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Race, Poverty and SAT Scores: Modeling the Influences of Family Income on Black and White High School Students' SAT Performance

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Background: Educational policy makers and test critics often assert that standardized test scores are strongly influenced by factors beyond individual differences in academic achievement such as family income and wealth. Unfortunately, few empirical studies consider the simultaneous and related influences of family income, parental education, and high school achievement on college admissions test scores.

Focus Of Study: This research was animated by the nagging question of the association of family income with SAT performance. For example, is the relationship between family income and SAT performance non-linear? Does the relationship differ markedly by race? More importantly, how strong are the effects of poverty on SAT performance?

Research Design: This study is a secondary analysis of a large national sample of Black and White college-bound high school students who took the SAT in 2003 ($N = 781,437$).

Data Collection And Analysis: Employing data from the College Board's Student Descriptive Questionnaire, this study used structural equation modeling (SEM) to estimate the effects of

family income on SAT scores for Black and White examinees accounting for the simultaneous effects of parental education and high school achievement.

Findings/Results: *Results suggest the effects of family income on SAT scores, though relatively modest in contrasts to high school achievement, are substantial, non-linear, and nearly twice as large for Black students. Moreover, the unstandardized direct effect of high school achievement on SAT performance is not enough to address the substantial effects of poverty for Black students.*

Conclusions/Recommendations: *The findings are discussed with respect to social inequality and educational opportunity in college admissions.*

INTRODUCTION

Over the past half century many criticisms have been leveled at standardized tests in education and, in particular, college admissions tests such as the SAT or ACT (see, for example, Crouse & Trusheim, 1988; Elert, 2008; National Association of College Admissions Counselors, 2008). One of the more vocal critics has been Harvard Law Professor Lani Guinier (Guinier & Torres, 2002). Guinier and others have suggested that the SAT is not useful in college admissions because, at its core, it is a “wealth test”—more a measure of family socioeconomic status than academic potential. While interpretations of these criticisms have been oversimplified,¹ such claims have been challenged by others who have examined the relationship between family wealth and academic achievement, and report small or negligible direct effects on achievement test scores (Dixon-Román, 2007; Orr, 2003; Phillips, Brooks-Gunn, Duncan, Klebanov, & Crane, 1998; Yeung & Conley, 2008).

Although the relationship between wealth and achievement has been small, the relationship between family income and academic achievement appears to be more substantial (Anyon, 1997; Bowen & Bok, 1998; Dixon-Román, 2007; Duncan & Brooks-Gunn, 1997a; Duncan, Huston, & Weisner, 2007; Everson & Millsap, 2004; Hedges & Nowell, 1998, 1999; Jencks & Phillips, 1998; Miller, 1997; Rothstein, 2004; Wightman, 1995). Indeed, the consistent relationship between family income and achievement has also been found with SAT performance (Benners & Everson, 2009; Bowen & Bok, 1998; Camara & Schmidt, 1999; Everson & Millsap, 2004; Zwick, 2004). For the most part, these studies have examined the relationship between family income and SAT performance by (1) assuming income is linearly related to SAT performance, (2) assuming no differential associations of family income by race, and (3) not modeling explicitly the direct and indirect effects of family income after controlling for the combined effects of parental education and high school

achievement (Camara & Schmidt, 1999; Everson & Millsap, 2005; Marsh & Kleitman, 2002; Zwick, 2004).

These assumptions have underestimated and simplified the association between family income and SAT performance. The assumed linear association between family income and SAT performance, we argue and empirically demonstrate, has led to the underestimation of the association. By conducting multiple group analyses, we examined to what extent the association of family income (as well as other estimates of association) substantially varied between Black and White test-takers. Moreover, the analyses of the direct and indirect effects of family income enabled us to decompose the unique and independent contribution of family income with SAT performance, controlling for the effects of parental education and high school achievement as well as how family income's association is additionally working indirectly via these other variables. These analyses provide a better empirical understanding of the dynamic influence that family income has on the performance of the SAT for Black and White test-takers.

In addition, our search of the literature uncovered no studies that examined the direct and indirect effects of extremely low levels of family income (i.e., poverty) on SAT performance. The sociological and economics literature has long established that family income has an increasing concave relationship with child outcomes, thus indicating a non-linear relationship and larger marginal return for lower income levels (e.g., poverty) (Becker & Tomes, 1979, 1986; Blau, 1999; Dixon-Román, 2007; Duncan & Brooks-Gunn, 1997a; Conley, 1999; Mazumder, 2005). This suggests that the previous literature that has assumed and estimated a linear relationship between family income and SAT performance has likely underestimated the association. Thus, our research was animated by the nagging question of the association of family income with SAT performance. For example, is the relationship between family income and SAT performance non-linear? Does the relationship differ markedly by race? More importantly, how strong are the effects of poverty on SAT performance? And similarly, to what extent does poverty account for the problematic Black-White performance differences on the SAT?

The current literature, as we show, is incomplete and leaves us with incomplete answers about the effects of poverty on SAT performance. With a renewed added emphasis on the achievement of students from disadvantaged backgrounds, we believe it is important to examine carefully the economic and academic factors associated with differences in performance on standardized tests – particularly, high stakes college admissions tests. The examination of these questions will reveal whether the association of family income with SAT performance has been under-

estimated, particularly for Black test-takers or those test-takers living in poverty, and to what extent this may account for Black and White differences in SAT performance.

We begin by discussing the research on the influences of extremely low levels of family income (i.e., poverty) on academic achievement. After setting the context for our study, we then move to a more focused discussion of the literature on extremely low levels of family income and performance on high stakes tests. This is followed by a description of our sample and data sources, and an outline of the structural and measurement models developed to guide our analyses. The fourth section of the paper presents the results of our model fitting efforts, and offers interpretations of the model parameters. The paper concludes with a discussion of our findings and places them in the larger context of social inequality and educational opportunity.

LITERATURE REVIEW

INCOME, POVERTY AND ACHIEVEMENT

Parental income and other indicators of socioeconomic status are related to various educational outcomes (Bowen & Bok, 1998; Dixon-Román, 2007; Duncan & Brooks-Gunn, 1997a; Jencks & Phillips, 1998; Orr, 2003; Phillips et al., 1998; Rothstein, 2004; Sexton, 1961; Yeung & Conley, 2008; White, 1982; White et al., 1993). Recent research suggests that income has a substantial effect on academic achievement and accounts for a meaningful proportion of the score gap between Black and White test-takers on most achievement measures (Blau, 1999; Bowen & Bok, 1998; Datcher-Loury, 1989; Dixon-Román, 2007; Dooley & Stewart, 2004; Duncan & Brooks-Gunn, 1997a; Jencks & Phillips, 1998; Orr, 2003; Phillips, Brooks-Gunn, Duncan, Klebanov, & Crane, 1998; Rothstein, 2004; Sirin, 2005). Using data from the *National Longitudinal Survey of Youth* (NLSY), Blau (1999) found meaningful positive effects of permanent income (i.e., a multi-year average of income) on the PIAT mathematics and reading comprehension scores, as well as on the PPVT-R. Phillips et al. (1998) not only found a meaningful positive effect of income on the PPVT-R using data from the *Children of the National Longitudinal Study of Youth* (CNLSY), but levels of income were also related to meaningful reductions in the Black-White differences in academic achievement. Moreover, Sirin's (2005) meta-analysis of the research literature for the decade from 1990 and 2000 on socioeconomic status and achievement indicated that, on average, there was a modest size effect correlation coefficient (0.29) for family income on academic achievement.

