Unfulfilled Potential: High-Achieving Minority Students and the High School Achievement Gap in Math

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This study uses multilevel modeling to examine a subset of the highest performing 9th graders and explores the extent that achievement gaps in math widen for high performing African American and Latino students and their high performing White and Asian peers during high school. Using nationally representative data from the High School Longitudinal Study of 2009 (HSLS:09), this study aims to address three research questions: 1) To what degree does the achievement gap widen between different ethnic groups during high school; 2) To what extent can a widening achievement gap be explained by individual and school characteristics of students?; and 3) To what extent are the effects of various factors on achievement moderated by race/ethnicity? The study finds that factors such as advanced course placement and socio-economic status (both individual and school SES) explain away the gap for high achieving Latino 11th graders and some of the gap for African American 11th graders while student background explains away the large advantage for Asian 11th graders. Notably, the effect of math efficacy on math achievement is shown to vary by race/ethnicity. This study has important implications for post-secondary opportunities for high-achieving African American and Latino students.

Keywords: achievement gap, tracking, ecological theory, opportunity gap

The No Child Left Behind Act (NCLB) brought renewed attention to racial achievement gaps in the United States by quantifying achievement levels for subgroups within and between schools (Lubienski & Crocket, 2007). However, almost 15 years since the passing of NCLB, African American and Latino high school students still perform significantly worse in math than White and Asian students (Plucker, Burroughs, & Song, 2010; Venzant Chambers & Huggins, 2014). Many scholars (Farkas, 2004; Harris & Robinson, 2007) suggest that this achievement gap persists because minority students are more likely to enter high school without the necessary skills. It is well documented and fairly intuitive that 9th grade students lacking strong foundational math skills will have difficulty excelling in high school math. However, less attention has been given to how the math achievement gap widens during high school for African American and Latino students who enter high school with exceptional math abilities as well as the degree to which these disparities result from uneven opportunity structures (Bromberg & Theokas, 2014; Hedges & Nowell 1999; Riegle-Crumb & Grodsky, 2010)[1].

Using the most recently available nationally representative data from the High School Longitudinal Study of 2009 (HSLS:09), this study examines a subset of the highest performing 9th graders and explores the extent that achievement gaps in math widen

[1] African American and black are used interchangeably throughout this article.

for high performing African American and Latino students and their high performing White and Asian peers during high school. Exclusively studying high-achieving students allows us to better understand the complex ecological process in which individual and school-level factors contribute to the opportunity gap for high-ability minority students (Bronfenbrenner, 1979; Stewart, 2008a).

Much of the previous research on high ability minority students utilizes qualitative research (McGee, 2013; Tyson, 2011; Venzant Chambers, Huggins, Locke, & Fowler, 2014; Wiggan, 2008) or localized quantitative samples (Gonzalez & Padilla, 1997). Moreover, the few large-scale quantitative studies of the high achievers gap in high school utilize data that is over a decade old or more (see Covay Minor, 2016; Riegel-Crumb & Grodsky, 2010 for examples). By using the most recently available nationally representative data, this study adds to the literature by examining a cohort of students that came of age exclusively in the NCLB era, when schools were supposedly under greater scrutiny to promote achievement amongst all subgroups.

The study reveals that, despite the fact that the high-achievers have similar math achievement scores when they start 9th grade regardless of race or ethnicity, African American students fall far behind their high-achieving peers by the 12th grade, while high-achieving Asian students expand their aggregate advantage over other groups. The aim of this study is to disentangle the opportunity structures and individual factors that stratify these high-achieving students by race/ethnicity as they progress through high school. Although ecological theory has been applied to explain minority student development throughout pre-K-20 experiences (Broussard & Garrison, 2004; Slaughter-Defoe et al., 1990; Stewart, 2008a), this analysis hones in on high school students for several key reasons. First, high school is a particularly pivotal time in terms of course placement steering certain students towards different post-secondary options (Solorzano & Ornelas, 2004). Secondly, adolescents are particularly vulnerable to the acceptance or influence of their peers—even peers outside their immediate group of friends or the students enrolled in their classes (Gutman, 2006; Tyson, 2011). The subsequent analysis utilizes multi-level modeling to estimate the unique effects of several factors including course placement and peer effects to explain the high school achievement and opportunity gap.

Literature on the Achievement Gap

The achievement gap refers to the difference in academic performance between two subgroups when one group outperforms another group. Racial achievement gaps such as the Black-White achievement gap are the most widely studied and discussed disparities in the United States (Covay Minor, 2016; Farkas, 2004; Jencks & Phillips, 1998; Lubienski, 2002). Although less attention has been devoted to other racial achievement gaps, there is increased interest in Latino and Asian achievement, as these groups constitute an increasing share of the school-age population (Galindo & Pong, 2011; Reardon & Galindo, 2009). Most studies of the racial achievement gap focus on overall averages of grades or test scores between subgroups, but ignore the heterogeneity within ethnic groups (Flores, 2007; Lee, 1994; Mckown, 2013; Wing, 2007). However, many scholars point out that there is more variance within racial and ethnic groups than between them (Valencia & Suzuki, 2000). For instance, Asian student achievement varies greatly depending on social class, immigrant status, and attitudes towards schooling (Lee, 1994; Wing, 2007). Thus, it is important to examine how social, environmental, and psychological factors contribute to gaps amongst students at different achievement levels.

