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Black–White Achievement Gaps Differ by Family Socioeconomic Status From Early Childhood Through Early Adolescence

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Theory and limited research indicate that race and socioeconomic status (SES) interact dynamically to shape children's developmental contexts and academic achievement, but little scholarship examines how race and SES intersect to shape Black–White achievement gaps across development. We used data from the Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 ($N \approx 9,100$)—which tracks a nationally representative cohort of children in the United States—to investigate how race and family SES (i.e., parental education and household income) intersect to shape trajectories of academic skills development from kindergarten entry through the spring of eighth grade. Results reveal that household income and parental education were differentially related to academic development, with Black–White gaps narrowing (and Black children's skills growing slightly faster) at higher income gradients but widening (and Black children's skills developing more slowly) at higher levels of educational attainment. Despite performance advantages at kindergarten entry, large baseline disparities meant that higher-income Black students underperformed their White peers by middle school, whereas Black students with better-educated parents consistently trailed their White counterparts. Taken together, these findings suggest that failure to examine how race and SES intersect to shape achievement gaps may obscure complex patterns of educational inequality.

Educational Impact and Implications Statement

This study examines how the Black–White achievement gap among U.S. students develops from kindergarten through middle school. Results indicate that the academic returns to family socioeconomic status (SES) differ for Black and White children. Specifically, gaps narrow at higher income levels but grow at higher levels of parental education. This research indicates that socioeconomic advantage may not bestow the same benefits on Black children that it does on White children whereas socioeconomic adversity may not confer equivalent disadvantages on White children as it does on Black children. These findings suggest that the structural and social privileges and constraints related to SES differ for Black and White children and highlight why we must consider how race and SES intersect to shape children's learning experiences.

Keywords: Black-White achievement gap, academic achievement, school readiness, inequality, intersectionality

The Black–White achievement gap undermines the future welfare of Black children in the United States (Fryer, 2011; Johnson & Neal, 1998; Mazumder, 2008). A compelling array of research shows that poorer academic achievement among Black American children and youth contributes to an ongoing pattern of Black– White inequity in markers of adult success, such as educational attainment and wages, in U.S. society (Fryer, 2011; Heckman, 2011). Indeed, multiple studies report that boosting the academic skills of Black students would eliminate racial disparities in high school graduation and college matriculation and substantially reduce inequalities in employment rates, annual earnings, and economic mobility (Cameron & Heckman, 2001; Fryer, 2011; Mazum-der, 2008, 2014). Such findings highlight the key role achievement disparities play in undermining Black children's life chances and future opportunities (Acs, 2011; Fryer, 2011; Mazumder, 2014).

On average, Black children grow up in more socioeconomically disadvantaged families than White children, yet race disparities in basic markers of socioeconomic status (SES), such as household income and parental education, rarely explain the entirety of the

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achievement gap (Magnuson & Duncan, 2006; S. F. Reardon, Kalogrides, & Shores, 2016). Moreover, recent research suggests that Black–White skills gaps differ by income and education (Davis-Kean, 2005; Dixon-Román, Everson, & McArdle, 2013; Ferguson, 2007; Fryer & Levitt, 2004; Yeung & Pfeiffer, 2009). However, because of methodological limitations, this extant scholarship has yielded divergent findings, leaving it unclear whether race gaps expand or contract as income and education increase.

The Black-White achievement gap in theoretical and empirical literature generally treats racial disparities in SES as the precursor or source of racial skills gaps (Duncan & Magnuson, 2005; Magnuson & Duncan, 2006). Yet, if gaps vary by SES and in fact persist or grow more pronounced at higher levels of household income and parental education, such patterns call into question the prevailing perspective on the origin of gaps, which posits that narrowing or eliminating Black-White disparities in SES would eradicate race gaps in achievement. This study uses nationally representative data from the Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS-K) to improve understanding of the independent and interactive contributions of race and family SES (i.e., income and education) to the development of the Black-White achievement gap from kindergarten entry through eighth grade. Notably, little work examines the developmental progression of Black-White skills disparities among children in families with comparable parental schooling and household income levels (for an exception, see Burchinal et al., 2011), and we could identify no studies that simultaneously investigate whether and how both income and education uniquely moderate race gaps across three key developmental periods-early childhood, middle childhood, and early adolescence. The study is grounded in intersectional theory, which brings into focus the reasons why the educational returns to family SES may differ for Black and White children.

An Intersectional Perspective on Why the Academic Returns to SES Differ by Race

Intersectionality frameworks highlight the ways social categories or social group memberships interact dynamically to configure macrolevel contexts and, in turn, shape everyday experiences and individual norms, beliefs, and practices (Cole, 2009; Crenshaw, 1991). Social categories (or ascribed social identities), such as race and social class, are inextricably interlinked and therefore operate jointly to structure families' social, economic, and cultural contexts (Cole, 2009; Collins, 1998). We use social category and social identity interchangeably to denote where individuals fall in a system of stratification based on their group membership. Simply put, race and SES represent structural (as well as individual) constructs and processes, which in turn, influence microlevel individual and family processes. Children's family lives and developmental outcomes can therefore be influenced by the intersection of multiple social categories (both before and after they develop a firm sense of or can define their identities). A key insight derived from intersectionality theory is that complex configurations of advantage and disadvantage can arise at the intersection of social categories, especially status-based categories that may confer conflicting degrees of privilege and disadvantage, such as race and SES (Cole, 2009; McCall, 2001, 2005). Intersectionality thus underscores the need to consider how the mutual influence of race

and SES shapes development (Henry, Votruba-Drzal, & Miller, 2019b; Warner, 2008). Complex forms of inequality can emerge because the combined, interlocking effects of multiple social categories play out in dynamic ways, meaning, for example, race may fundamentally alter the experiences of Black Americans no matter the socioeconomic strata from which they hail or to which they ascend.

Contemporary social categories are informed by and reflect long-standing historical processes of inequality (Cole, 2009). In the United States, because systems of racial and social stratification were historically interconnected (Garcia Coll et al., 1996; Ladson-Billings, 2006), contemporary Black families confront greater proximity to intergenerational, spatial, and relational disadvantage than White families, who conversely tend to benefit from greater proximity to advantage (Gosa & Alexander, 2007). Regardless of SES, Black Americans are more likely to have grown up in poor households and communities (Sharkey, 2013), to live in or near distressed neighborhoods (Logan, 2011; Pattillo-McCoy, 1999), and to be embedded in disadvantaged kin and peer networks (Chiteji & Hamilton, 2002; Tigges, Browne, & Green, 1998). As a result, dimensions of SES, such as household income and parental education, may not hold the same meaning and afford the same experiences (or conditions of advantage and disadvantage) to Blacks and Whites. In particular, higher family SES may not translate into similar gains in achievement for Black and White children because proximity to (dis)advantage shapes Black and White families' access to resources, exposure to stressors, and cultural logic of child rearing in disparate ways (Henry, Votruba-Drzal, & Miller, 2019a; Lareau, 2011). Indeed, an extensive theoretical literature posits that social class differences in resources and investments (e.g., time, money, and materials), environmental stressors (e.g., economic hardship and neighborhood disorder), and sociocultural factors (e.g., cultural repertoires and social norms) at the family and community level give rise to socioeconomic disparities in development (Magnuson & Votruba-Drzal, 2009). Greater proximity to (dis)advantage may therefore alter the association between child development and both household income and parental education by (a) limiting or facilitating access to salutary resources (e.g., safe neighborhoods, social, cultural, and economic capital, i.e., wealth), (b) exacerbating or mitigating the effects of family and environmental stressors (e.g., financial strain and community disadvantage), and (c) shaping child rearing styles, practices, and attitudes. Nevertheless, little extant research has adopted an intersectional perspective to explore how race, household income, and parental educational attainment interact to shape academic development.