These consistent, meaningful, and positive effects of income on academic achievement have been found not only with data from the United States, but also in studies using international achievement data. Aughinbaugh and Gittleman (2003), for example, used the NLSY data and data from the *National Child Development Study of Great Britain* to examine the comparative differences in the effects of income on achievement. Their results suggested that the relationship between income and achievement test scores is similar to what has been reported in the United States. Similar findings also come from work in Canada, using the *National Longitudinal Survey of Canadian Youth*. Dooley and Stewart (2004) examined the magnitude of the effect of income on three measures of cognition—including the PPVT and modified versions of the *Canadian Achievement Tests* for mathematics and reading comprehension. Their results indicated that the effect of income was meaningful and positive, but they suggested it was likely smaller than conventional estimates reported in the literature.

Although the majority of these studies have consistently found meaningful, positive effects of income on achievement, Mayer's (1997) work provides a more complicated perspective. Using data from the NLSY, Mayer argued that low-income parents may differ from middle- or high-income parents with respect to social adjustment, enthusiasm, dependability, academic skills, and motivation, suggesting a spurious income effect. In other words, she argued it is these social and emotional differences, rather than differences in income, that account for the differences in children's academic achievement outcomes.

While others have argued that what Mayer (1997) is referring to as a spurious effect, is in fact an indirect or unobserved variable effect. For example, Duncan, Huston, and Weisner (2007) found that earnings supplements do matter for children's academic achievement in poor families. In a random assignment study, they evaluated the effect of the *New Hope Program* that provided poor families with an earnings supplement, subsidized health insurance, subsidized childcare, and a temporary community-service job while searching for employment. Their evaluation found that, on average, children in the program scored higher than children in the control group. These findings speak to the non-spurious effects of income for poor families, and the possible meaningful effect of poverty on academic achievement.

Moreover, poverty is known to be related to poor nutrition, exposure to lead poisoning, low-birth weight, attention deficit hyperactive disorder, learning disabilities, lack of health insurance, poor quality housing, poor quality schooling, school per-pupil expenditures, parenting practices, high school equivalent or lower parental education, parental unemployment,

single-parent homes, et cetera (Birch & Gussow, 1970; Bowles, Durlauf, & Hoff, 2006; Lareau, 2003; Lee & Wong, 2004; Fass & Cauthen, 2008). In a report from the *National Center for Children in Poverty*, Fass and Cauthen (2008) reported that 18% of children in the United States live below the federal poverty level (i.e., a family income of less than \$22,050 annually); 34% of Black children live in poor families while, in contrast, 10% of White children. It is for these reasons that there has been extensive research on the effect of poverty on children's academic achievement.

While investigating the effect of childhood poverty on educational achievement, Payne and Biddle (1999) examined the effect of school funding and child poverty on mathematics achievement for a number of school districts across the United States. Using data from the *Second International Mathematics Study* and the *School District Data Book*, they found that after controlling for a school district's total annual per-student school funding, percent of non-White students, and average level of curricular instruction, that measures of child poverty had a meaningful effect on mathematics achievement.

In other work, the duration and timing of poverty has been a focus of interest. Guo (1998) indicated that long-term poverty has substantial influences on both ability and achievement, but the patterns of these influences may differ by age. Childhood appears to be a much more crucial period for the development of cognitive ability than early adolescence. In contrast, poverty experienced in adolescence appears to have a stronger influence on academic achievement than poverty experienced earlier in life, a relevant finding for the current study on the SAT performance of rising high school seniors.

In summarizing the work in the edited volume, *Consequences of Growing Up Poor*, Duncan and Brooks-Gunn (1997b) concluded that not only does poverty have its greatest impact during early and middle childhood, they also suggested that parental income is a stronger correlate of children's academic ability and achievement than maternal education levels and family structure. Given the reviewed research it is clear that income matters for childhood academic achievement, especially for the poor.

INCOME, POVERTY AND SAT PERFORMANCE

While there has been extensive research on income and academic achievement, in general, there has been less research on the relationship between family income and college admissions tests, and, in particular, performance on the SAT. Using data from the *National Education Longitudinal Study* of 1988, Owings, McMillen, and Burkett (1995) examined the social demographics of students who would make the cut-off

criteria for selective colleges and universities (including total SAT scores greater than 1100). They found that college-bound seniors from high socio-economic status (SES) families were more likely to meet the cut-off criteria than their middle and low SES contemporaries. One corollary of the differences in the SAT distributions, students from middle SES families were also more likely to meet the cut-off criteria than their low SES counterparts.

Camara and Schmidt (1999) from the College Board investigated the relationship between parental income and education on SAT performance. Their results indicated that parental income and education bear a strong relationship to performance on a variety of measures, with parent education showing the stronger relationship. However, they argued that: (1) parental income and education are related to most other predictors and outcomes of academic performance, such as high school GPA and rank; and (2) Hispanic and African-American students from comparable socioeconomic families scored lower than their Asian-American and White peers.

In examining the relationship of SES and SAT performance, Zwick (2004) also found, referencing descriptive statistics from other studies, that SES influences a variety of academic outcomes and academic performance indicators. The outcomes related to SES included the percentage of students passing the mathematics and language arts tests for the *California High School Exit Exam*, the percentage of students attaining basic versus proficient levels on the *National Assessment of Educational Progress* mathematics assessment, the percentage of students that meet the selection criteria for admissions into selective universities, high school grade point average, and the likelihood of children to be read to at home by a family member. Thus, Zwick argued that the SAT is a “wealth test” only in the sense that every other measure of educational achievement is a wealth test. Furthermore, she suggested that in order to improve diversity on college campuses, additional indicators of diversity ought to be incorporated explicitly in admissions policies.

In an article published in *The Journal of Blacks in Higher Education* (1998), it was argued that family income differences do not explain the differences in total SAT scores by race/ethnicity. The article, however, does report that Black students from families with incomes between \$80,000 and \$100,000 perform 141 points lower on the SAT than their White counterparts. Moreover, the Journal authors claimed that Black students from families with incomes between \$80,000 and \$100,000 in fact scored lower on the SAT than did White students from families with incomes of less than \$10,000. Further, it was argued that Black and White families with similar incomes tend to have very different social and

educational characteristics and experiences. Thus, it was asserted that there is much more to the Black-White SAT performance gap than what is captured by indices of a family's economic background.

In a study using SAT data collected in 1995, Everson and Millsap (2004) examined both individual and school-level effects on the achievement gap using multilevel latent variable modeling techniques. Their results indicated that after accounting for the school-level effects, the SAT performance gaps were reduced on average by a half of a standard deviation—approximately 50 points on the SAT. For instance, the gap between Asian American and African-American males on the SAT Mathematics Reasoning tests was reduced by 56 points. These findings suggest dramatic differences in the distribution of resources between schools, which are also closely tied to a family's income and socio-economic status (Massey & Denton, 1993), and their effects on SAT score differences.

The existing research on income and SAT performance has shed light on the importance and limitations of family income in accounting for SAT performance differences. However, these studies have not adequately accounted for the possible non-linear relationship between family income and achievement (Dixon-Román, 2007; Conley, 1999; Mazumder, 2005). More importantly, for the most part, prior research has not examined the differential effects of income on academic achievement by race/ethnicity. Thus, there remains a need for closer investigations of the effects of poverty on SAT performance, and the differences between poor Black and White test-takers. Although we know poverty is related to other measures of academic achievement, we are much less certain about the relative effects of poverty on SAT performance.

In this study we set out to develop an appropriate and well-specified model of the relationships among and between students' academic achievements, parental education, and family income, and their unique and joint influences on the SAT scores of both Black and White students, with a focus on students from low-income families.

METHOD

The analytic models we present in this paper examined the influences of parental education, family income, and academic achievement on Black and White high school students' verbal and mathematics SAT scores. The explanatory models were fit and tested for model invariance between Black and White college-bound students. Below, we describe our sample and data sources, as well as our model-based analytic approach.