One understudied area of the racial achievement gap is the prevalence of the achievement gap amongst the highest achieving students and the extent that such

disparities are a function of an "opportunity gap" in terms of coursework, resources, and other factors (Flores, 2007; Ladson-Billings, 2006). Although African Americans and Latinos are underrepresented amongst the highest achieving students (Gandara, 2005; Hedges & Nowel, 1999; Plucker, Burroughs, & Song, 2010; Reardon, 2008; Tyson, Darity, & Castellino, 2005), many minority students enter high school with above average math skills[2]. Thus, the most widespread explanations for the achievement gap such as family socioeconomic status (Alexander et al., 1997; Coleman et al., 1966; Jencks & Phillips, 1998), stereotype threat (Steele, 1997) and insufficient prior skills (Farkas, 2004; Harris & Robinson, 2007) become *less* applicable for this high-achieving group. After all, students who are high-achieving through the first nine grades of formal schooling seemingly possess resources, skills, and efficacy to perform well in high school. For instance, Gandara (2005) found that, on average, Latino high-achievers came from wealthier, more educated, two-parent households. Moreover, even if some high-achieving students lack material, educational, or social capital resources, the fact that they enter high school with such high math abilities suggests a positive orientation towards schooling and math as well as an ability to overcome barriers to high achievement (at least during their K-8 education). Still, it is also possible that certain disadvantages or environmental factors emerge for high achieving minorities only in the high school years.

Conceptual Framework

This study draws on the work of Bronfenbrenner (1979) whose *ecological systems theory* recognizes the complex web of influences on child development that includes peers, schools, family, and other social structures. His theory has been used to explain student outcomes such as achievement (see Slaughter-Defoe, Nakagawa, Takanishi, & Johnson, 1990 for summary of studies; Stewart, 2008a for more recent study) as well as student attitudes including motivation (Broussard & Garrison, 2004), effort (Stewart, 2008b) and civic capacity (Greenberg, 2001). By applying this framework to high achieving 9th graders, it helps to disentangle the role of three key interrelated factors, which potentially influence math performance as they progress through high school: 1) student and family background; 2) student-school experiences; and 3) school-level factors. These factors persist thru pre-K-20 schooling and of course prior achievement contributes to high school learning experiences. However, only studying high achieving 9th graders provides an opportunity to focus on how ecological systems theory plays out for a group of high school students that seemingly start with a similar level of prior achievement. Although these students enter 9th grade with similar achievement levels, they also come from unique communities and attend high schools with vastly different demographics, peer influences, and teacher quality. Moreover, several features of schooling such as course tracking and peer influence take on an elevated role during the adolescent years.

An important feature of ecological theory is that it emphasizes the intersection of various influences including family, peers, school, and society (Basham, Israel & Maynard, 2010; Ream, Ryan, & Espinoza, 2012; Rice et al. 2013; Stewart, 2008a). Ecological theory recognizes the extent that the local community plays in the development of the child in terms of the local social network, neighborhood safety, and economic opportunity structure. In many ways, families, friends, and schools reflect the local community and how it indirectly influences achievement. In sum, an

[2] "Minority students" is used to refer to African American and Latino students. Although Asians are also a minority group and are disadvantaged in some situations, they generally perform better on achievement tests than non-Asians.

ecological framework is applicable for a complex process such as schooling since these factors clearly do not exist independently from each other and constantly influence the dynamic of a child's development. Although the subsequent review of literature addresses many of these influences independently in order to fully appreciate their role, where possible, connections are drawn between overlapping factors such as schools and family.

The Role of Schools

High schools often stratify students through a variety of mechanisms including tracking (Burris & Welner, 2005; Hallinan, 2001), segregation (Orfield, Kuscera, & Siegel-Hawley, 2012), teacher quality (Flores, 2007), and peer effects. Minority students are more likely to attend lower-SES schools regardless of their own socio-economic standing (Goldsmith, 2011). These segregated, higher poverty schools often lack high quality teachers (Flores, 2007), possess fewer resources (Reardon, 2008), and have more behavioral issues (Kotok, Ikoma, & Bodovski, 2016). Covay Minor (2015) observed that trigonometry students in high minority classrooms actually received less instruction in trigonometry and other advanced concepts than their peers in predominantly White classrooms. Even when minority students attend more racially and economically diverse schools, they are more likely to be enrolled in lower track courses (Archbald & Farley-Ripple, 2012; Ladson-Billings, 2006; Martinez & Guzman, 2013). Moreover, Latinos and African American students are more likely than Whites and Asians to be placed in lower track courses even when they score in the top math percentiles (Bromberg & Theokas, 2014; Oakes, 1995). Notably, entry and success in advanced rigorous courses may advantage some students for post-secondary opportunities (Bromberg & Theokas, 2014).

In addition to structural characteristics, schools also can promote or constrain educational opportunity through teacher attitudes (Brophy, 1983; Riegel-Crumb & Humphries, 2012; Rumberger & Palardy, 2005; Wiggan, 2008) and student-teacher relationships (Carter, 2005; Johnson, Crosnoe, & Elder, 2001; Valenzuela, 1999). Rosenthal and Jacobson (1968) famously suggested that high teacher expectations for students lead to better academic outcomes, above and beyond actual student skills. Subsequent studies support the idea that both positive and negative expectations influence student achievement and attainment (Brophy, 1983; Rumberger & Palardy, 2005; Steele, 1997).

Teacher expectations may also contribute to greater sense of student belonging— the extent that students feel attached to their school. This sense of attachment and belonging has been linked with improved student effort, engagement, and performance (Crosnoe et al., 2004; Pong & Zeiser, 2012; South, Haynie, and Bose, 2007; Stewart, 2003; Stewart, 2008b; Wentzel, 1997). Further, a strong school connection may be especially salient for both high ability and minority students. For instance, high-achieving Latinos (Gonzales & Padilla, 1997) and African Americans (Gutiérrez, 2000) often feel more connected to their schools than low or average achieving minority students, though the high-achievers may harbor such positive feelings towards their school because they perform well so there is uncertainty on the directionality.