Recently, some scholars have argued for the importance not only of incorporating intersectionality theory into developmental research but also understanding how mutually constitutive social categories shape children's outcomes across developmental stages (Ghavami, Katsiaficas, & Rogers, 2016). Furthermore, a rich body of interdisciplinary scholarship notes the salience of developmental transitions for children's positive long-term adjustment (Bronfenbrenner & Morris, 2006; Elder & Shanahan, 2006). In particular, the consequences of successful or troubled school transitions can produce developmental cascades that buoy or undermine children's future psychological and academic functioning (Benner & Graham, 2009; Lord, Eccles, & McCarthy, 1994; Sabol & Pianta, 2012). Of particular note, the academic skills children evince at school entry often forecast their later achievement trajectories and ultimate educational attainment (Alexander, Entwisle, & Horsey, 1997; Duncan et al., 2007; Entwisle, Alexander, & Olson, 2005). Alongside their academic development, children's personal and social identities are taking shape between early childhood and early adolescence. However, the central aim of the current study is to understand how the intersecting social positions defined by race and SES shape children's skills acquisition and achievement trajectories. Indeed, before ongoing research can identify and test the pathways underlying these relations, a requisite foundational step is describing the field of inequality (i.e., how race, income, and education interact to configure children's academic outcomes over time; McCall, 2005). Understanding these associations will better provide insight into which mechanisms are at work and how they may operate. For instance, if Black-White skills gaps are small or nonexistent among affluent families at kindergarten entry but grow substantially across primary school, this would suggest that racial disparities in school-related factors (rather than early formative experiences) may be key contributors to educational inequality.

The Black–White Achievement Gap in Early and Middle Childhood

On average, Black children enter school with more poorly developed literacy and math skills (S. F. Reardon & Portilla, 2016). Past scholarship has identified Black-White gaps of roughly 0.40 of a standard deviation in literacy skills and disparities ranging from 0.60-0.75 SDs in math skills at kindergarten entry (Burchinal et al., 2011; Fryer & Levitt, 2004; Yeung & Pfeiffer, 2009). More recently, Quinn (2015) found Black-White gaps of just 0.32 SD and 0.54 SD in reading and math, respectively, in a national sample of children who entered kindergarten in 2010-2011. However, S. F. Reardon and Portilla (2016) reported that these race gaps did not differ significantly in size from those observed in an earlier kindergarten cohort, leaving it uncertain whether these disparities have declined meaningfully or remained stable. Far fewer studies have examined early racial gaps in science achievement, but recent work revealed that Black children lagged 0.62 SD behind their White peers in science knowledge at kindergarten entry (Morgan, Farkas, Hillemeier, & Maczuga, 2016) and 0.82 SD behind White students in science skills by the spring of kindergarten (Curran & Kellogg, 2016).

As children move through school, Black–White achievement gaps seem to hold steady, if not increase slightly. For example, Fryer and Levitt (2004) found that Black–White achievement disparities increased by 0.10 *SD* per year. By fifth grade, racial gaps reach 1.00 *SD* in math and 0.75 *SD* in reading (S. F. Reardon & Robinson, 2007), and thereafter stay stable through eighth grade (S. F. Reardon, Robinson-Cimpian, & Weathers, 2015). With respect to science achievement, Black–White gaps exceed 1.00 *SD* by third grade (Kohlhaas, Lin, & Chu, 2010; Rathbun & West, 2004) and likewise persist essentially unchanged (Quinn & Cooc, 2015) or increase only marginally (Morgan et al., 2016) through eighth grade.

How Race and SES Intersect to Shape Achievement

Given Black families' higher rates of socioeconomic disadvantage, scholars often consider the additive associations between

SES, race, and skills gaps to address the confounding of race and SES. Like race, family SES is strongly linked to children's academic performance (Duncan, Magnuson, & Votruba-Drzal, 2015). Efforts to elucidate the channels through which SES affects skills have culminated in a substantial body of scholarship evincing a clear connection between academic competence and household income and parental education in particular. For example, poor and low-income children dramatically lag behind their higher-income peers in reading and math achievement (Lee & Burkam, 2002), with skills disparities between poor children and their middleincome peers exceeding roughly 0.48 SD and 0.56 SD in reading and math, respectively, whereas gaps between low-income children and their highly affluent counterparts surpass 1.00 SD in both reading and math (Isaacs & Magnuson, 2011). S. F. Reardon (2011) reported that the size of the income-achievement gap changes little as children progress through primary school.

Similarly, children with highly educated parents enter school with better academic skills and exhibit stronger academic performance and higher educational attainment into adulthood (Carneiro, Meghir, & Parey, 2013; Davis-Kean, 2005). At kindergarten entry, school readiness gaps exceed 1.00 SD between children whose mothers completed a bachelor's degree and those whose mothers did not graduate from high school (Isaacs & Magnuson, 2011; S. F. Reardon, Robinson-Cimpian, et al., 2015). By the spring of eighth grade, math gaps (between children from the least- and mosteducated families) have narrowed modestly (by roughly 0.07 SD) while reading gaps have grown by 0.18 SD (S. F. Reardon, Robinson-Cimpian, et al., 2015). Over the same period, skills gaps between students whose parents did not complete schooling beyond high school and their peers with college-educated parents have increased by about 0.10 SD to reach 1.00 SD in magnitude in math and by approximately 0.07 SD to hit nearly 1.00 SD in reading (Reardon, Fox, & Townsend, 2015).

Overall, this literature suggests that large income- and education-related achievement gaps are evident at school entry and economic disparities seem to remain constant as children progress through school whereas parental education-related gaps appear to widen. Although family socioeconomic standing has obvious implications for children's scholastic performance, basic markers of SES (i.e., household income and parental educational attainment) rarely fully explain early Black–White achievement gaps and generally account for a diminishing proportion of race disparities as children progress through school (Fryer & Levitt, 2006; Murnane et al., 2006).

Furthermore, a growing body of research evinces that race and family SES intersect to shape academic outcomes in nuanced ways (see Campbell, Haveman, Wildhagen, & Wolf, 2008; Davis-Kean, 2005; Dixon-Román et al., 2013; Farkas & Beron, 2004; Ferguson, 2007; Fryer & Levitt, 2004; Lindsay, 2011; Ogbu & Davis, 2003; Raver, Gershoff, & Aber, 2007; Yeung & Pfeiffer, 2009). These studies have yielded disparate findings, with some finding Black– White skills gaps grew at higher SES levels (or finding weaker links between SES and achievement among Blacks; Davis-Kean, 2005; Farkas & Beron, 2004; Ferguson, 2007; Fryer & Levitt, 2004; Yeung & Pfeiffer, 2009) and others indicating that racial gaps contracted at higher SES gradients (or showing stronger relations between SES and skills among Blacks; Dixon-Román et al., 2013; Raver et al., 2007). Studies that use composite SES variables leave it unknown whether there are differences in how household income and parental education shape achievement gaps (Farkas & Beron, 2004; Ferguson, 2007; Fryer & Levitt, 2004). In the research that has tested moderation of Black–White achievement gaps by only income or education in isolation, there is some indication that racial differences decrease at higher income levels (Dixon-Román et al., 2013; Raver et al., 2007) but grow at higher parental education levels (Lindsay, 2011). However, studies that have investigated moderation by income and education in the same model have also produced inconsistent results, in one case showing smaller associations between achievement and both income and education among Black children (Davis-Kean, 2005) and in the other showing that racial skills disparities in math were largest among children from higher-income families but finding no moderation by parental educational attainment (Yeung & Pfeiffer, 2009).

This extant literature reveals that additive models, by failing to consider how income and education may relate differentially to academic development for Black and White children, can limit our knowledge of how achievement gaps take shape. However, the body of scholarship that examines the interactive effects of race and SES on skills is beset by methodological limitations that likely underlie the inconsistent findings across studies and obscure a clear picture of these relationships.