PARTICIPANTS

Participants for this study come from the population of the 2003 cohort of college-bound seniors who took the SAT during their junior or senior year of high school, and who graduated from high school in 2003 ($N = 1,417,374$). In general, this cohort represents about 45% of all the high school seniors in the United States. Females make up about 54% of this group, and the cohort is largely White (69%), with 11% Black, 8% Asian American, 4% Mexican American, 4% other Latinas/os, 1% Native American, and 3% who marked “other” when noting their race or ethnicity. Our analyses, however, focus on the Black ($n = 121,722$) and White ($n = 659,715$) students in the 2003 cohort of the SAT. We focus on White and Black examinees for interpretational simplicity in this study and because these are the two groups often explored in the test score gap literature. Of this sample 59.1% of the Black test-takers were females and 54.5% of the White sample were females. This sample has slightly more females than in contrast to the US population 15 to 19 years of age in 2003, where Black females were 51% and White females were 49% (U.S. Census Bureau, 2003). Given that the study sample is the total population of Black and White test-takers in the 2003 cohort sample weights were not used nor were they appropriate.

While we acknowledge the ethnic variation within both Black and White racial categories we were constrained by the racial/ethnic categories of the *Student Descriptive Questionnaire* (described next). Thus, we do not refer to the self-identified Black test-takers as African American because they may also be West Indian, African, or of Latina/o origin. Similarly, we do not refer to self-identified White test-takers as European American because they may also be from an Eastern or Western European countries, Jewish, Canadian, African, or of Latina/o origin.

DATA SOURCE

When students register with the College Board to sit for the SAT they complete a lengthy questionnaire called the *Student Descriptive Questionnaire* (SDQ; see www.collegeboard.org). The SDQ includes questions on students' high school courses, class rank, parental education, family income, and their race or ethnicity. Responses to these questions provided the data for this study. Appendix A provides further detail about the SDQ questions and how they were scored.

In addition, the SDQ asks students to indicate their average grade in specific subject areas of high school courses and to report their cumulative grade point average (GPA) on a scale of A+ to F. The score range of

A+ to F is placed on a 4.0 grade point average scale with a 4.3 for A+. Students report their most recent class rank on a scale from lowest fifth to highest tenth. The SDQ also asks students to report their parent(s) level of education from grade school to graduate or professional degree. Parental levels of education were scaled in actual years of education. That is, a high school diploma or equivalent was scored a 12 and a bachelor's degree was scored a 16. Students also reported their best estimates of annual family income, with reporting categories ranging from a minimum of less than \$10,000 to a maximum of \$100,000 or more per year. Lastly, each student's SAT verbal reasoning and mathematics reasoning scores are included separately in the data set of these 2003 cohort of college-bound seniors. SAT scores are reported on a 200 to 800 scale. These background variables and SAT scores, 13 in all, were used in our models.

A MODEL-BASED APPROACH

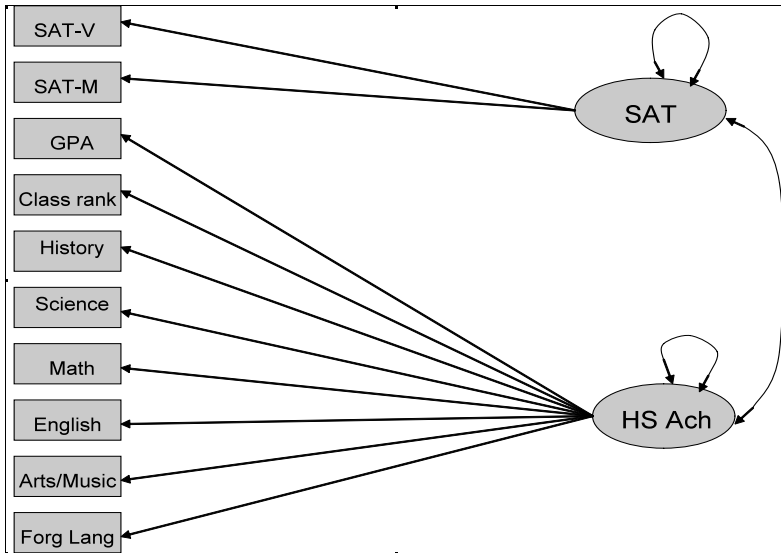
In the absence of random assignment, we do not engage in causal inference but rather the estimation of the partial direct and indirect associations of family income and poverty on SAT performance. Thus, we employed structural equation modeling (SEM) with *Mplus*, a latent variable modeling software package (Muthén & Muthén, 1998-2010), in order to model the hypothesized associations. This approach is particularly well suited for our study because of the unobserved latent variables of the model (i.e., high school achievement and SAT performance) that are measured by a large number, 10 in all, of observed variables and the hypothesized direct and indirect effects of family income on SAT performance (see Figure 2). In addition, the estimation of the partial association of family income with performance on the SAT accounting for other relevant individual differences such as parental education and high school achievement can be fit simultaneously and with much more flexibility and power within the SEM framework.

SEM analyses often include three broad stages: specifying the model that relates the variables one to another; estimating the parameters of the model; and, finally, estimating how well the model fits the empirical data, i.e., how well the theoretical model replicates the empirical correlations between and among the variables included in the model. In addition, we also conducted a multiple group analysis (Horn & McArdle, 1980, 1992) in order to test the model invariance between Black and White students in the 2003 cohort of college-bound seniors. Multiple group analysis in SEM is a simultaneous and flexible way of testing for group invariance in model parameters, which is analogous to evaluating for interaction effects. It is via the multiple group analysis that we evaluate to what extent

there is a differential association between family income and SAT performance by race.

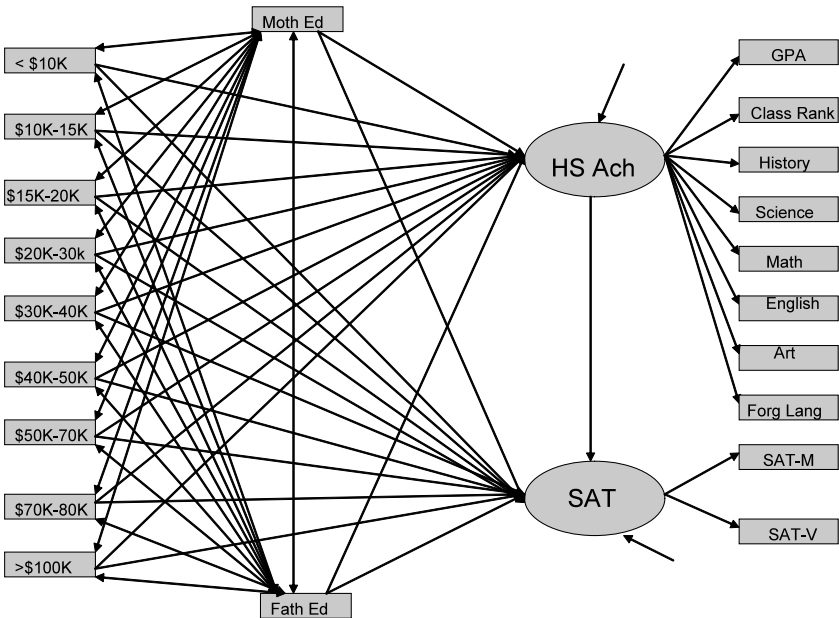
Given that it is well known in the sociological and economics literature that income has a non-linear effect on social and behavioral outcomes (Becker & Tomes, 1979, 1986; Dixon-Román, 2007; Conley, 1999; Mazumder, 2005) family income was converted into a dummy variable in order to better estimate the non-linear association of family income with SAT performance. The hypothesized measurement model and structural model for this study are depicted in Figures 1 and 2 below.