Peer Attitudes

In an ecological perspective, peer attitudes represent an intersection of two major systems, the school and the neighborhood (Stewart, 2008a), and peer influences are especially strong during the adolescent years. Peer attitudes often shape a child's academic and social life. These relationships or absence thereof can be especially salient during adolescence when teenagers depend the most on the acceptance of their peers (Coleman, 1960; Milner, 2013; Nichols & White, 2001; Tyson, 2011). Thus, a student is much more likely to remain engaged in school if their friends share an interest in

school and higher learning (Wang & Eccles, 2012). Concurrently, peer influences may assume a more globalized cultural identity linking students to a larger ethnic or religious attachment during the teen years as students search for acceptance amongst their classmates and community outside of school (Umaña-Taylor, Bhanot, & Shin, 2006).

High-achieving minority students must often weigh a "racial opportunity cost" when enrolling in advanced courses frequently composed of mostly White and Asian students (Venzant Chambers, Huggins, Locke, & Fowler, 2014). Given the aforementioned underrepresentation of minorities in such advanced courses, high ability minority students often end up feeling alienated from their same-race peers and identity if they choose to pursue advanced courses in a racially mixed school (Venzant Chambers & Huggins, 2014). Tyson (2011) elaborates that the stigma from other African Americans towards those enrolling in advanced courses is actually most extreme at racially integrated high schools where tracking is most racialized. Further, Tyson (2011) suggests the notion of advanced courses as "White classes" is almost non-existent in predominantly minority schools since tracking does not take on this racialized identity.

Attitudes Towards Education

Student attitudes towards formal education encapsulate a cross-section of ecological factors including peer influences, relationships to school, and, perhaps most importantly, family influences. These attitudes towards formal education amongst adolescents have been found to vary by race/ethnicity (Mickelson, 1990) as well as gender (Roderick, 2003), social class (Ikoma & Brauer, 2015), and immigrant status (Portes & Zhou, 1993). For instance, Asian students and parents – often referred to as a model minority– are thought by some to value education more than other ethnic groups (e.g. "The Tiger Mom" stereotype) (Wing, 2007), but many scholars point out that this positive orientation towards schooling is actually a function of first generation immigrant cultures and such values towards education diminish after Asians become more assimilated (Galindo & Pong, 2011; Kao & Tienda; 1995). Conversely, some scholars such as Fordham and Ogbu (1986) suggest that African American and Latino students exhibit "an oppositional culture" towards education due to a social and economic system which does not evenly reward the merit of minorities in terms of occupational opportunities and salaries (also see Matute-Bianchi, 1986; Portes & Zhou, 1993). Yet, several other researchers have actually found that African Americans and Latinos actually view education far more positively than their peers since education is seen as such an important lever of mobility, even if minorities may have to work harder in the face of discrimination (Harris, 2006; Mickelson, 1990, Valencia, 2002). Thus, culture is likely manifested in attitudes, but there is a danger in labeling specific elements of culture as being linked to achievement.

Educational Expectations

One common way of measuring student orientation towards education is student expectations for higher education (Bodovski, 2014; Byun, Meece, Irvin, & Hutchins, 2012). From an ecological perspective, educational expectations reflect a combination of family resources, individual attitudes, and opportunity structures in school and society (Bronfenbrenner, 1994). Relatedly, achievement and socio-economic status have been found to greatly influence student perceptions of post-secondary opportunity (Gandara, 2005). For instance, in a recent analysis of high school students' aspirations and expectations over time, Ikoma & Broer (2015) observe that post-secondary expectations for low-SES high-achieving students actually lagged behind their low-achieving mid and high-SES peers. The notion of locus of control has been used to explain this perceived opportunity gap (Bandura, 1977; Bodovski, 2014; Kao, 1999). Lower-SES students and minorities are more likely to have an external locus of control

in which they attribute opportunity to external forces such as luck or chance while higher-SES children tend to have an internal locus of control in which they believe they that their effort, ability, and actions dictate their educational opportunity (Ogbu, 1977; Willis, 1977).

Many studies find that African American students are far more likely than Whites, Asians, and Latinos to *aspire* to a 4-year college when controlling for prior achievement and socio-economic status (Flowers, Milner, & Moore, 2003; Roderick et al, 2011; Rumberger, 1983), but these aspirations do not always manifest into higher achievement due to what Bronfenbrenner terms the exosystem and mesosystem—the elements of the ecological framework that shape economic opportunity. According to Mickelson (1990), an attitude-achievement paradox exists wherein African Americans greatly value education as a means of social mobility when asked abstract questions such as "education pays off in the future," but their responses to concrete questions such as "studying in school rarely pays off" are much more cautious due to a constrained opportunity structure in the United States (Ainsworth-Darnel & Downey, 1998). So while her findings contradict the oppositional culture hypothesis that African Americans undervalue education (Fordham & Ogbu, 1986; Portes & Zhou, 1993), she affirms that minority students are more likely to possess an external locus of control regardless of socio-economic status and prior achievement. Yet, while Mickelson considers intersections between race, gender, and social class, her study fails to consider how attitudes of high-achieving minorities may differ from their lower achieving peers (Carter, 2009).

Attitudes Towards Math

Since this study focuses on the math achievement gap, it is necessary to also consider specific attitudes towards math rather than just general orientation towards school and education. Math self-concept usually connotes an abstract idea about whether you are a "math person" who enjoys and is interested in math. Immigrant groups sometimes gravitate towards mathematics because it requires less mastery of the dominant language and it is emphasized as a means of mobility at home (Hao & Woo, 2012). Several studies also find that African American and Latino students enjoy math more than their White peers (Catsambis 1994; Else-Quest et al., 2013; Riegle-Crumb et al. 2011). Notably, Riegle-Crumb et al. (2011) found that math self-concept and enjoyment were more important than prior achievement in predicting if students pursued a STEM career. Yet, math interest and enjoyment lose some importance if students do not feel capable of performing well in their math courses.