Contributions of the Current Study

Our research addresses these limitations and enhances this scholarship in three principal ways. First, it is only one of three investigations (see also Davis-Kean, 2005; Yeung & Pfeiffer, 2009) to test the moderating roles of both income and education separately when examining Black-White achievement gaps. More often studies have used an SES composite (see Farkas & Beron, 2004; Ferguson, 2007; Fryer & Levitt, 2004), treated community SES as a proxy for family SES (see Ogbu & Davis, 2003), or focused solely on family income (see Campbell et al., 2008; Dixon-Román et al., 2013; Raver et al., 2007) or parental education (see Lindsay, 2011) as a moderator. These methodological choices present a few problems. Composite measures of SES are difficult to interpret and can obscure unique associations between different components of SES and academic achievement. Although family income and parental schooling level are correlated, they are not perfectly so, and extant studies document their independent relations to academic outcomes (Chevalier, Harmon, O'Sullivan, & Walker, 2013; Davis-Kean, 2005; Isaacs & Magnuson, 2011; S. F. Reardon, 2011). In fact, multiple lines of research demonstrate that distinct dimensions of family SES, such as household income and parental educational attainment, differ in the strength of their associations with academic skills as well as the pathways connecting them to academic development (Davis-Kean, 2005; Duncan & Magnuson, 2003; S. F. Reardon, 2011). Moreover, community SES is a distal measure of family SES that is better conceived of as a correlate rather than a core component of family SES (Cowan et al., 2012; Duncan et al., 2015).

A second contribution of our research is that it is just one of two studies (see also Farkas & Beron, 2004) to investigate the trajectory of within-SES Black–White achievement gaps across three developmental stages in a longitudinal cohort. We improve upon the Farkas and Beron (2004) study by (a) assessing the independent links between income and education and skills disparities, rather than using a composite SES measure; (b) examining trajectories of multiple achievement outcomes, rather than a single achievement measure (i.e., oral vocabulary development) in isolation; and (c) perhaps most noteworthy, making the investigation of within-SES racial skills disparities the primary focus of study, rather than an ancillary or supplemental issue. Unlike other work (see also Fryer & Levitt, 2004; Yeung & Pfeiffer, 2009) wherein the question of how SES moderates Black–White gaps was a post hoc concern (i.e., examined as part of sensitivity or supplemental analyses), answering this important question is the central aim of the current research. As such, our study is more theoretically informed and thus better lays the groundwork for future research to delineate the processes underlying these associations.

The final major contribution of our research is that it is the lone study to examine trajectories of skill development across three developmental phases and patterns of moderation by income and education for three key indices of achievement-namely, math, reading, and science. Prior studies have primarily focused on cross-sectional differences in student achievement (see Campbell et al., 2008; Davis-Kean, 2005; Dixon-Román et al., 2013; Ferguson, 2007; Fryer & Levitt, 2004; Lindsay, 2011; Raver et al., 2007; Yeung & Pfeiffer, 2009), including work that assesses a single measure of skills or relies on student self-reports of achievement (e.g., Campbell et al., 2008; Ferguson, 2007; Lindsay, 2011) or only investigates disparities in adolescence or early adulthood (e.g., Campbell et al., 2008; Dixon-Román et al., 2013; Ferguson, 2007; Lindsay, 2011). Instead, this investigation considers trajectories of academic achievement in three subjects starting at kindergarten entry and continuing through the end of middle school, providing a more complete portrayal of the early emergence of skills gaps and the persistence and growth of skills disparities across middle childhood and early adolescence.

Research Aims

Analysis of the Black-White achievement gap pervades the psychological, sociological, and education literatures, yet little scholarship has systematically considered how race and SES intersect to shape skills trajectories. This study aims to investigate how race and family SES, measured with household income and parental education, intersect to shape trajectories of academic skills from early childhood (i.e., kindergarten entry) through adolescence (i.e., eighth grade). To do so, we pursued two aims. We first examine the additive associations between race, SES, and children's developmental trajectories of reading, math, and science skills from kindergarten through eighth grade. Next, we investigate whether Black-White disparities in achievement trajectories differ by family SES level. As discussed earlier, the existing research has produced disparate results when testing whether achievement gaps narrow or grow at higher levels of family SES. This scholarship also yields limited insight into whether income and education operate similarly with respect to their associations with achievement gaps. As a result, we derive our hypotheses from the relevant literature as well as the theoretical framework guiding this study. Specifically, because of racial disparities in families' proximity to (dis)advantage, similar household income and parental education levels may not translate into comparable degrees of contextual advantage or disadvantage for Black and White children. We therefore expect that Black-White skills gaps will increase as household income and parental educational attainment rise. We anticipate that these differences will be evident when children first enter school in the fall of kindergarten and that these gaps will be exacerbated as children move through elementary and middle school.

Method

Sample

Data were drawn from the ECLS-K ($N \approx 21,000$), a longitudinal, nationally representative, and multimethod study that tracked the educational experiences and development of U.S. children from the fall of kindergarten through the spring of eighth grade. The ECLS-K possesses two key strengths. First, it is racially, economically, and geographically diverse. Second, it includes repeated and consistent measures of parental demographics, family and home environments, and children's academic development, allowing us to estimate models of children's academic skills development from kindergarten through eighth grade.

This study's analytic sample consists of roughly 9,100 Black and White children whose parents were born in the United States. Because foreign-born Blacks (and their children) have not been subject to the identical historical pressures and multigenerational systems of stratification as their native-born peers, proximity to (dis)advantage likely operates differently for immigrant families. For this reason, analysis was limited to children from native-born families to control for the confounding effects of nativity status. Among these children, 44.02% had complete data on all variables included in the analyses. The percentage of missing data for each variable ranged from 0.1% to 24.25% and varied depending on the source of information: from 0% to 7.1% for the invariant child characteristics, from 0.1% to 20.88% for children's time-variant characteristics, from 1.18% to 21.44% for the academic assessments, and from 0.01% to 24.25% for the parent and household characteristics. Missing data were addressed using multiple imputation. Multiple imputation for all variables with missing values was carried out using Bayesian estimation via the DATA IMPU-TATION command in Mplus. Fifteen data sets were imputed and analyzed using the TYPE = IMPUTATION in the DATA command.

Measures

Academic achievement. Direct assessments measured math, reading, and, science achievement at kindergarten fall, kindergarten spring, first grade fall, first grade spring, and in the spring of third, fifth, and eighth grades. These 100-item tests were designed by ECLS-K researchers to assess age- and grade-appropriate skills and knowledge as well as to align in content with National Association of Educational Progress frameworks (Najarian, Pollack, & Sorongon, 2009). Math assessments measured number sense, pattern recognition, and numerical operations, estimation, and measurement skills, spatial reasoning and geometry knowledge, probabilistic reasoning and statistical inference, and understanding of functions and algebraic concepts. Reading tests assessed letter recognition, phonological awareness, vocabulary knowledge, reading comprehension and interpretation, and critical reflection and analysis. In kindergarten, a general knowledge test appraised chil-

dren's factual knowledge about and conceptual understanding of the natural sciences and social studies. Prior work has shown this general knowledge test is highly predictive of later science achievement (Morgan et al., 2016); thus, we used it as a proxy measure for science skills at school entry. Beginning in third grade, a science test evaluated conceptual understanding and scientific investigation skills across the multiple fields, including earth, space, physical, and life sciences.

Assessments were delivered in a two-stage adaptive process. First, a common set of items was presented to all children. Second, children's performance on this baseline assessment determined whether they were routed to a set of more or less challenging test questions. Because not all children received the same questions, item response theory (IRT) scores were calculated to generate comparable scores across children and to facilitate longitudinal analysis of achievement. The IRT scores estimate children's performance on the assessments as if they had been administered the entire test battery. The theta reliabilities for the reading assessments at kindergarten entry and in Grades 3, 5, and 8 were 0.92, 0.94, 0.93, and 0.87, respectively; for the math tests, reliabilities reached 0.91, 0.95, 0.95, and 0.92 for each grade; and for the science instruments, the theta reliabilities were 0.88, 0.88, 0.87, and 0.84, respectively (Najarian et al., 2009).

Importantly, NCES researchers also conducted formal tests to determine whether there was evidence for differential item functioning (DIF) among subgroups of children (Najarian et al., 2009; Rock, Pollack, & Hausken, 2002). Comparing subgroups of children who achieved equivalent total (or overall) scores on a specific achievement assessment (and were thus matched on average performance levels), DIF analyses tested whether focal subpopulations of children (e.g., Black children, Hispanic children, girls) performed significantly worse than their reference group (i.e., White children, boys) on any item in the test battery. If DIF analyses indicated a particular item in the battery performed differently for a population subgroup, such as Black children, and thus evinced potential bias, a committee of experts (which included members of the subgroup) examined the item to determine whether it employed language or contextual information unfairly biased against the focal subgroup. Items deemed unfair were removed from the assessments. NCES analyses revealed that very few items in the test batteries showed evidence of differential functioning, and among those that did, any items suspected to be biased were eliminated. These results indicate that the ECLS assessments represent valid measures of academic achievement for both Black and White children and do not systematically underestimate Black children's scholastic skills.