Figure 1. The Measurement Model of SAT Performance and High School Achievement



Using SEM, we explored the direct associations of students' high school achievement, and their parents' education levels and family income on SAT verbal and mathematical reasoning test scores (see Figure 2). This model also evaluates the indirect associations of family income with SAT performance via both parents' education and the test-takers high school achievement. Based on the existing literature, this study hypothesizes that higher levels of test-takers' high school achievement and both parents' education and family income are associated with higher levels of SAT performance. Similarly, the structural model hypothesizes that higher levels of family income and both parents' education are associated with higher levels of high school achievement.

Figure 2. The Structural Model of SAT Performance and High School Achievement



Given the degree of missing data in our sample, we employed full information maximum likelihood (FIML) estimation procedures with data missing at random to account for the incomplete cases on each of the measured variables (Muthén, Kaplan, & Hollis, 1987). Simulation studies have demonstrated that FIML performs well with at least 30% covariance coverage (Peng, Harwell, Liou, & Ehman, 2006). This assumes data are missing at random (MAR). MAR does not assume that data are missing completely at random (which is rarely ever the case) but that the probability of Y being missing does not depend on the missing value itself, but does depend on observed values of Y or other completely observed variables (Xs).

RESULTS

Descriptive statistics for each of the analysis variables across both the Black and White student cohorts are presented in Table 1, below, in order to characterize the sample.

Table 1. Descriptive Statistics and Percent Missing for All Measured Variables by Black and White Test-takers

| | Black Test-takers | Percent Missing | White Test-takers | Percent Missing |
|---------------------------------|---|-----------------|---|-----------------|
| | Mean (SD) | | Mean (SD) | |
| Father Education ^a * | HS Diploma/Equivalent (HS Diploma – AA Degree) | 17.2 | AA Degree (HS Diploma – Some Graduate) | 13 |
| Mother Education ^a * | Some College (HS Diploma – BA Degree) | 10 | AA Degree (HS Diploma – BA Degree) | 12 |
| Family Income ^b * | \$30K to \$35K (\$15K-\$20K – \$ 50K-\$60) | 23.2 | \$60K to \$70K (\$40K-\$50K – \$80K-\$100K) | 31.9 |
| Overall HS GPA * | 2.97 (0.66) | 3.8 | 3.46 (0.68) | 4.7 |
| Class Rank ^a * | Second Fifth (Middle Fifth – Second Tenth) | 30.9 | Second Tenth (Second Fifth – Highest Tenth) | 34.9 |
| GPA English * | 3.00 (0.70) | 6.3 | 3.36 (0.65) | 9.5 |
| GPA Foreign Languages * | 2.94 (0.87) | 11.5 | 3.29 (0.77) | 12.8 |
| GPA Arts & Music * | 3.56 (0.67) | 23.4 | 3.80 (0.46) | 22.3 |
| GPA Mathematics * | 2.71 (0.83) | 6.9 | 3.19 (0.76) | 10.1 |
| GPA Natural Sciences * | 2.88 (0.75) | 9.1 | 3.31 (0.68) | 10.8 |
| GPA History * | 3.05 (0.74) | 7.6 | 3.45 (0.65) | 10.2 |
| SAT Verbal * | 430 (99) | 0 | 529 (100) | 0 |
| SAT Math * | 424 (98) | 0 | 533 (103) | 0 |
| N of Students | 121,722 | | 659,715 | |

^a Given that these are ordinal categorical variables, the estimates presented are modes and interquartile ranges are presented in the parentheses.

^b These are the median category estimates of family income and interquartile ranges are presented in the parentheses.

* Indicates statistically significant mean differences between Black and White test-takers.

The magnitude of the Black/White differences among the measured variables is evident in Table 1. The White students in our sample are higher on all measured variables. Levels of parental education, for example, among Whites were reported, on average, to be at the college-level, while Blacks reported their parents' education at the high school level. Measures of academic achievement, here measured as grade point average (GPA)—both overall, class rank, and within subject areas—were also different for Black and White students. White students, on average, reported a higher overall GPA and class rank. There were also differences in the degree of missing data on each of the variables, particularly for family income.

Perhaps the greatest differences between the Black and White students

were found in reported family income and SAT scores. Black students, for example, reported annual family income levels about half that of their White counterparts, approximately a \$30,000 to \$35,000 difference. In addition, their Mathematics and Verbal SAT scores are about 100 points lower (roughly one standard deviation) than White students. Recall, the central focus of our analysis is the influence of family income on SAT scores. To set the context, Table 2, below, presents the average SAT scores by family income levels for the entire 2003 cohort of SAT college-bound seniors and for Black and White families separately.

Table 2. Mean SAT Mathematics and Verbal Scores by Family Income for the 2003 College Bound Cohort

| <u>Family Income</u> | Black Test-takers | | White Test-takers | | Total Sample | |
|-----------------------|-----------------------------|-------------------------------|-----------------------------|-------------------------------|-----------------------------|-------------------------------|
| | <u>Math</u> <u>Score</u> | <u>Verbal</u> <u>Score</u> | <u>Math</u> <u>Score</u> | <u>Verbal</u> <u>Score</u> | <u>Math</u> <u>Score</u> | <u>Verbal</u> <u>Score</u> |
| Less than \$10,000 | 382 | 381 | 478 | 480 | 418 | 418 |
| \$10,000 to \$15,000 | 395 | 398 | 478 | 481 | 435 | 439 |
| \$15,000 to \$20,000 | 400 | 405 | 485 | 488 | 446 | 450 |
| \$20,000 to \$25,000 | 409 | 413 | 493 | 495 | 460 | 463 |
| \$25,000 to \$30,000 | 411 | 419 | 495 | 497 | 466 | 470 |
| \$30,000 to \$35,000 | 419 | 426 | 502 | 504 | 479 | 482 |
| \$35,000 to \$40,000 | 422 | 430 | 504 | 505 | 484 | 487 |
| \$40,000 to \$50,000 | 431 | 438 | 510 | 510 | 496 | 498 |
| \$50,000 to \$60,000 | 441 | 450 | 516 | 514 | 507 | 506 |
| \$60,000 to \$70,000 | 440 | 450 | 521 | 519 | 512 | 512 |
| \$70,000 to \$80,000 | 448 | 457 | 528 | 524 | 521 | 518 |
| \$80,000 to \$100,000 | 461 | 468 | 539 | 534 | 533 | 529 |
| More than \$100,000 | 490 | 495 | 568 | 557 | 564 | 555 |
| No Response | | | | | | |

We clearly see in Table 2 that SAT scores increase monotonically as family income levels increase. Moreover, the correlation between family income and SAT Math and SAT Verbal indicates a moderate positive relationship. It is this relationship, unconditioned by high school achievement and parental education levels, which leads many to infer a strong causal relationship between family income and performance on the SAT. It is important to note that the amount of missing data on family income (30.6%), as well as the truncated distribution of income at greater than \$100,000, constrain our analyses. Nevertheless, we attempt to account for these limitations in the structural equation modeling approaches described below.

As a preliminary exploratory analysis, we used principal components of the SAT and high school achievement variables in separate group ordinary

least squares regressions. Although not reported here these analyses revealed that not only did family income have a meaningful direct association with the SAT, but that its association was non-linear and substantially higher for Black test-takers than for White test-takers, particularly at lower levels of family income. In addition, the estimated regression coefficients were comparable to the structural estimates reported below in the multiple group structural equation model. For instance, the unstandardized regression coefficient for the high school achievement principle component for Black test-takers was 0.53 (*SE* 0.00) and in the multiple group structural equation model the standardized direct effect was 0.57 (*SE* 0.00). While these results are comparable to the below structural equation model results, SEM enabled us to examine and evaluate the fit of the larger conceptual model with the analysis of both direct and indirect effects of family income simultaneously. Thus, we turn to the structural equation modeling.