Self-efficacy refers to a student's belief that they can succeed on a particular task (Bandura, 1993; Stevens, Olivarez, Lan, & Tallent-Runnels, 2004). Social psychologists (Steele, 1997) suggest that minorities—particularly African Americans— experience lower efficacy in math due to perceived low-expectations in math. This stereotype threat and subsequent lowered efficacy creates test anxiety on entry exams and may discourage some minority students from taking challenging math courses and pursuing STEM careers (Anderson & Ward, 2014). Even when minority students possess high efficacy, it may not translate to academic success at the exact same level as their White peers. While some scholars find that efficacy was more important for minorities (Stevens, Olivarez, Lan, & Tallent-Runnels, 2004), at least one nationally representative study of achievement found that African Americans and Latinos derive less academic benefit from high efficacy than their White peers (Cheema & Galluzo, 2013). Perhaps the role of math efficacy varies as a function of coursework, schools, and peers. An above average college athlete may think he or she is very talented until they begin playing professionally and realize their skills are below average. A similar

phenomenon likely plays out for high achieving minority students in what Marsh (1987) calls "a big fish in a small pond" effect where high-achieving minority students at low-achieving schools receive more praise and attention from staff than if they had attended a higher-SES school with more academic competition and rigor.

Given the framework of ecological systems theory, it is evident that a multitude of internal and external factors affect an outcome such as math achievement. Although several studies seek to understand this multi-layered developmental process, the following analysis focuses on high-achieving 9th graders. Specifically, this study aims to address three research questions: 1) To what degree does the achievement gap widen between different ethnic groups during high school; 2) To what extent can a widening achievement gap be explained by individual and school characteristics of students; and 3) To what extent are the effects of various factors on achievement moderated by race/ethnicity?

Data and Methods

The study utilizes restricted data from High School Longitudinal Study of 2009 (HSLS:09), a nationally representative survey of high school schools and students conducted by the National Center for Education Statistics (NCES). The HSLS:09 sample design is a multi-stage process utilizing stratified random sampling of schools and random sampling of students at the school level. The sample included both private and public schools. The full HSLS:09 sample includes approximately 24,000 students attending 944 schools, but this study mainly analyzes a subsample of students scoring in the top quintile of math achievement according to their baseline scores from the Fall of 9th grade (n=4,600). I use data from the baseline survey conducted at the beginning of 9th grade and the first follow-up at the end of 11th grade.

Weights. I weighted all analysis using the Student Longitudinal Analytic Weight for the First Follow-Up (W2W1STU) so that the findings can be generalized to the national population of high school students. This weight is recommended for any longitudinal analysis using the first follow up.

Variables. I use the end of 11th grade math first follow-up test as an outcome. The 11th grade math score was calculated using Item Response Theory (IRT) and tested six domains of algebraic content and four domains of algebraic processes (NCES, 2013). As a frame of reference, the average score for the full sample was approximately 65 points and the maximum score for 11th grade was 115 points. The beginning of 9th grade math score served as a control for prior achievement. On both the 9th and 11th grade test, students took an initial baseline test that routed them towards low, moderate, or difficult test material for the remaining questions. According to NCES (2013), approximately 25% of students were routed to the difficult material. Some additional challenging questions were added on the 11th grade test to guard against a ceiling effect for students. These additional questions allow measurement of growth over time. Several independent variables were included in the model to represent the range of contributing individual, family, school and even community factors that contribute to student achievement.

Family Background. Student background variables included race/ethnicity (reference: White), gender, and socio-economic status (a composite based on parent's income, education, and occupational prestige).[3] Student's language status (spoke language other than

[3] All standardized factors were constructed by NCES using the entire sample. I elected to use these factors since it indicates where student was relative to entire high school population.

English first, spoke English and another language first, or spoke only English first) was used a proxy for whether a student was an immigrant or not.

Attitudes. I used a 10-level ordinal variable for academic expectations (how far in school the student expects to go) to reflect the orientation towards higher education. Standardized factor variables created by NCES measured math self-efficacy and math identity (whether a student and his/her peers considered themselves a math person). Both composites had high reliability with Chronbach's alpha of 0.90 and 0.84, respectively (see appendix for more details on all composite variables).

School-Student. School-student factors differ from school-level factors as the former represented variables specific to the individual at the school rather than variables where the school was the unit of analysis. The advanced math track variable, based on if the student was placed in any advanced level math course in the 9th grade (Algebra 2, Statistics, Advanced Math, Geometry, Integrated Math 2 or Trigonometry), provided information on whether the high achieving student was placed in a course track commensurate with their high abilities. For peer engagement, a binary variable measured whether the student's best friend was interested in school. A standardized composite variable measured students' sense of belonging at the school, indicating whether students felt connected to their schools and teachers.

School-Level. Several factors were measured at the school level. School SES was the average socio-economic status of the school based on the individual standardized SES measure aggregated up to the school-level. Additionally, a standardized factor composite for school safety measured the frequency of school behavior problems such as bullying, fighting, and drug use (Chronbach's alpha=0.88) and academic climate measuring items such as teacher expectations for teaching and learning. (Chronbach's alpha=0.88). A control was included for school type indicating if a student attended a public or private Catholic, or private non-Catholic school.

Community. Urbanicity indicated if a student attended a school in an area considered urban, rural, suburban, or town as defined by the U.S. Census.