Family SES. Measures of family SES were derived from parents' reports. Household income and parental education served as indices of family SES. We constructed continuous measures of household income scaled in \$10,000 units and inflated to 2007 dollars using the Consumer Price Index. For education, dummy variables designated whether parents' highest level of educational attainment was less than a high school degree (reference group), a high school diploma, some college or vocational training, or a bachelor's degree or higher.

Two sets of SES variables were used in the analytic models. First, household income and parental educational attainment reported at kindergarten entry were used in the models predicting academic skills at kindergarten entry. Second, cumulative income and education measures (which were devised by compiling data across all seven waves from kindergarten entry through the spring of eighth grade) were used in the models predicting the rate of change in skills across primary school. Cumulative income was averaged across all waves. Parental educational attainment reflected the schooling level into which the most highly educated parent in the household was categorized for the majority of the study. Parents who did not spend a preponderance of time (i.e., more than 50% of the waves) in any single education category were assigned the highest education level they reported.

Among White families in our analytic sample, correlations between household income and the parental education categories (i.e., less than high school, high school or some college, and bachelor's degree) were -.11, -.36, and .39, respectively, at baseline. For Black families, these correlations were -.25, -.09, and .28. By eighth grade, income's correlations with each successive education category reached -.14, -.46, and .51 for White families and -.19, -.17, and .37 for Black families.

Child characteristics. All child characteristics were derived from parents' reports. A dichotomous indicator denoted whether children were Black or White (reference group) and had nativeborn U.S. citizen parents. Dummy variables indicated whether children were classified as male or female (reference group) or born low (<2,500 g) or normal birth weight ($\geq 2,500$ g; reference group).

Parental and household characteristics. Dichotomous indicators of maternal employment status denoted whether mothers worked more than 35 hr a week, worked less than 35 hr a week, or were unemployed (reference group). We operationalized family structure using three variables: categorical indicators denoted whether parents were married and continuous measures reflected the number of children under age 18 and adults ages 18 and over in the household. Information collected at kindergarten entry was used to predict the intercepts in the growth models, while composite covariates aggregated across all seven data collection periods were used to predict the slopes. Like parental education level, all categorical time-varying covariates (i.e., employment status, marital status) represent the category into which parent respondents were assigned for the majority of the study. When parents did not spend a preponderance of time in any single category, information from the final wave of data was used. Continuous time-varying covariates (i.e., number of children under age 18 in the household, adults ages 18 and over in the household) were averaged across all waves of available data to form cumulative composite variables.

Data Analysis

To explore whether family SES moderated the size of Black– White achievement gaps between the kindergarten entry and eighth grade, linear latent growth models with individually varying times of observation were estimated in Mplus 6 (Muthén & Muthén, 1998–2011). The linear latent growth model estimates the rate of change in skills accounting for the individual variances around the average growth trajectory (Bollen & Curran, 2006; Newsom, 2015). Independent analyses were estimated for reading, math and science achievement by specifying latent variables for the intercept and the slope. The models included two levels, with school random effects that adjusted for the nesting of children within schools. In addition, a baseline population weight (C1CW0) was applied to the analyses to account for the ECLS-K's differential sampling and to ensure that all results were nationally representative.

Loadings for the slope factors were set equal to the data collection time point, which reflected the number of months that had passed since the first assessment occasion. The loading was set to zero at the fall of kindergarten. This was done because the ECLS-K data are not time structured, thus there could be large differences in the number of months that passed between each assessment. The TSCORES option in Mplus was used to allow the slope for time to vary by person—an approach consonant with using repeated measures in a long format but permitting equivalent estimations in a wide format. In this way, the model generates a random slope for a random time variable and enables the residual variances to differ across the waves.

We first estimated unconditional growth models to examine the average achievement scores in the fall of kindergarten and the average growth in skills for the entire sample. We also used this model to assess whether there was significant variability in the intercept and growth parameters of children's reading, math, and science skills trajectories. After finding significant variability in the unconditional model, we adopted an intercategorical approach to guide our analyses (McCall, 2005; Warner, 2008), meaning we considered how the superordinate categories of race and social class related to achievement before we tested how the intersections of these categories predicted skills gaps. Therefore, three subsequent growth models were estimated for each academic domain. The first model included only race and SES variables as predictors to consider their additive associations with achievement trajectories. The second model examined whether race and SES intersect to shape academic skills trajectories and included interactions between race and income as well as race and each level of parental education as predictors. In the third model, several demographic characteristics that tend to be correlated with family SES and race were added to control for their potentially confounding influence. Models included a combination of time-invariant (i.e., race, child gender) and time-varying (e.g., household income, parental education) variables as predictors for the intercepts and slopes of academic skills trajectories. We used time-varying measures assessed at the fall of kindergarten to predict the intercepts of the academic trajectories. Cumulative measures of time-varying covariates were used to predict the slopes of the growth trajectories.

Results

Table 1 reports descriptive statistics for the entire sample of Black and White children. Across time, parental education and household income increased modestly and the percentage of nonworking mothers decreased, while most other demographic factors remained effectively stable. Significant Black–White differences appeared on all markers of SES and child, parental, and household characteristics, with the sole exception of gender. Black families were far more socioeconomically disadvantaged than White families. Average household income for White families was more than twice that of Black families. Approximately 43% of White parents held a bachelor's degree, while about 14% of Black parents completed a college degree or more at the baseline wave. White children were more likely to be born normal birth weight and to have married parents. Black mothers, however, were more likely to be employed and tended to work greater hours.

		Whole sample			Black			White	
Variable	M (SD)	Baseline M (SD) or %	Cumulative M (SD) or %	M (SD)	Baseline M (SD) or %	Cumulative M (SD) or %	M (SD)	Baseline M (SD) or %	Cumulative M (SD) or $\%$
Academic achievement Math Kindergarten fall****	20.95 (7.50)			16.81 (5.73)			21.75 (7.54)		
Kındergarten spring First grade fall ^{***}	29.23 (8.77) 34.40 (9.30)			23.76 (7.48) 28.81 (8.56)			30.28 (8.61) 35.47 (9.05)		
First grade spring***	44.81 (8.96)			39.05 (8.87)			45.92 (8.54)		
Third grade ^{***} Fifth orade ^{***}	86.68 (17.54) 115 3 (21-13)			73.22 (17.30) 98 11 (21 42)			89.27 (16.36)		
Eighth grade***	142.27 (21.61)			124.86 (21.75)			145.63 (19.91)		
Keauing Kindergarten fall ^{***}	23.32 (8.50)			20.18 (7.15)			23.93 (8.81)		
Kindergarten spring***	33.28 (10.26)			29.15 (9.58)			34.07 (10.20)		
First grade tall	39.66 (3.33) 57.36 (13.49)			50.95 (11.71) 50.95 (13.64)			40.58 (12.38) 58.60 (13.10)		
Third grade	110.4 (19.79)			96.52 (19.93)			113.07 (18.61)		
Fifth grade***	142.08 (22.79)			125.27 (23.40)			145.33 (21.19)		
Eighth grade ^{***} Science	171.73 (26.98)			149.59 (27.78)			176.00 (24.63)		
Kindergarten fall***	23.94 (7.38)			17.53 (6.06)			25.18 (6.96)		
Kindergarten spring ^{***} Eiret grade fall ^{***}	29.05 (7.60) 31.08 (7.54)			22.22 (6.87) 25.41 (7.00)			30.37 (7.00) 33.74 (6.05)		
First grade spring***	36.31 (6.93)			30.05 (7.33)			37.51 (6.16)		
Third grade ***	36.05 (9.63)			27.03 (8.70)			37.78 (8.80)		
Fifth grade ^{***} Fichth orade ^{***}	59.97 (13.80) 85 45 (15 51)			46.41 (13.69) 70 11 (15 58)			62.58 (12.19) 88 41 (13 63)		
Family socioeconomic status									
Household income****		6.95(6.61)	7.30 (5.50)		3.34 (4.75)	3.47 (3.98)		7.64 (6.70)	8.04 (5.45)
Parental education	2000	3 2002			17 5000	0 6002		J 600c	1 0002
HS/some college****	57.50%	56.10%			73.50%	74.00%		54.40%	52.70%
Bachelor***	38.30%	40.70%			14.00%	16.40%		43.00%	45.40%
Child characteristicsa									
Sex: temale	50.90%				49.90%			51.10%	
Normal birth weight Household characteristics	02.00				82.10%			0/05.16	
Maternal employment									
Mom does not work***	28.6%	10.50%			26.10%	24.70%		29.00%	18.60%
Mom works under 55 hr	24./0% 46.70%	24.00% 55 90%			02.21% 61.40%	13.30% 62 00%		27.10% 43 90%	20./0% 54 70%
Married/stably married***		75.10%	75.10%		34.50%	36.30%		82.90%	82.60%
Number of children ^{***}		2.44 (1.08)	2.42 (.99)		2.65 (1.37)	2.63 (1.24) 1 07 (50)		2.40 (1.01)	2.38 (.94)
		(10) 001	2.01 (.72)		1.04 (.10)	1.00) 10.1		(10) 107	(CT.) CN.7