The fit statistics for the separate group and multiple group analyses (MGA) of the measurement model (e.g., confirmatory factor analysis (or CFA) model) and the structural model were evaluated. The estimates of the root mean square error of approximation (RMSEA, ϵ_a , the comparative fit index (CFI), and the Tucker-Lewis index (TLI) indicate the closeness of model fit to the empirical data. An RMSEA of 0.05 or less and a CFI or TLI of 0.95 or higher indicate a close fit and plausible model (Bollen, 1989; Kline, 2005; Loehlin, 2004; Raykov & Marcoulides, 2006).

The separate group analyses began by fitting a series of measurement models including the hypothesized and alternative models. Each of the alternative measurement models (e.g., a single achievement factor; quantitative/science and language/humanities two-factor model; high school subject area; high school global achievement; and SAT performance three-factor model) had a poor fit to the data with the exception of the three-factor model. Each of these alternative models were nested models and did not add any additional observed variables to the model. Thus, the chi-square differences test was used to evaluate the difference between the models. While the chi-square difference test suggests that the three-factor model is a closer fit to the data than the hypothesized two-factor model of high school achievement and SAT performance, the three-factor model for White test-takers had a positive definite covariance matrix with a correlation of 1.013 between the high school subject area and global achievement latent variables. The latent variable correlation greater than one suggests a high degree of redundancy between the two measures, which indicates that they are likely measuring the same construct. Thus, we proceeded with the hypothesized two-factor measurement model.

Separate group analyses were also conducted with the structural model fitting both the hypothesized model and an alternative model. The alternative structural model included a continuous observed measure of family income assuming a linear relationship between family income and SAT performance. Although the alternative model was found to have a closer fit based on the chi-square difference test, the RMSEA, which accounts for sample size and model complexity, suggests a closer fit of the hypothesized model (0.04) over the alternative model (0.06). In addition, given that the model with the income dummy variable adds more observables, model parameters, and model complexity, we also evaluated the fit based on the Akaike Information Criteria (AIC). The AIC accounts for model complexity based on the model degrees of freedom and an AIC reduction of 10 units or more is considered to be a more plausible model. The model with the income dummy variable reduced the AIC 2,928,301 units for the model of White test-takers and 360,251 for Black test-takers. These AIC reductions further indicate that the model with the dummy variable of family income is closer fit to the data and more plausible. Moreover, as discussed earlier and demonstrated below, the assumed linear relationship of the alternative model underestimates the family income effect on SAT performance. Thus, we employed the hypothesized model for the multiple group analyses.

The MGA began with a fully constrained model then we allowed specific model parameters to be freely estimated, and tested for meaningful group differences in those specific model parameters. The fit indices for the MGA indicate that there was a meaningful difference between Black and White students for the covariance estimate between high school achievement and SAT performance in the measurement model. There were also meaningful differences in the regression parameters between family income and SAT and high school achievement and SAT. Therefore, the final MGA model with the unconstrained regression estimates between family income and SAT performance and high school achievement and SAT performance was the final model reported in this paper.

The measurement model shown in Figure 1 posits both SAT-Verbal and SAT-Mathematics as measurement indicators of a latent variable of cognitive ability, which we are calling SAT performance. It also includes measures of GPA, class rank, and GPA for history, science, math, English, art/music, and foreign language and each are posited, collectively, as indicators of high school achievement. The SAT latent variable is scaled to the SAT-Mathematics scale, which ranges from 200 to 800, and the high school achievement latent variable is scaled to the standard four-point scaling for GPA (with a maximum of 4.3 points for an A+) (see Table 3). While it is theoretically problematic to model SAT performance

as a total score rather than each subtest, we decided to model what is generally evaluated in practice by college admissions—SAT total scores.

Table 3. The Unstandardized Measurement Model Estimates (Multiple Group Incomplete Case Analysis)

| <u>Latent Variables</u> | | <u>Black Test-takers</u> | <u>White Test-takers</u> |
|--------------------------|-----------------------|--------------------------|--------------------------|
| SAT Performance | BY | | |
| | SAT Math | 1.00 (0.0)* | 1.00 (0.0)* |
| | SAT Verbal | 0.92 (0.0)* | 0.92 (0.0)* |
| HS Achievement | BY | | |
| | Overall HS GPA | 1.00 (0.0)* | 1.00 (0.0)* |
| | Class Rank | 1.67 (0.0)* | 1.67 (0.0)* |
| | GPA English | 0.85 (0.0)* | 0.85 (0.0)* |
| | GPA Foreign Languages | 0.96 (0.0)* | 0.96 (0.0)* |
| | GPA Arts & Music | 0.36 (0.0)* | 0.36 (0.0)* |
| | GPA Mathematics | 0.95 (0.0)* | 0.95 (0.0)* |
| | GPA Natural Sciences | 0.90 (0.0)* | 0.90 (0.0)* |
| | GPA History | 0.82 (0.0)* | 0.82 (0.0)* |
| <u>Measurement Error</u> | | | |
| | SAT Math | 0.23 (0.0)* | 0.26 (0.0)* |
| | SAT Verbal | 0.33 (0.0)* | 0.32 (0.0)* |
| | Overall HS GPA | 0.08 (0.0)* | 0.04 (0.0)* |
| | Class Rank | 0.78 (0.0)* | 0.52 (0.0)* |
| | GPA English | 0.26 (0.0)* | 0.20 (0.0)* |
| | GPA Foreign Languages | 0.46 (0.0)* | 0.31 (0.0)* |
| | GPA Arts & Music | 0.38 (0.0)* | 0.18 (0.0)* |
| | GPA Mathematics | 0.40 (0.0)* | 0.28 (0.0)* |
| | GPA Natural Sciences | 0.30 (0.0)* | 0.21 (0.0)* |
| | GPA History | 0.31 (0.0)* | 0.21 (0.0)* |

* $p < .05$

The final model was fit, indicating the plausibility of the conceptual model, using full information maximum likelihood (FIML) estimation with data missing at random. In order to evaluate the model performance of incomplete case analysis with FIML we fit the same model using listwise deletion and found the same model fit and very minor variation in the parameter estimates. As mentioned earlier, there is a meaningful difference in the measurement model between the Black and White students: The covariance between SAT performance and high school achievement is greater for White students than for Black students.

Moreover, there was a 218-point difference in total SAT performance between Black and White students. This would be approximately the summed difference in the observed data of SAT-V and SAT-M.

The structural model in Figure 2 posits various direct and indirect effects of family income on SAT performance. As before, the model's structural or path coefficients were computed using maximum likelihood estimation assuming data missing at random. The combining of income categories was conducted due to homogeneity of categories in the bivariate analyses. However, we also did not want to collapse too many categories as this would have taken away from the sensitivity of capturing the non-linear relationship between family income and SAT performance. In addition, the \$80,000 to \$100,000 category was the contrast group so it does not appear in the model. Again, there are a number of differences in the structural model between the Black and White students: (1) the effect of income on SAT performance is meaningfully larger for the Black test-takers, and (2) the effect of high school achievement on SAT performance is meaningfully larger for the White test-takers in our sample. The effect of income on high school achievement was negligible for both groups.

Table 4, below, presents the unstandardized structural estimates.