Analytic Method

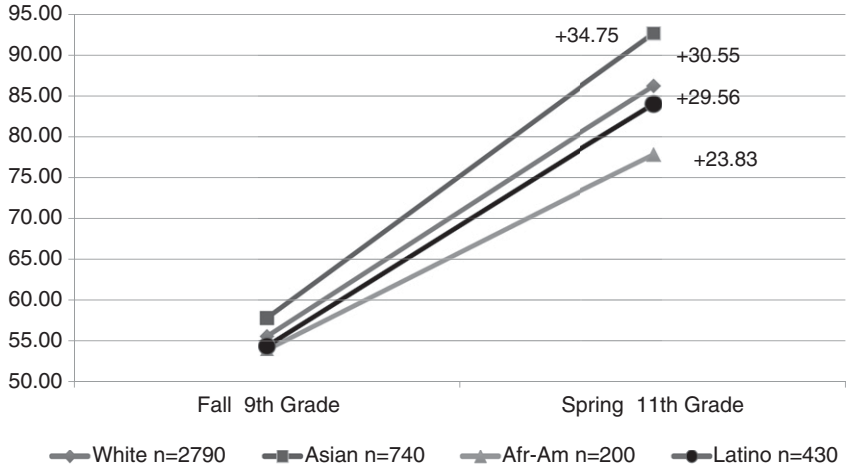
This study employed inferential statistics to analyze if descriptive data varied by race and multilevel modeling to measure the unique effects of the independent variables on 11th grade math achievement. Descriptive data are provided for all variables and inferential statistics were used to evaluate if the mean values for African Americans, Latinos, and Asians differed significantly from White high achievers. For the multi-level model, a baseline model was run only including the variables for race/ethnicity. I subsequently added variables for student-school experiences, attitudes and family background, school factors and location. To answer the third research question, interaction terms were tested to examine if peer effects, math self-identity, self-efficacy, and advanced course taking depended on race since some of the aforementioned literature has suggested minorities may be more influenced by some of these factors than White students. Ultimately, efficacy was the only significant moderator based on the F-statistic. Since the continuous variables were standardized, there were no issues with collinearity and thus no need to center these variables.[4]

[4] Three variables (student expectations, academic climate, and school safety) had high levels of missing data. Mean imputation was used for these 3 variables and a variable was created to control for missing. This variable was included in all analyses, but it was not significant indicating that data was missing at random and did not affect overall results.

Results

Although the baseline 9th grade math scores varied significantly by race/ethnicity, the differences were fairly small (see Figure 1). Yet, disparities grew greatly during high school. In both years, Asian students performed significantly better than White students while African American and Latino students scored significantly lower ($p<.001$). On average, Asian students scored almost 4 points higher than African American high achievers in 9th grade. However, by the end of 11th grade, Asian high-achievers were scoring almost 15 points higher than African American high-achievers. In fact, Asians gained almost 35 points on their math score between 9th and 11th grade while Whites and Latinos gained around 30 points, but African Americans only gained around 24 points. In sum, although all four racial groups entered 9th grade with fairly comparable math abilities and all four groups made gains during high school, Asian high achieving students seem to be experiencing larger gains than Latinos and Whites while African Americans had the smallest gains. Thus, uncovering exactly why there is such a disparity throughout high school becomes an empirical question.

Figure 1: Math achievement: fall 9th grade and spring 11th grade by race



In terms of background, there were some notable differences by race/ethnicity (see Table 1). On average, the socio-economic status of both Asian and White high-achievers was over a half of standard deviation (SD) above the mean while African American and Latino students were right around the mean for *all students* in the HSLS sample. Over a third of Asian and Latino students had first learned a language other than English compared to only 2% of Whites and African Americans. An additional quarter of Asian high achievers spoke both English and another language suggesting that the majority of Asians in this sample was first or second generation immigrants. Notably, a larger share of African American high-achievers was female—63%—more than any other race/ethnicity.

There are somewhat conflicting trends regarding attitudes toward math and education. For instance, African Americans had the highest self-efficacy, but the lowest math identity and their peers were the least engaged of the four main groups. On average,

Table 1: *Descriptive statistics for high-achieving students by race/ethnicity*

		White	Asian	Afr Amer	Latino
Math Scores					
	Fall 9th Grade	55.69	57.92***	54.04***	54.49***
		(4.48)	(5.20)	(3.12)	(3.75)
	Spring 11th Grade	86.24	92.67***	77.87***	84.03**
		(13.03)	(12.27)	(12.57)	(14.46)
Background					
	%Female	0.48	0.53	0.63*	0.53
		(0.50)	(0.50)	(0.48)	(0.50)
	SES (Socio-Economic Status)	0.55	0.56	0.10***	-0.04***
		(0.71)	(0.80)	(0.70)	(0.72)
	Bilingual	0.01	0.25***	0.03	0.13***
		(0.12)	(0.43)	(0.16)	(0.34)
	ESL	0.02	0.37***	0.02	0.34***
		(0.14)	(0.48)	(0.14)	(0.47)
School -Student					
	Advanced Math Track	0.69	0.83***	0.62	0.62**
		(0.46)	(0.38)	(0.49)	(0.49)
	Peer Engagement	0.75	0.76	0.68	0.76
		(0.43)	(0.42)	(0.47)	(0.43)
	School Belonging	0.28	0.12**	0.32	0.11***
		(0.90)	(0.87)	(0.80)	(0.91)
Attitudes					
	Math Efficacy	0.43	0.38	0.51	0.47
		(0.89)	(0.95)	(0.85)	(0.97)
	Math Identify	0.60	0.64***	0.54	0.55***
		(0.86)	(0.83)	(0.85)	(0.85)
	Student Expectations	7.87	8.26***	8.02	7.45***
		(1.80)	(1.83)	(2.39)	(2.27)
School Characteristics					
	School Socio-Economic Status	0.22	0.30***	0.04***	0.04***
		(0.41)	(0.43)	(0.43)	(0.39)
	School Safety	-0.30	-0.60**	-0.32	-0.57***
		(0.91)	(1.21)	(0.72)	(0.99)
	Academic Climate	0.18	0.20	0.28	0.30***
		(0.75)	(0.68)	(0.62)	(0.63)
	Catholic	0.07	0.03***	0.02	0.04
		(0.26)	(0.16)	(0.15)	(0.20)
	Private Non-Catholic	0.07	0.07	0.03	0.04
		(0.26)	(0.26)	(0.16)	(0.19)
Community					
	City	0.27	0.48*	0.38	0.45
		(0.44)	(0.50)	(0.49)	(0.50)
	Town	0.10	0.02**	0.06	0.03**
		(0.30)	(0.13)	(0.24)	(0.18)
	Rural	0.26	0.08	0.21*	0.14
		(0.44)	(0.28)	(0.41)	(0.34)
number (rounded to nearest 10)		2790	740	200	430