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Table 1 Descriptive Statistics 1477

Note. HS = high school. ^a Time-invariant characteristics. *** Difference with p < .001.

Table 2 Unconditional Growth Models

	Math	l	Reading		Science	
Variable	Coeff.	SE	Coeff.	SE	Coeff.	SE
Intercept	20.36***	.14	22.49***	.17	24.87***	.14
Slope	1.42***	.01	1.8^{***}	.01	.56***	.01
Random variances						
Intercept	34.03***	.82	60.05***	2.03	28.81***	.62
Slope	.04***	.00	.06***	.00	.01***	.00

*** p < .001.

Table 2 displays the unconditional growth models for each academic trajectory from the fall of kindergarten through the spring of eighth grade. Average math, reading, and science scores in the fall of kindergarten were 20.36, 22.49, and 24.87, respectively. Not surprisingly, children's academic skills grew each month with children's scores in math, reading, and science increasing by 1.42 points (0.19 SD), 1.80 points (0.21 SD), and 0.56

Table 3

Moderation of Black–White	Math Achievement	Gaps by F	Family Sc	ocioeconomic	Status
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points (0.08 SD) per month, respectively. Importantly, there was significant between-child variability in both the intercepts and slopes of the achievement trajectories. The variance in the intercepts and slopes of each trajectory are significantly different from zero, indicating that there was adequate variability over time to proceed with analyses.

The Size and Stability of Racial and Socioeconomic Achievement Gaps Across the Primary School Years

Results displaying Black-White differences in math, reading, and science achievement trajectories appear in Model 1 of Tables 3, 4, and 5. As expected, even after adjusting for SES factors, race gaps were large at kindergarten entry and increased as children progressed from kindergarten through eighth grade. When it came to math skills, Black students trailed their White peers by 0.93 points (0.12 SD) at kindergarten entry and their math skills grew 0.15 points (0.02 SD) less per month. Similarly, Black students fell behind White students in reading skills by 1.81 points (0.21 SD) at kindergarten entry and these gaps grew 0.17 points (0.02 SD) per

Variable Coeff.	SE	Coeff.	SE		
			SE	Coeff.	SE
Intercept					
Black93***	.22	-1.04^{+}	.60	63	.62
Income .12***	.02	.12***	.02	$.11^{***}$.02
HS/some college 2.28***	.31	3.33***	.44	3.03***	.43
Bachelor 4.94***	.36	6.16***	.47	5.73***	.47
Black \times Income		.20**	.07	.17*	.07
Black \times HS/Some College		-2.41^{***}	.65	-2.2^{***}	.64
Black \times Bachelor		-4.65***	.84	-4.54^{***}	.84
Gender				.04	.14
Normal birthweight				1.09^{***}	.24
Married				.99***	.19
Work over 35 hr				13	.18
Work under 35 hr				.39*	.19
Number of children				24***	.07
Number of adults				52***	.13
Intercept 16.75***	.33	15.71***	.44	15.83***	.56
Slope					
Black15***	.01	15***	.02	14***	.03
Income .005***	.00	.004***	.00	.004***	.00
HS/some college .09***	.01	.10***	.02	.09***	.02
Bachelor .15***	.01	.17***	.02	.15***	.02
Black \times Income		.01***	.00	.01***	.00
Black \times HS/Some College		04	.03	- 03	.03
$Black \times Bachelor$		06 [†]	.03	06*	.03
Gender				.04***	.01
Normal birthweight				04***	.01
Married				02**	.01
Work over 35 hr				.02**	.01
Work under 35 hr				03***	.01
Number of children				- 01	01
Number of adults				-01^{*}	.00
Intercept 1 26***	02	1 25***	02	1 21***	.00
Random variances	=	1120			.02
Intercept 32 53***	78	32.42***	78	32.09***	.77
Slope 03***	.00	.03***	.00	.03***	.00

Note. HS = high school. [†] p < .10. ^{*} p < .05. ^{**} p < .01. ^{***} p < .001.

	Model Main ef	1: fects	Mode Interact	1 2: tions	Model 3: Demographics	
Variable	Coeff.	SE	Coeff.	SE	Coeff.	SE
Intercept						
Black	-1.81^{***}	.31	-1.40^{+}	.77	31	.78
Income	.13***	.2	.12***	.02	.11***	.02
HS/some college	3.27***	.37	3.90***	.55	3.44***	.53
Bachelor	6.29***	.42	7.00***	.57	6.38***	.56
Black \times Income			.50**	.11	.42***	.11
Black \times HS/Some College			-2.15^{**}	.81	-2.08^{**}	.80
Black \times Bachelor			-3.99^{***}	1.13	-4.10^{***}	1.11
Gender					-1.56***	.17
Normal birthweight					1.00**	.32
Married					1.62***	.24
Work over 35 hr					61**	.24
Work under 35 hr					.14	.26
Number of children					83***	.09
Number of adults					56***	.16
Intercept	17.68***	.40	17.17***	.55	19.66***	.68
Slope						
Black	17***	.01	15***	.04	12***	.03
Income	.01***	.00	.01***	.00	.01***	.00
HS/some college	.12***	.02	.15***	.02	.13***	.02
Bachelor	.20***	.02	.24***	.02	.22***	.02
Black \times Income			.02***	.00	.01***	.00
Black \times HS/Some College			08^{*}	.03	08^{*}	.03
Black \times Bachelor			16*	.04	16***	.04
Gender					03***	.01
Normal birthweight					.01	.01
Married					.02	.01
Work over 35 hr					.03*	.01
Work under 35 hr					.04***	.01
Number of children					- 02***	.00
Number of adults					- 01	.00
Intercept	1.63***	.02	1.61***	.02	1.64***	.03
Random variances	1.00	=		=		.55
Intercept	57.49***	1.97	57.25***	1.97	55.63***	1.93
Slope	06***	.00	06***	.00	06***	00

 Table 4

 Moderation of Black–White Reading Achievement Gaps by Family Socioeconomic Status

Note. HS = high school.

 $^{\dagger}p < .10. ~^{*}p < .05. ~^{**}p < .01. ~^{***}p < .001.$

month, as Black students' math skills grew more slowly than their White peers. Finally, Black students performed 4.73 points (0.64 SD) worse in science achievement at kindergarten and these disparities grew as children moved through elementary and middle school, with the science skills growth of White students outpacing the growth of Black students (0.01 SD difference per month).