Table 4. The Unstandardized Structural Estimates (Multiple Group Incomplete Case Analysis)

| <u>Effects</u> | | <u>Black Test-takers</u> | <u>White Test-takers</u> |
|-------------------|------------------|--------------------------|--------------------------|
| SAT | ON | | |
| | HS Achievement | 138.40 (0.8)* | 180.80 (0.40)* |
| | Mother Education | 8.20 (0.0)* | 8.10 (0.00)* |
| | Father Education | 9.40 (0.0)* | 9.40 (0.00)* |
| | Family Income: | | |
| | < \$10K | -92.20 (2.8)* | -48.20 (2.0)* |
| | \$10k to \$15K | -70.20 (2.8)* | -48.20 (1.8)* |
| | \$15K to \$20K | -64.80 (2.8)* | -38.40 (1.8)* |
| | \$20K to \$30K | -48.00 (2.6)* | -29.00 (1.2)* |
| | \$30K to \$40K | -37.40 (2.6)* | -24.60 (1.0)* |
| | \$40K to \$50K | -27.20 (2.8)* | -18.80 (1.0)* |
| | \$50K to \$70K | -16.40 (2.6)* | -13.60 (0.8)* |
| | \$70K to \$80K | -10.80 (3.2)* | -7.40 (1.0)* |
| | > \$100K | 35.20 (3.2)* | 29.00 (0.8)* |
| HS Achievement ON | | | |
| | Mother Education | 0.02 (0.0)* | 0.02 (0.0)* |
| | Father Education | 0.03 (0.0)* | 0.03 (0.0)* |
| | Family Income: | | |
| | < \$10K | -0.04 (0.0)* | -0.04 (0.0)* |

| | | | |
|---------------------------|------------------|--------------|--------------|
| | \$10k to \$15K | -0.02 (0.0)* | -0.02 (0.0)* |
| | \$15K to \$20K | -0.02 (0.0)* | -0.02 (0.0)* |
| | \$20K to \$30K | -0.02 (0.0)* | -0.02 (0.0)* |
| | \$30K to \$40K | 0.00 (0.0) | 0.00 (0.0) |
| | \$40K to \$50K | 0.01 (0.0)* | 0.01 (0.0)* |
| | \$50K to \$70K | 0.01 (0.0)* | 0.01 (0.0)* |
| | \$70K to \$80K | 0.00 (0.0) | 0.00 (0.0) |
| | > \$100K | 0.00 (0.0) | 0.00 (0.0) |
| Mother Education WITH | | | |
| | Father Education | 3.35 (0.0)* | 3.72 (0.0)* |
| <u>Residual Variances</u> | | | |
| | SAT | 0.47 (0.0)* | 0.41 (0.0)* |
| | HS Achievement | 0.33 (0.0)* | 0.31 (0.0)* |

* $p < .05$

Notes. Family income estimates are in contrast to a family income between \$80,000 and \$100,000. Unstandardized estimates for the SAT endogenous variable were in total SAT score units.

Figure 3, below, presents a plot of family income and the direct income effects by race in order to observe the non-linear differential direct income effect on SAT performance.

Figure 3. Plot of Direct Income Effects by Race

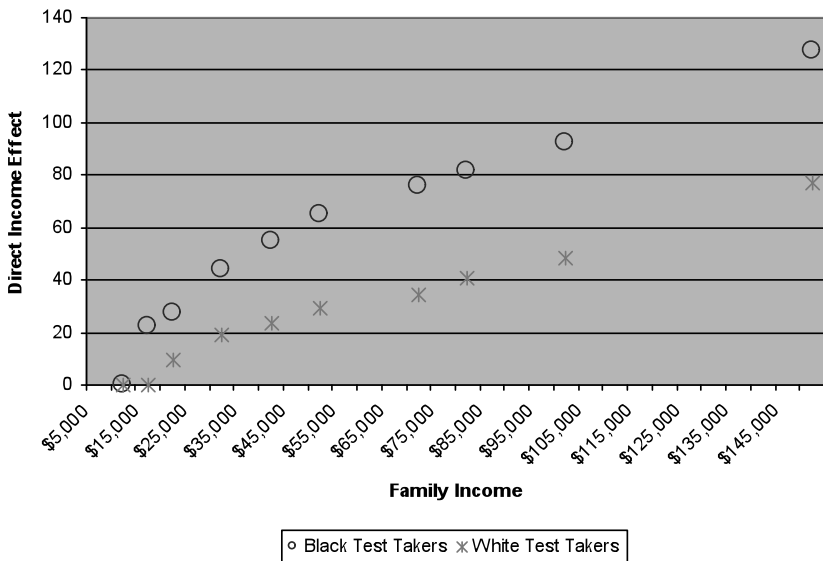


Figure 4. Plot of Observed and Model-Based Estimates of SAT Total Score Differences by Race

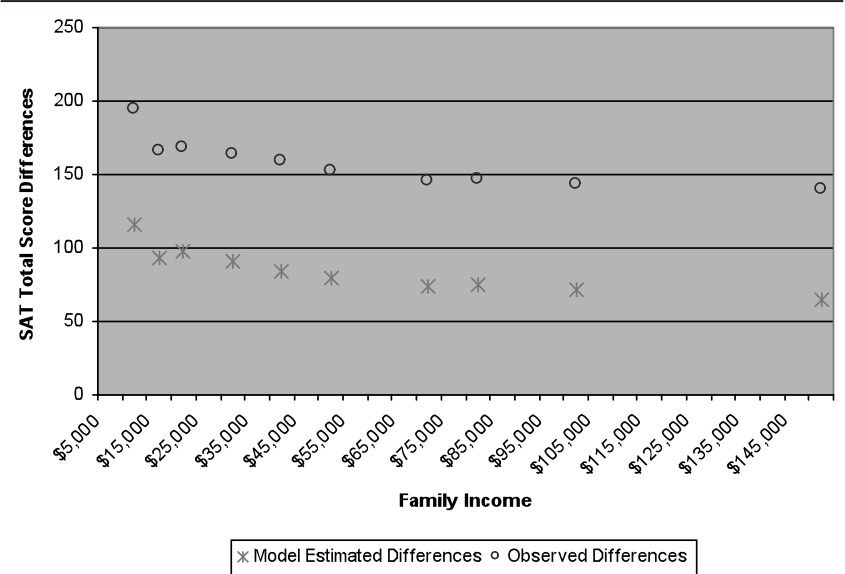


Figure 4 presents a plot of the observed and model-based estimates of total SAT score differences by race for each category of income. This plot shows how the estimated total SAT score differences ranged from 65.2 points for test-takers from family incomes greater than \$100,000 to 115.4 points for test-takers from a family income less than \$10,000, again indicating the non-linear differential effect of income, the narrowing of SAT performance differences as income increases, and the effect of poverty.

THE EFFECT OF POVERTY

In order to estimate the effect of poverty on SAT performance a separate model was fit with a dummy variable for family poverty in contrast to family income of \$80,000 to \$100,000. Given that the weighted average poverty threshold for a four-person family in 2003 was \$18,979 (DeNavas-Walt, Proctor, & Mills, 2004), family poverty was measured by truncating the first three income categories to measure family incomes less than \$20,000. This created a poverty category that ranged from \$0 to \$20,000 that was in contrast to the \$80,000 to \$100,000 income category. The additional structural equation model fit in order to estimate the effect of family poverty maintained closeness of fit as well as all of the same parameter estimates as the previous model with the exception of the parameter estimates for the poverty dummy variable.

The unstandardized effect of the dummy variable for family poverty was -77 for Black students and -44.2 for White students. Independent of the effects of both parents education and students high school academic achievement, these unstandardized effects indicate that in contrast to students of middle-income families, White students living in poverty perform 44.2 total SAT score points lower and Black students living in poverty perform 77 total SAT score points lower. Moreover, the unstandardized effect of family poverty for Black students is more than one half of the unstandardized effect of academic achievement suggesting that a 77 total SAT score point difference continues to remain between those in poverty and those from middle-income families even when there is a 1-unit increase in high school academic achievement for Black students. As discussed below, this dynamic is exacerbated under conditions of extreme poverty.