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

Asian high-achievers held the highest academic expectations while Latino high-achievers had the lowest expectations with an average of 7.45 points meaning that, on average, Latinos did not expect to receive a bachelors degree. Student-school experiences also varied by race. Most notably, African Americans and Latinos were least likely to enroll in advanced math courses in 9th grade at 62% compared to 69% of Whites and 83% of Asians.

The multi-level analysis explains away the Asian math advantage relative to Whites and partially explains away the African American gap (see Table 2). Model 1 provides the coefficients for race/ethnicity not controlling for any other variables. African American and Latinos had statistically significant lower 11th grade math scores from Whites with the former scoring 6.34 points worse and the latter group scoring 3.05 points worse. Conversely, on average, Asians scored 5.25 points better than Whites without including any controls. In model 2, the inclusion of student-school variables greatly narrows both the African American-White and Asian-White gaps and eliminates the Latino-White gap. Specifically, on average, students enrolled in an advanced math track scored over 4 points higher than their peers in a non-advanced math course. Having a highly engaged closest friend also was positively associated with higher math achievement with almost a 2 point increase ($p<.05$). Prior math achievement also influenced the achievement gap amongst high-achieving students with a 1 point increase in 9th grade achievement being associated with a 1.4 point increase in 11th grade math achievement. Notably, when controlling for student-school experience, the African-American gap decreases by almost half and the Asian advantage decreases by more than half relative to White students.

Student attitudes toward math and some of the family background variables were significant predictors of higher math achievement (see models 3 and 4, respectively). Interestingly, math self-efficacy and math identity were both positively associated with higher math achievement, but educational expectations did not have a statistically significant effect on 11th grade achievement. When controlling for student attitudes, the average African American-White gap actually widens. Yet, when the family background is included in model 4, the African American-White disparity narrows again from 4 points to 3.3 points, which suggests that differences in socio-economic status and speaking a language other than English partially explained the gap. Both of these measures were statistically significant and quite large in magnitude. In the case of SES, an increase of 1 SD was associated with a 2.5 point increase in 11th grade math uscore. Notably, when SES and language are included in model 4, the Asian advantage ceases to be statistically significant.

School SES was the only school or community characteristic that was statistically significant in model 5 and the effect was extremely large in magnitude. A 1 SD increase in school SES was associated with almost a 2.5 point increase in student achievement. Notably, the effect of school SES was larger in magnitude than individual SES. However, adding school SES and the other school characteristics did not change the significance levels of the other variables (and barely changed their magnitude) between models 4 and 5.

When I added the interaction terms in model 6, I found that math self-efficacy varied by race/ethnicity both in magnitude and direction. Notably, a 1 SD increase in efficacy was associated with a 3.71 point increase on math achievement for Latinos and 1.90 point increase for Whites. However, on average, higher self-efficacy for African Americans was inversely related to math achievement at a statistically significant level. Specifically, on average, a 1 SD increase in self-efficacy for African Americans

Table 2: *The relationship between individual and school factors on the math achievement gap*

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Race/Ethnicity (Ref:white)						
Hispanic	-3.05* (1.38)	-0.53 (1.32)	-0.82 (1.27)	-0.56 (1.26)	-0.54 (1.26)	-2.38 (1.71)
Asian	5.25*** (0.85)	2.48** (0.77)	2.58** (0.79)	2.12 (1.14)	2.14 (1.13)	1.92 (1.13)
Black	-6.34*** (1.30)	-3.15* (1.36)	-4.00** (1.44)	-3.33* (1.39)	-3.37* (1.39)	-1.85 (1.40)
Amer-Indian	-0.40 (2.95)	-1.53 (4.04)	-1.49 (3.93)	-2.65 (3.65)	-2.76 (3.55)	-2.63 (3.51)
Multi-Race	-1.56 (1.44)	-0.24 (1.26)	-0.50 (1.24)	-0.32 (1.19)	-0.31 (1.19)	-2.63 (3.51)
Pacific Islander	3.26 (10.91)	3.72 (11.25)	3.25 (10.59)	2.65 (3.65)	2.72 (10.88)	-13.89 (12.92)
Student-School Experience						
9th Math Score		1.40*** (0.06)	1.23*** (0.06)	1.20*** (0.06)	1.20*** (0.06)	1.19*** (0.06)
Advanced Math Track		4.22*** (0.78)	4.33*** (0.73)	3.92*** (0.71)	3.94*** (0.72)	4.08*** (0.71)
Peer Engagement		1.85* (0.75)	1.78* (0.76)	1.59* (0.73)	1.57* (0.73)	1.55* (0.69)
Sense of Belonging		0.86 (0.55)	-0.01 (0.48)	-0.10 (0.44)	-0.08 (0.43)	-0.17 (0.38)
Math Efficacy			2.41*** (0.54)	2.38*** (0.50)	3.94*** (0.49)	1.90*** (0.37)
Math Identity			0.87* (0.44)	1.08** (0.41)	1.09** (0.47)	1.19** (0.40)
Student Expectations			0.10 (0.16)	0.04 (0.15)	0.04 (0.15)	0.09 (0.14)
Family Background						
SES				2.08*** (0.40)	2.09*** (0.40)	2.13*** (0.40)
Bilingual				-2.72 (2.16)	-2.67 (2.16)	-1.59 (1.62)
ESL				3.10** (1.05)	3.05** (1.04)	3.49** (1.02)
Female		-0.99 (0.55)	-0.17 (0.62)	-0.11 (0.62)	-0.11 (0.61)	-0.06 (0.60)
School-Level Variables						
School SES					2.41** (0.83)	2.25** (0.83)
Academic Climate					0.39 (0.45)	0.36 (0.44)
School Safety					0.55 (0.36)	0.53 (0.36)
Catholic School					0.46 (0.88)	0.67 (0.88)
Private non-Catholic					-0.51 (1.05)	-0.57 (1.07)