Family SES also consistently related to trajectories of academic skills in these models (see Model 1 of Tables 3 through 5). More specifically, upper-income students scored significantly higher in math, reading, and science achievement at the fall of kindergarten and their achievement skills grew slightly faster each month as they progressed through school. When children entered kindergarten, a \$10,000 increase in household income was associated with higher math (0.02 *SD*), reading (0.02 *SD*), and science (0.01 *SD*) skills. The income-achievement gap grew slightly between early childhood and early adolescence, with the academic skills growth of students from higher income families outpacing the growth of their lower income peers. Sizable disparities in achievement trajectories related to parental education were evident at kindergarten entry and exacerbated as children progressed through elementary

and middle school. More specifically, when compared to children with the least-educated parents, having parents who completed high school or some college predicted more advanced math (0.30 SD), reading (0.38 SD), and science (0.29 SD) skills at kindergarten entry. Children whose parents completed at least a bachelor's degree outpaced their peers with the least-educated parents by even larger margins at kindergarten entry: 0.66 SD in math, 0.74 SD in reading, and 0.64 SD in science. These gaps exacerbated slightly as students progressed through school and the academic skills of students whose parents had a high school degree or some college and students whose parents had at least a bachelor's degree grew between 0.01 and 0.02 SD faster each month than did the achievement skills of students with the least educated parents.

Exploring How Black–White Achievement Gaps Differ by Family SES From Early Childhood Through Early Adolescence

Interactions between family SES and race were entered in Model 2 and Model 3 of Tables 3–5 to examine how family SES

	Model Main eff	1: ects	Model Interacti	2: ons	Model Demograp	3: phics
Variable	Coeff.	SE	Coeff.	SE	Coeff.	SE
Intercept						
Black	-4.73***	.24	-3.56***	.67	-2.57^{***}	.67
Income	.10***	.01	.09***	.01	.09***	.01
HS/some college	2.14***	.31	2.88***	.48	2.57***	.48
Bachelor	4.71***	.33	5.55***	.50	5.13***	.49
Black \times Income			.22**	.07	.15*	.07
Black \times HS/Some College			-1.87^{**}	.70	-1.95^{**}	.68
Black \times Bachelor			-3.39***	.85	-3.60***	.83
Gender					.45***	.13
Normal birthweight					.65**	.23
Married					1.13***	.19
Work over 35 hr					12	.16
Work under 35 hr					.47*	.18
Number of children					.64***	.06
Number of adults					24*	.11
Intercept	22.12***	.32	21.42***	.48	22.02***	.56
Slope						
Black	08^{***}	.04	08^{***}	.02	07^{***}	.02
Income	.01***	.00	.01***	.00	.01***	.00
HS/some college	.06***	.01	.07***	.01	.07***	.01
Bachelor	.09***	.01	.10***	.01	.10***	.1
Black \times Income			.01***	.00	.01***	.00
Black \times HS/Some College			04^{*}	.02	03^{*}	.02
Black \times Bachelor			03	.02	03	.02
Gender					.03***	.01
Normal birthweight					.01*	.00
Married					.01*	.00
Work over 35 hr					.00	.00
Work under 35 hr					.01	.01
Number of children					01^{**}	.00
Number of adults					00	.00
Intercept	.49***	.01	.49***	.01	.47***	.01
Random variances						
Intercept	26.88***	.59	26.82***	.59	26.19***	.57
Slope	.01***	.00	.01***	.00	.01***	.00

Ta	bl	le	5

Moderation of Black–White Science Achievement Gaps by Family Socioeconomic Status

Note. HS = high school.

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

and race intersect to shape students' trajectories of achievement from kindergarten through 8th grade. Model 2 shows unadjusted associations between the SES and race intersection and student achievement. Model 3 of Tables 3–5 introduce several child and family characteristics as control variables. Overall, the pattern of interactive associations was similar in the unadjusted and adjusted models. We therefore present results from the adjusted models below.

In the fall of kindergarten, as income increased, racial disparities in math, reading, and science decreased in magnitude, though the size of skills gaps differed by academic outcome. Black–White math gaps varied from 0.46 points (0.06 *SD*) at the bottom of the income distribution (with poor Blacks scoring lower than poor Whites) to 2.77 points (0.37 *SD*) at the top of income scale, with affluent Blacks performing better than affluent Whites (see Figure 1). Analysis testing income's moderation of early Black–White reading gaps unearthed a corresponding pattern (Table 4, Model 2). Racial gaps in reading skills ranged from 0.11 points (0.01 *SD*) at the bottom of the income ladder, with Black children slightly lagging behind, to 8.09 points (0.95 *SD*) at the top of the income distribution, with Black children scoring much higher than White children. Although race gaps in science also shrank as income increased, Black children's disadvantage in science scores persisted among all but highly affluent families (i.e., those with incomes exceeding about \$160,000; see Figure 2). More precisely, racial gaps in science ranged from 2.42 points (0.33 *SD*) among the poorest families (with Black children trailing their White peers) to 0.43 points (0.06 *SD*) among the most affluent families (with Black children surpassing their White counterparts). (We use figures to illustrate the interactive results for math and science only because findings were generally concordant for math and reading).

With respect to the growth of achievement trajectories, as income increased, Black children's math, reading, and science skills grew at negligibly faster rates per month, amounting to 0.001 *SD* per month faster growth across elementary and middle school. Practically speaking, however, due to the baseline intercept-level disparities, all but the most affluent Black students trailed their White peers in math (see Figure 1) and reading achievement across middle childhood and early adolescence. By contrast, Black children from middle-income families in particular closed science



Figure 1. Black–White Gaps in math skills by household income level at kindergarten entry, in 5th grade, and in 8th grade.

gaps, while Black students from upper-income households surpassed their White counterparts in science achievement by eighth grade (see Figure 2).

In contrast to the pattern for income, Black-White skills gaps grew as parental education increased at kindergarten entry (see Figure 3 which depicts results for math), and these disparities in achievement trajectories were stable or increased only modestly in math and science but more substantially in reading. At school entry, among families in which parents did not complete high school, Black children scored 0.63 points (0.08 SD), 0.31 points (0.04 SD), and 2.57 points (0.35 SD) lower than comparable Whites in math, reading, and science, respectively, with only the difference in science being statistically significant at the p < .05level. Among families wherein parents' highest education level was a high school diploma or some college, Blacks trailed Whites by 2.83 points (0.38 SD) in math, 2.39 points (0.28 SD) in reading, and 4.52 points (0.61 SD) in science when children transitioned into kindergarten. All of these gaps were statistically significant. Finally, among children whose parents completed a bachelor's degree or higher, race gaps (with Black children scoring considerably lower) reached 5.17 points (0.69 SD), 4.41 points (0.52 SD), and 6.17 points (0.84 SD) in math, reading, and science, respectively.

When considering the growth of achievement trajectories across middle childhood and early adolescence, relative to their White peers, Black children's academic skills grew at a slightly slower pace at each level of parental education (see Tables 3–5, Model 2). Specifically, among children whose parents did not complete high school, racial gaps widened by 0.14 points (0.02 SD) in math, 0.12 points (0.01 SD) in reading, and by 0.07 points (0.01) in science per month. By comparison, Black-White gaps among students

whose parents completed high school or some college did not increase at significantly different rates in math but grew by 0.20 points (0.02 SD) and 0.10 points (0.01 SD) per month in reading and science, respectively. Among children with the most-highly educated parents, race disparities increased marginally in math (0.21 points; 0.03 SD per month) and reading (0.28; 0.03 SD per month) but did not grow appreciably faster in science (in comparison with students whose parents did not complete high school).

Ultimately, by the spring of eighth grade, sizable Black-White achievement gaps persisted at each level of parental education (see Figure 3). At low levels of parental education, gaps reached 15.17 points (0.70 SD), 12.77 points (0.47 SD), 9.84 points (0.63 SD) in math, reading, and science respectively. At moderate levels of educational attainment, Black students lagged behind White students by 20.48 points (0.95 SD) in math, 23.16 points (0.86 SD) in reading, and 14.90 points (0.96 SD) in science. Finally, by eighth grade, skills gaps among children with highly educated parents reached 26.97 points (1.25 SD) in math, 33.48 points (1.24 SD) in reading, and 16.55 points (1.07 SD) in science.