In order to estimate the effect of extreme poverty we return to the multiple group structural equation model absent the poverty effect dummy variable (i.e., Table 4). Table 5 below provides the direct, indirect, and total effects of extreme poverty as measured by a family income less than \$10,000 on SAT performance. The direct effects have been taken directly from the 2003 structural model. The indirect effects were computed by the product of the effect of income on the mediating variable(s) and the effect of the mediating variable(s) on SAT. The total effect was computed by adding the direct effect to the indirect effect.

Table 5. Unstandardized Direct, Indirect, and Total Effects of Extreme Poverty (Family Income less than \$10,000) on SAT Scores

| Income Effects | Direct | | Indirect | | Total | |
|-----------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|
| | <u>Black</u> | <u>White</u> | <u>Black</u> | <u>White</u> | <u>Black</u> | <u>White</u> |
| Poverty on SAT | -92.2 (2.8) | -48.2 (2.0) | | | | |
| Via | | | | | | |
| HS Achievement | | | -5.7 | -7.4 | -97.9 | -55.6 |
| Via | | | | | | |
| Father Education | | | -1.3 | -0.3 | -99.2 | -55.9 |
| Via | | | | | | |
| Mother Education | | | -1.4 | -0.2 | -100.6 | -56.1 |
| Via | | | | | | |
| Father Education & HS Achievement | | | -0.6 | -0.2 | -101.1 | -56.2 |
| Via | | | | | | |
| Mother Education & HS Achievement | | | -0.5 | -0.1 | -101.6 | -56.3 |

Notes. In total SAT score units. The indirect and total effect estimates could not be calculated in *Mplus* because the indirect estimation option requires each of the mediators to be endogenous. This model specifies family income to co-vary with both parents education thus the standard errors were not estimated for these indirect and total effects.

As Table 4 indicates, the direct and total effect of extreme poverty for Black students is almost twice that of their White counterpart. The unstandardized effects of extreme poverty for White students ($B = -48.2$, $SE = 2.0$) and Black students ($B = -92.2$, $SE = 2.8$) indicate that in contrast to students of middle-income families, White students living in extreme poverty perform 48.2 total SAT score points lower and Black students living in extreme poverty perform 92.2 points lower. Moreover, the unstandardized direct effect of extreme poverty for Black students ($B = -92.2$, $SE = 2.8$) is more than two thirds of the unstandardized direct effect of high school achievement ($B = -138.6$, $SE = 0.8$) suggesting that a 92.2 total SAT score point difference continues to remain between those in poverty and those from middle-income families even when there is a 1-unit increase in high school academic achievement for Black students. These are non-negligible findings given that over 11% of the sample of Black students that reported family income were in this category, which was the modal income estimate for Black students.

Tables 4 and 5 illustrate the extent to which family income independently effects the SAT performance of Black and White college-bound students. As reported earlier, White students performed 218 points higher, on average, than their Black counterparts. After conditioning SAT performance on high school achievement and both parents' education and income the difference reduced to 71.4 points for students with family incomes between \$80,000 and \$100,000 (and 65.2 points for students with family incomes greater than \$100,000). Moreover, the effect of poverty was moderate to large and nearly twice as large for Black students than for White students.

DISCUSSION & CONCLUSIONS

Using multiple group structural equation modeling, this study sought to examine the independent direct and indirect associations of family income and poverty on the SAT reasoning test scores for both Black and White test-takers, while controlling for their academic achievements in high school, and their parents' reported educational achievement levels. Overall, results indicate that family income and, in particular, extremely low levels of family income (what we refer to as poverty) has a meaningful contribution to the total SAT reasoning test scores for both Black and White test-takers, and helps to explain the SAT performance differences between the two social groups of students.

Family income, for example, was found to have a nonlinear, differential direct effect on total SAT performance for both Black and White students. In fact, for some family income levels the effect was nearly twice as

large for Black test-takers than it was for the White test-takers in our sample. The literature to date examining the effect of family income on SAT performance has been limited to observational data. While there is no way to introduce true random design elements to this problem, the resulting models are providing estimates as of the direct and indirect associations of family income partialing out the co-variation of test-taker high school achievement and both parents' education. Moreover, the existing literature has assumed linear, universal effects of family income, and as a result reports somewhat smaller effects of family income on SAT performance (Bowen & Bok, 1998; Camara & Schmidt, 1999; Everson & Millsap, 2004). This study, in contrast, indicates that the smaller income effects found in previous research are a result of model mis-specification, particularly at the lower levels of family income, resulting in underestimations of the effects of family income on SAT performance, particularly for Black test-takers.

Moreover, the results of this research also challenge findings from the 1999 College Board report *Reaching the Top: A Report of the National Task Force on Minority High Achievement* (College Board, 1999). The College Board's *Reaching the Top* report found that Black students with college-educated parents score lower on standardized tests than White students whose parents did not graduate from high school. The results from the models reported here, however, suggest that not only does parental education have a small effect relative to high school achievement, but also that parental income may serve as an equalizing factor (though not bringing parity to Black and White students' SAT performance). That is to say, as the exogenous variables in the models increase, parental income remains the only variable that appears to narrow the SAT score differences between Black and White examinees. The meaningfully larger effect of family income for Black test-takers, and the meaningful reductions in score differences by social group in total SAT reasoning performance suggest the relative and substantial influence of family income for enabling social and educational opportunities. Social and educational opportunities, therefore, appear to be substantially constrained for test-takers—both Black and White—living in poverty. Indeed, the models described in this study indicate a large meaningful effect of poverty, especially extreme poverty, on SAT performance for both Black and White test-takers. In fact, the large and differential effect of extreme poverty suggests that even if Black test-takers living in extreme poverty were to boost their high school academic achievement by one point (clearly a feat on a 4.0 scale!) they would, nevertheless, perform 25.2 points below their White middle-income counterparts who achieved one point lower in high school achievement. Thus, the focus on high

school achievement for students in poverty may not be sufficient for providing them with an equal opportunity to higher education based on the measured proxy of total SAT scores.

While the effect of high school achievement may not alleviate the effect of extreme poverty, it remained relatively larger than the effects of higher income levels. The strongest influence in our model is overall high school achievement, which was measured on the traditional 4.0 grade point average scale. For White students, the effect of high school achievement suggests that for every unit increase in high school achievement (GPA) there is a 180-point increase on the total SAT scale. For Blacks, the increase is approximately only 138 points on the total SAT scale, suggesting, again, the importance of high school achievement for increasing performance on total SAT reasoning scores. However, high school achievement does not have as large an effect for Black test-takers as it does for White test-takers. Thus, as high school achievement increases for both Black and White test-takers the between-group differences in total SAT performance increases rather than decreases.

The differential effect for high school achievement, along with the differential and large poverty effect, in part, suggests an effect of schooling where Black test-takers, especially those living in poverty, are likely attending poorer quality schools. This implication resonates with the findings reported earlier by Everson and Millsap (2004) and Benners and Everson (2009). In addition, the differential direct and indirect effects of income on high school achievement and, in turn, high school achievement on SAT scores may also be explained in terms of residential racial and economic segregation which are, through property values and tax policies, related to the quality of schooling (see Berends & Peñaloza, 2010; Card & Rothstein, 2007; Everson and Millsap, 2004; Massey, Condrón, & Denton, 1987; Mickelson, 2006; and Wilson, 1987). Moreover, the poverty effects reported here suggest the lack of social and educational resources in the larger community that are needed to supplement and complement the learning taking place in schools (Gordon, Bridgall, & Meroe, 2005).

However, given their finding that most of the variation in student achievement is within schools and not between schools, Konstantopoulos and Hedges (2008) caution on the focus of school reform based on social group parity in achievement as the benchmark. They suggest that interpreting the magnitude of the school reform effect on social group differences in standardized test performance will not only be disappointing, but misleading. Relatedly, Dixon-Román (2010) and Gutierrez and Dixon-Román (2011) argue that the “gaze” on achievement or test score gaps are not just misleading but overlook the problematic inequity in

social and pedagogical conditions. These cautionary arguments need to be given serious consideration in any school reform effort strategy to address differences in SAT performance.

