispanic. * p<.05; ** p<.01; *** p<.001.

APPENDIX FIGURES

Figure A1. Association between Differences in Exposure to Minority Schoolmates and Achievement Gaps and Gap Growth Rates, White-Hispanic Gaps

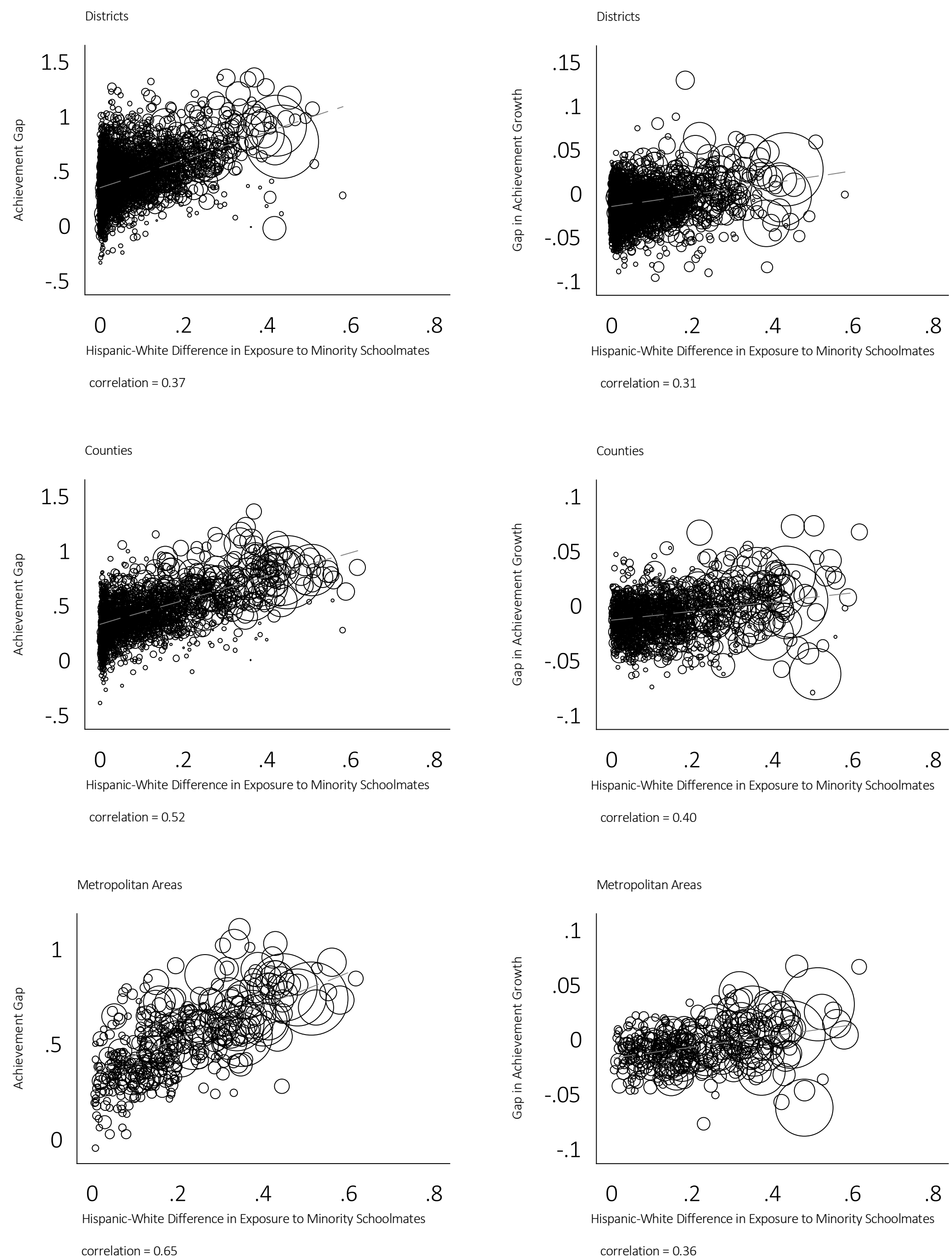


Figure A2. Association between Differences in Exposure to Poor Schoolmates and Achievement Gaps and Gap Growth Rates, White-Hispanic Gaps