Continued on next page

Table 2: *Continued*

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Community						
City					-0.15 (0.60)	-0.13 (0.61)
Town					-1.51 (0.91)	-1.54 (0.94)
Rural					-0.96 (0.74)	-1.07 (0.75)
Interactions						
Black * Efficacy						-.3.76** (1.39)
Hisp * Efficacy						3.71 (1.79)
Asian *Efficacy						-0.62 (0.90)
Pac Isl *Efficacy						26.08* (11.45)
Multi-Race*Efficacy						0.79 (1.09)
Constant	85.00*** (0.37)	3.78 (3.28)	10.56** (3.38)	12.12*** (3.45)	12.98*** (3.47)	13.24*** (3.48)
N	4,600	4,200	4,100	4,100	4,100	4,100

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

was associated with a 3.76 drop in math achievement controlling for model variables. Concurrently, when including this interaction term, the unique effect of being African American is no longer significant, though individual SES, school SES, and peer effects continue to be positively associated with math achievement at a statistically significant level. This finding indicates that although an achievement gap exists, it varies with attitudes towards math.

Discussion

As racial and ethnic diversity in the United States increases and as the labor market demands that prospective employees have higher-level STEM skills, it is imperative that African American and Latino students have an equal opportunity to excel in high school. Using the most recent publicly available nationally representative data on high school students, this study contributes to our understanding of why the achievement gap widens between the most promising African American and Latino high school students with the highest achieving White and Asian students. This study focuses on the ninth grade as it represents a key pathway year for high-achieving students as they prepare for post-secondary options and thus merits a study such as this. By utilizing an ecological systems framework, the multi-level analysis explains achievement differences between Asian and Latino high-achievers relative to Whites and explains much of the disparity between African Americans and Whites. Some of the critical factors in explaining these perceived gaps include course tracking, peer engagement, self-efficacy, SES (both individual and school SES), and immigration status. Finally, this study indicates that the effects of one particular attitude—student math efficacy—vary by race/ethnicity. In fact, the effect of math self-efficacy operates in complete opposite directions for African American high achievers compared to White and Latino high achievers.

Course tracking and school SES play crucial roles in the widening achievement gap for high-achieving students, but other school factors did not seem to contribute to the gap. The fact that school SES contributes to the high achiever gap further suggests that an opportunity gap drives the achievement gap in terms of school quality, peer effects, and resources. Studies documenting the influence of school SES on achievement have been prevalent since the Coleman Report (1966). However, several scholars note that, in recent years, segregation by income is worsening in American schools (see Owens, Reardon, & Jencks, 2016 for most recent evidence) suggesting that opportunities may be increasingly stratified by social class. Even when minority students attend higher-SES schools, they are likely to be enrolled in lower-tracks regardless of skills. High-achieving Asian students were 25% more likely to be enrolled in advanced math than their high-achieving African American and Latino peers, and around 17% more likely than their White peers. Due to the sequential nature of high school math courses, 9th grade placement stratifies student opportunity and achievement through future course placement and preparation for exams such as advanced placement tests and the SATs (McFarland, 2006). Moreover, when qualified students miss out on opportunities in high school, it likely affects their opportunity for attending/graduating selective colleges and performing high on college entrance exams and obtaining coveted jobs after college.

Another important aspect of course tracking pertains to peer effects and peer support networks. In an ecological framework, peers represent a confluence of school, community, and even broader social identities (especially for minorities). Notably, having your closest friend interested in school was positively associated with math learning. Of the four groups in this study, African American students were least likely on average to have a best friend who was engaged in school. This finding is consistent with the qualitative work of Venzant Chambers and Huggins (2014) who find that high-achieving African American students were more likely to socialize with students outside their advanced courses than White and Asian students. Yet, within the advanced courses, minority students often feel a sense of alienation. As noted by scholars such as Tyson (Tyson, K., Darity, W., & Castellino, D. R., 2005; 2011), African American students in advanced courses often do not socially fit in White-dominated spaces, and other minority students in lower track courses view the high-achieving minority students with some disdain. If all high-achieving minority students were placed appropriately in advanced courses, it would provide a more diverse network of peers for high-achieving minority students.