Our models also suggest that parental education levels, though relatively small, are also important influences on SAT scores, independent of family income and high school achievement. These measures of mothers' and fathers' education were scaled by each matriculated year of education toward a diploma or degree. The models for both the Black and White examinees indicated that the joint direct effects of mothers' and fathers' education are approximately 8 to 9 points on the total SAT scale. Again, this estimate is roughly equivalent for both Black and White students.

Moreover, the differential association of family income and high school achievement with SAT performance by race is theoretically suggestive of the continued effects of racism and discrimination in the United States. Although the nation may be "post-intentional" in race relations (Perry, 2011) there are still the produced unintended consequences of what Jackson (2008) describes as a sense of racial distrust and even paranoia. This racial paranoia, fear, and social distrust produces unconscious and unquestioned actions and responses to racial difference in social situations which, in the cumulative, enable differential "treatments" even within the same classrooms or income levels. These differential treatments are also related to the linguistic and cultural variation between and within Black and White cultural communities. Inherently, the SAT makes strong assumptions of linguistic and cultural universality at the symbolic cost of all those that do not comport or perform to those aims (Freedle, 2003; Santelices & Wilson, 2010). The results of this study would suggest that there is a social distribution to these racialized effects where those of higher incomes are more familiar with the cultural capital assessed on the SAT (Bourdieu, 1986).

While these theoretical comments are speculations that are not empirically grounded with the current examination of the SAT the results of this study do indicate how race and class are co-constitutive and inextricably tied. This is an important finding that has both theoretical and policy implications. On the one hand, there has and continues to be an agenda in sociological and educational research to empirically provide support for the William Julius Wilson argument of class increasingly trumping race (Wilson, 1980) despite his own re-positioning on this debate (Wilson, 2009). This study suggests that for SAT performance race and class inform and constitute each other. On the other hand, there has been a peeling away of race-conscious policies such as affirmative action over the past 30 years. The substantial interaction effect

between race and income as well as race and high school achievement indicates that these policy shifts have been empirically misguided, particular as it pertains to SAT performance. Both theoretical and policy implications of the race and income dynamic of this study point toward important directions for future research in order to further understand this dynamic with SAT performance.

While the results of this study appear robust, it is important to note the limitations inherent in our data. For example, with the exception of SAT scores, all other measures were derived from students' self-reports. Perhaps more importantly, family income was reported and measured on an interval scale and was truncated at incomes greater than \$100,000 (the upper categorical limit on the SDQ). As a consequence, we were unable in our modeling efforts to account for the variation on SAT scores for family incomes greater than \$100,000. It is important to point out that this is also a single-year self-report of family income, and therefore does not account for the potential transitory shocks to family income that can occur in volatile economic times. Lastly, the model does not account for other potentially relevant variables such as parental occupational prestige, family wealth, grandparents' socioeconomic variables, access to test preparation services, or variations in parenting practices.

Future research is needed to account for the limitations in our data (e.g., with Asian Americans and Hispanic/Latinos), as well as to better understand the racially differential effects of low levels of family income on access to higher education. The results reported here also suggest the need to further our understanding of how variations in school resources influence performance on standardized test scores, and subsequent access to postsecondary education. Moreover, it would be useful, we suspect, to develop models that include other intervening variables, such as test-prep or coaching, variations in parenting practices, as well as other community and neighborhood resources that may serve to mediate the effects of family income and poverty. With the increasing availability of latent growth models (see McArdle, 2008), we are now positioned to examine further the effects of family income and poverty on the growth and change in total SAT reasoning scores over multiple test administrations. The latent variable models described in this paper, we believe, may help provide a better understanding of the direct and indirect effects of family income, poverty, and high school achievement on access to higher education.

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Notes

1. In *The Miner's Canary*, Guinier and Torres (2002) stated, "Of course, this is an oversimplification. The SAT and other 'norm-referenced' aptitude tests do tell us something about one's capacity to do analytic thinking. The problem is that such capacity is often improved by practice; practice comes from coaching (which costs money), from experience taking the test (which means exposure to the opportunity of learning from previous mistakes), and from other kinds of exposure to travel, books, and unusual words. Thus, while the tests do tell us something about those who do well, they often tell us less about those who do poorly; that is, they do not tell us what a poor performer is actually capable of doing, only what that person has already learned or not learned to do" (p. 387).

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Appendix A

THE SAT QUESTIONNAIRE

This questionnaire is completed by the students when they register with the College Board to sit for the SAT. The questionnaire contains 43 items surveying students on high school courses taken, participation in a sweep of extracurricular activities, academic achievement levels (i.e., grades), parental education, combined family income, and their race/ethnicity (see <http://www.collegeboard.org> for a copy of the SAT Questionnaire). Responses to these questions formed much of the data for this study. In particular, we examined responses to parental education, combined family income, high school GPA measures, and reported ethnicity. A sampling of the used items in this study is provided below. We also provide the scoring (termed *Value* below) used for the responses to the SAT Questionnaire item.

Enter the average grade for all courses you have already taken in each subject:

Arts and Music

English

Foreign and Classical Languages

Mathematics

Natural Sciences

Social Sciences and History

| Student Response | Value |
|---|-------|
| A or excellent (usually 90-100) | 4 |
| B or good (usually 80-89) | 3 |
| C or fair (usually 70-79) | 2 |
| D or passing (usually 60-69) | 1 |
| E or F or failing (usually 59 or below) | 0 |

Indicate your cumulative grade point average for all academic subjects in high school.

| Student Response | Value |
|-------------------|-------|
| A+ (97-100) | 4.3 |
| A (93-96) | 4.0 |
| A- (90-92) | 3.7 |
| B+ (87-89) | 3.3 |
| B (83-86) | 3.0 |
| B- (80-82) | 2.7 |
| C+ (77-79) | 2.3 |
| C (73-76) | 2.0 |
| C- (70-72) | 1.7 |
| D+ (67-69) | 1.3 |
| D (65-66) | 1.0 |
| E or F (below 65) | 0 |

What is your most recent high school class rank?

| Student Response | Value |
|------------------|-------|
| Highest tenth | 6 |
| Second tenth | 5 |
| Second fifth | 4 |
| Middle fifth | |
| Fourth fifth | 2 |
| Lowest fifth | 1 |

Indicate the highest level of education completed by your father and mother.

| Student Response | Value |
|--------------------------------------|-------|
| Grade school | 1 |
| Some high school | 2 |
| High school diploma or equivalent | 3 |
| Business or trade school | 4 |
| Some college | 5 |
| Associates or two-year degree | 6 |
| Bachelor's or four-year degree | 7 |
| Some graduate or professional school | 8 |
| Graduate or professional degree | 9 |

What was the approximate combined income of your parents before taxes last year?

| Student Response | Value |
|------------------------------|-------|
| Less than \$10,000 | 1 |
| About \$10,000 to \$ 15,000 | 2 |
| About \$15,000 to \$ 20,000 | 3 |
| About \$20,000 to \$ 25,000 | 4 |
| About \$25,000 to \$ 30,000 | 5 |
| About \$30,000 to \$ 35,000 | 6 |
| About \$35,000 to \$ 40,000 | 7 |
| About \$40,000 to \$ 50,000 | 8 |
| About \$50,000 to \$ 60,000 | 9 |
| About \$60,000 to \$ 70,000 | 10 |
| About \$70,000 to \$ 80,000 | 11 |
| About \$80,000 to \$ 100,000 | 12 |
| More than \$100,000 | 13 |

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