Discussion

Consistent with the relevant scholarship, this study finds sizable gaps in academic achievement persist between Black and White children even after accounting for family SES (Murnane et al., 2006; S. F. Reardon & Robinson, 2007). Racial skills gaps in math, reading, and science were evident at kindergarten entry and grew substantially across the primary school years, in math and reading especially, because Black children's academic skills grew more slowly. As expected, family SES was also linked with achievement trajectories, with parental education serving as a particularly robust

1481



Figure 2. Black–White gaps in science skills by household income level at kindergarten entry, in 5th grade, and in 8th grade.

predictor. Nevertheless, although our research supports earlier work showing the persistence of the Black–White achievement gaps across the primary school years (Fryer & Levitt, 2006; S. F. Reardon, Robinson-Cimpian, et al., 2015), its novel contribution is its delineation of how race and SES interact to shape academic skills trajectories from early childhood through early adolescence.

Family SES Moderates Black–White Achievement Gaps From Early Childhood Through Early Adolescence

Our investigation of how race and SES intersect uncovered complex patterns of educational inequality. Results reveal that family SES moderates the size of racial skills gaps, with the interactions between race and parental education level and race and household income producing divergent patterns. Black-White disparities in the growth of achievement trajectories, however, did not vary substantially by income and education. More precisely, although the growth rate of academic skills between kindergarten entry and the conclusion of eighth grade differed for Black and White children, with Black students' skills developing at a marginally faster pace as income increased but growing more slowly on average as educational attainment increased, these differences were not sizable. Instead, baseline gaps in achievement appeared to play a more prominent role in shaping long-term academic trajectories among Black and White children from families with comparable income and education profiles. Specifically, in early childhood, Black children's disadvantages in academic skills narrowed and eventually evaporated at high income levels. In fact, Black children's achievement scores outpaced those of White children at the middle and top of the income distribution. In contrast, at each successive level of educational attainment, racial disparities in math, reading, and science skills increased in magnitude, with Black children lagging behind their White peers.

This pattern of findings persisted across middle childhood and early adolescence, with higher parental education seeming to exacerbate achievement disparities and higher household income appearing to narrow (or ultimately reverse) Black-White gaps. However, because the size of aggregate-level race gaps (in math and reading particularly) increased dramatically between early childhood and early adolescence, our results suggest that, relative to their performance at school entry, lowand middle-income Black students ultimately lost ground to their White peers, whereas affluent White students seemingly gained ground on their upper-income Black peers. In science, Black-White differences followed an analogous pattern in both early and middle childhood: Specifically, racial disparities diminished as income increased, but only at high levels of affluence did Black children close the gap or outperform their White peers. At the same time, Black-White math, reading, and science gaps among children whose parents had similar levels of educational attainment grew in magnitude across primary school. Adjusting for differences in family background and child characteristics reduced these gaps only negligibly or not all and did not substantially alter these interactive patterns.



Figure 3. Black–White gaps in math skills by parental education level at kindergarten entry, in 5th grade, and in 8th grade.

Overall, however, demographic factors explained a larger proportion of the joint effect of race and income.

Yet, given this intricate pattern of associations-a key question emerges: What are the practical implications of these findings? To understand better how the observed differences in the moderating effects of income and education shape racial achievement gap trends, we plotted the combined effects of income and education on children's skills at different points in the socioeconomic distribution. To begin unpacking these results, we first considered how Black-White achievement gaps differed by parental education level among representative children from low-, middle-, and highincome families. As depicted in Figure 4, when Black and White families have equivalent earnings at kindergarten entry, race gaps widen as parents' educational attainment rises. For example, at a \$50,000 income level, disparities among children whose parents completed high school or some college exceeded those found among children with the least-educated parents by a factor of 3.2 in math, 8.2 in reading, and by 31% in science (see Figure 4A). By 8th grade, these gaps had grown and this trend persisted (see Figure 4B). By contrast, among children whose parents achieved similar schooling levels, Black-White performance gaps narrowed at higher household income levels (see Figure 4C and 4D). To illustrate, in early childhood, among students whose parents held a college degree and whose household earnings reached \$100,000, racial academic gaps narrowed by 10% in math, 41% in reading, and 6% in science relative to disparities evident among families earning \$75,000. Once again, these interactive associations played out similarly in early adolescence. These plots are instructive. First, although race gaps do indeed shrink at higher income levels, the magnitude of the effect is comparatively modest in relation to the magnitude of baseline skills disparities and the (negative) moderating effect of educational attainment, which exacerbates Black-White gaps. (This finding is consistent with scholarship showing that parental education tends to be more strongly linked

with children's academic achievement than household income (S. F. Reardon, 2011)). As a result, Black–White educational disparities exist at each rung on the socioeconomic ladder.

These results illustrate the importance of considering how dimensions of privilege and disadvantage interact dynamically to shape academic development. Specifically, our research demonstrates that a failure to consider how race, income, and education jointly configure achievement gaps may obscure a complete portrait of the magnitude, direction, and sources of disparities. Indeed, it is likely that not only do racial skills gaps differ by SES, but so too do the underlying processes that give rise to them. Specifically, although racial disparities in stressors and resources may drive racial differences in the academic returns to SES, the dominant forces and specific mechanisms shaping development might vary across the socioeconomic spectrum. For low-income Black families, for instance, cumulative adversity (e.g., economic strain, extreme neighborhood poverty, and parental psychological distress) may be a central stressor affecting family contexts and thereby shaping children's development (Slopen et al., 2016). Among highly educated Black and White families, however, disparities in patterns of investment and child rearing repertoires (fomented by diminished access to social capital, cultural capital, and wealth attendant to more disadvantaged family backgrounds) might be the primary forces driving greater returns to SES for middle-class White children. We must reiterate, however, that this interpretation is based on results from an additive set of two-way interactions. Analyses that considered three-way interactions might produce different results and conclusions.

This research also underscores the insights gained from and thus the utility of disaggregating SES and simultaneously investigating the independent associations between race, dimensions of SES, and academic development. For example, although prior work (Quinn, 2015) has shown that, at school entry, Black children score higher in reading after controlling for family SES, our findings

b а Household Income is \$50,000 Household Income is \$50,000 0.00 0.00 HS/Some college Less than HS ess than HS Bachelor's or more HS/Some colleg £ HS/Some college -0.20 Por Bachelor's or more HS/Some college Less than HS -0.20 Bachelor's or mor Less than than -0.40 **Bachelor's or** -0.40 ome Standard Deviations -0.60 ess Standard Deviation: -0.60 -0.80 -0.80 Bac -1.00 -1.00 -1.20 -1.20 -1 40 -1 40 -1.60 -1.60 -1.80 -1.80 -2.00 -2.00 ■ B-W Math Gaps in Spring of 8th Grade B-W Math Gaps at KG Entry B-W Reading Gaps in Spring of 8th Grade B-W Reading Gaps at KG Entry B-W Science Gaps at KG Entry B-W Science Gaps in Spring of 8th Grade d С Parental Education is Bachelor's or more Parental Education is Bachelor's or more 0.00 0.00 \$50,000 \$75,000 \$50,000 \$75,000 \$75,000 \$100,000 \$100,000 \$50,000 \$75,000 \$100,000 \$50,000 100,000 -0.20 -0.20 -0.40 -0.40 Standard Deviations standard Deviations -0.60 -0.60 -0.80 -0.80 -1.00 -1.00 -1.20 -1.20 -1.40 -1.40 -1.60 -1.60 -1.80 -1.80 -2.00 -2.00 B-W Math Gaps in Spring of 8th Grade B-W Math Gaps at KG Entry B-W Reading Gaps in Spring of 8th Grade B-W Reading Gaps at KG Entry B-W Science Gaps in Spring of 8th Grade B-W Science Gaps at KG Entry

Figure 4. Patterns of income moderation among college-educated parents and education moderation among middle-income families at kindergarten entry and in 8th grade.

indicate that markers of SES, such as household income and parental education, do not operate in a uniform fashion with respect to their connections to skills gaps and the growth of achievement trajectories, meaning merely controlling for SES can obfuscate unanticipated patterns of academic advantage and disadvantage (as well as potential areas of risk and resilience).

Why Do Household Income and Parental Education Operate Differently in Shaping Disparities in Achievement Trajectories?

In light of the foregoing results, what remains unanswered is, why might household income and parental education operate differently in predicting skills for Black and White children? One hypothesis is that the processes underlying proximity to (dis)advantage play out differently across levels of income and education. Gains in household income may narrow race gaps across economic strata, whereas Black–White gaps widen as parental educational

attainment rises because income is a stronger marker of human and cultural capital than educational attainment for Black parents. Indeed, research shows that accounting for racial differences in cognitive skills dramatically narrows wage disparities for Black men and produces a wage advantage for Black women (Carneiro, Heckman, & Masterov, 2005; Fryer, 2011). By contrast, Lang and Manove (2011) found that, when matched on cognitive skills, Blacks obtain more education than comparable Whites as a signaling strategy to counteract racial bias in the labor market. Hence, equivalent levels of education may not translate into similar levels of human and cultural capital for Blacks and Whites. For this reason, among better-educated Black and White families, differences in patterns of investment and child rearing repertoires might be the primary forces driving greater returns to parental education for White children. For example, some research has shown racial disparities in home learning environments among children with college-educated mothers, with Black children having fewer books at home and experiencing less effective parental teaching strategies (Ferguson, 2007; Moore, 1986).

Ethnographic research shows that Black parents' educational attainment, wealth, and neighborhood conditions as well as their involvement and investment in children's education vary markedly across income levels, with upper-income Blacks displaying considerable advantages (Lacy, 2007). As a result, affluent Black children may benefit distinctly from resources and practices that promote their academic skills because their parents have reaped the benefits of enhanced human capital and endeavor to pass on those educational advantages (Lawrence & Mollborn, 2013; Smith, 2008). Higher household income may also afford Black families better access to high-quality child care programs, which have been shown to disproportionately benefit Black children in general and nonpoor Black children in particular (Bassok, 2010; Fuller, Bein, Bridges, Kim, & Rabe-Hesketh, 2017). Conversely, poor and low-income Black children may fall behind their White peers due to differences in exposure to extreme neighborhood disadvantage (e.g., poverty concentration, violent crime, and social disorder; Sampson, Sharkey, & Raudenbush, 2008). Specifically, these factors may be a central stressor affecting Black children's development as they mature and interact with their communities more directly. As such, higher income may afford Black families the ability to buy themselves into more advantaged communities with a wider array of salubrious resources, including denser, supportive social networks.

Prior research has shown a modest positive association between neighborhood SES and children's academic achievement, though the connection between educational outcomes and markers of neighborhood advantage and disadvantage appears to be stronger for White children than for Black children (Howell, 2019; Turley, 2003). Such findings suggest that it is important to consider both structural and social factors to understand what role neighborhood contexts may play in shaping the differential returns to family SES found in this study. For instance, Turley (2003) found that neighborhood income's positive links with children's outcomes were observed only among children whose families had stronger social connections within their communities. Notably, in this work, Black families had weaker social connections (i.e., parents knew fewer neighborhood children by first name), but higher neighborhood SES was only tied to achievement among Black children when a critical mass of Black families lived in their communities. This research suggests that social barriers may limit the ability of Black parents and children to join advantaged social networks in majority White communities, which could undermine Black youth's academic development. Relatedly, Chetty, Hendren, Jones, and Porter (2018) showed that, even when they grew up on the same neighborhood block in families of comparable economic status, middleand upper-SES Black children (particularly boys) were far more likely to fall down the economic ladder as adults. Black children escaped this pattern of downward mobility only when their communities had lower poverty rates and more positive racial and social climates.

Given the well-documented racial differences in neighborhood SES at each level of household income (Logan, 2011; S. F. Reardon et al., 2015), two important questions scholars should address in future work is whether income is more strongly correlated with dimensions of neighborhood quality than education, and

whether these associations differ by race/ethnicity—two issues which have not been examined in the extant literature. Moreover, although understanding the extent of Black–White disparities in structural dimensions of neighborhood contexts is important, more studies must also consider how structural and social factors interact to shape children's academic skills.

A final possible explanation for differences in the educational returns to income and education is that systematic disparities exist in the educational quality and experiences of Black parents because they are more likely to have grown up in disadvantaged families and communities, which might translate into cumulative disadvantages in school quality across their educational careers (Carnevale & Strohl, 2013; Massey & Denton, 1993; Pattillo-McCoy, 1999). In turn, these systemic differences may undermine the ability of Blacks to derive the same human, cultural, and social capital returns to educational attainment as their White peers (Carneiro et al., 2005). But more research into this issue is warranted.

Limitations

It is important to discuss the limitations of this research. First, although we used longitudinal data and included an extensive set of covariates, our results are ultimately descriptive and cannot be interpreted as causal. In addition, although these results indicate foundational skills have implications for future academic trajectories, connections between skills in early childhood and achievement later in development tend to be inflated in observational studies (Watts, Duncan, Clements, & Sarama, 2018). That important caveat noted, it is critical to remember that the principal goal of this research was not to establish that income and education cause racial disparities in academic trajectories but to explore differential associations between family SES and academic development among Black and White children. Indeed, the theoretical framing guiding this study acknowledges that social categories (such as SES and race) connote multifaceted endogenous influences, including "historical and continuing relations of political, material, and social inequality" (Cole, 2009 p. 173). Thus, it is to be expected that SES does not operate in a mechanistic fashion across groups. Second, the ECLS-K data, while offering comprehensive information on multiple stages of children's development, represent an older cohort of families and children, and replication analyses using more recent data will be necessary. Third, while this research lays the foundation for future work, we have not explicitly tested the proposed processes, such as racial disparities in spatial (or neighborhood) (dis)advantage, that give rise to the patterns of associations revealed in this study.

Relatedly, although a large number of family and child characteristics were included as covariates in our models, this study did not control for neighborhood SES. As noted earlier, neighborhood SES may be an important mediating mechanism that explains why associations between family SES and achievement differ for Black and White children, though evidence suggests that it is necessary to consider multiple facets of neighborhood quality rather than neighborhood SES measures, such as average income levels, in isolation. Finally, though this study brings an intersectional lens to the study of how race and SES shape achievement gaps, we did not investigate how these factors intersected with other salient social categories. Specifically, although we controlled for child gender in our analyses, we did not examine whether the observed racial differences in the academic returns to SES varied by child gender. Increasing research indicates that girls display greater academic resilience in the context of socioeconomic disadvantage than boys do (Autor, Figlio, Karbownik, Roth, & Wasserman, 2016; Chetty, Hendren, Lin, Majerovitz, & Scuderi, 2016). Conversely, a recent study revealed that gender gaps in math performance were largest in predominantly White, high-SES school districts (S. F. Reardon, Fahle, Kalogrides, Podolsky, & Zárate, 2018). Taken together, this work suggests that the risks and rewards associated with family and community SES may differ for boys and girls.

Relevant to these findings, the Black-White intergenerational mobility gaps among young adults from similar socioeconomic backgrounds reported in prior studies were driven primarily by disparities among men, with Black men faring far worse than their White male peers (Acs, 2011; Chetty et al., 2018). What this research leaves unanswered is whether gender disparities in academic skills account for gender differences in socioeconomic mobility. Research has shown that African American boys lag behind African American girls in academic performance (Cokley, McClain, Jones, & Johnson, 2012; Matthews, Kizzie, Rowley, & Cortina, 2010; Mickelson & Greene, 2006; Rowley et al., 2014), though the evidence for whether Black-White achievement gaps vary appreciably by gender is mixed and less well-studied (Jacobson, Olsen, Rice, Sweetland, & Ralph, 2001). Consequently, more work is needed to examine whether gender disparities in academic skills among Black students contribute to Black boys' greater rates of downward mobility.

Conclusion

Despite these limitations, this research examines an important and understudied issue in developmental research. Lack of attention to how Black–White skills gaps vary at different points in the socioeconomic distribution can hinder understanding of these disparities' underlying mechanisms, which may also differ by income and education. Hence, a prerequisite to isolating the distinct role family, school, and community factors play in producing skills gaps is examining how the interactive relationship between race, income, education, and achievement unfolds across development. This work provides compelling evidence that the educational returns to SES dimensions differ by race and illustrates the need for future research to consider in a nuanced fashion how race, income, and education jointly shape children's developmental contexts and academic trajectories.

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