Perhaps, the most perplexing finding in this study involved the role of self-efficacy for high-achieving students. The findings on self-efficacy challenge many commonly held beliefs regarding efficacy. For instance, the idea of stereotype threat has been proposed by Steele & Aronson (1995) to explain African American underachievement as well as Asian success in math (Shih, Ambady, Richeson, Fujita, & Gray, 2002). Yet, the HSLS survey results for high-achievers indicate that African Americans actually report the highest degree of self-efficacy in math while Asians report the lowest degree. Again, this may tie into course placement if Asians are on average taking the most difficult courses and feeling the most unequipped to be successful in those courses. These findings challenge Bandura's social cognitive theory (1977; 1986), which suggests self-efficacy always positively influences learning and partially support the findings of Cheema and Galluzo (2013). Specifically, the findings suggest a positive association between efficacy and achievement when all the groups are analyzed together, but the effects of self-efficacy vary with race/ethnicity. While Latino and Whites experienced a boost in achievement when they had higher self-efficacy, surprisingly, African Americans actually scored far lower on 11th grade math achievement

when they had higher math self-efficacy. At the same time, when I tested the interaction between African Americans and self-efficacy, the overall achievement gap between African Americans and Whites diminishes greatly and becomes non-significant. I suspect this paradox results from a big-fish little pond effect (BFLPE) (Goldsmith, 2011; Marsh, 1987) due to the fact that African Americans, on average, attend the most racially and economically segregated schools in the United States. The BFLPE theory suggests that it can often be advantageous for attitudes such as self-esteem and grade point average (Flores, 2007) to be an above average student in a school where most students are below average. However, in some cases, this may result in a false sense of efficacy that does not necessarily materialize in academic success on standardized tests due to other inequities such as course rigor and highly qualified teachers (Flores, 2007). If students find their math coursework to be easy, they may study less than students in more challenging courses. Yet, Latinos also are more likely than Whites to attend segregated schools and be placed in lower tracks so it is unclear why efficacy acts differently, on average, for them. This paradox presents a ripe area for future research.

Finally, these findings indicate that two family background factors—socio-economic status (SES) and immigrant status—are especially salient in explaining the achievement gap for these high-level students. Although countless studies indicate the influential role of SES on achievement, our findings illuminate that this status continues to play a sizable role even when high school students have a strong foundation of knowledge (Gandara, 2005). It is somewhat perplexing as to why individual SES would exert such a large influence in high school, given that this group of students had demonstrated high math achievement regardless of SES in prior grades. However, as content becomes more difficult, teacher quality, access to tutors, peer effects, summer learning loss, and parental assistance all can potentially represent advantages for higher-SES high school students. Future research should further explore the exact mechanisms for how SES influences disparities for high achievers.

Concurrently, the findings suggest that the perceived Asian advantage over White students actually may not be due to a race/ethnicity gap but rather an immigrant paradox. I found no evidence that Asian students outperformed White students when they were not immigrants. This immigrant achievement paradox has been found to be especially strong for East and South Asian students given their parents' relative high education and occupational status (Feliciano, 2005). Although immigrant aspirations towards mobility may play a role, these findings do not suggest a "Tiger Mom" phenomenon in which certain ethnic groups' values are somehow superior. In fact, given that I controlled for so many individual attitudes including educational expectations, it can be inferred that the White-Asian gap has more to do with immigrant selectivity and optimism rather than inherent cultural values (Pong, Johnston, & Chen, 2009).

This study has some limitations such as its reliance primarily on student and school-level data without knowing more about the opportunity structure in the community that may motivate certain students. Although the study enriches our understanding on the role of several important school factors such as course tracking, school climate, SES, and school type, the neighborhood opportunity structure certainly plays a role in student attitudes as well. Still, some of these effects are captured through the peer engagement variable and potentially through school SES; and school safety since it includes variables for gang and drug activity. Finally, this study fails to capture a causal relationship since there may be unobserved differences between students in terms of motivation and parental influence.

Conclusion

Most large-scale studies of the racial achievement gap focus on general trends rather than high ability students. Yet, the disparities in opportunity and achievement are often the widest at the highest levels of achievement (Harris, 2011). Recent analyses of the racial achievement gap increasingly focus on the importance of school readiness and family resources. As a consequence, policy makers concerned with equity have understandably prioritized early childhood education as a means for ensuring more students enter kindergarten with the requisite prior skills (Heckman, 2011). Although a focus on early childhood resources offers great promise for educational equity, these gains could be squandered away in middle and high school when course tracking becomes more prevalent. It is incumbent on policy makers and school leaders to ensure equitable placement of students into advanced courses and to provide support networks for minority students in White-dominated spaces.

This research supports the notion that there is an opportunity gap within the achievement gap Future research should examine other contextual factors that lead to high ability minority students continuing their success in high school. Specifically, researchers should closely scrutinize the process for how students are placed into advanced courses and investigate the role of minority students having greater numbers of same-race peers in their advanced courses.

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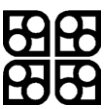

Appendix: List of Composite Variables

Math Efficacy (0.90)	Scale of student's confidence in certain math activities including:
	•doing excellent job on math tests
	•understanding the text book
	•mastering skills in the math course
	•do excellent job on math assignment
Math Identity (0.84)	Scale of student's math identify based on whether:
	•student saw themselves as a math person
	•student's peers saw them as a math person
School Belonging (0.65)	Scale of student's sense of school belonging based on whether:
	•student perceived school to be safe,
	•student was proud of their school,
	•student had an adult at the school who they could talk to about problems
	•student felt that school was a waste of time
	•student thought it was important to get good grades
School Safety (0.88)	Scale of administrator's assessment of his/her school climate based on the frequency of the following activities on campus: conflict, robbery, vandalism, drug use, alcohol use, drug sales, weapons, physical abuse, racial tension, bullying, verbal abuse towards teachers, misbehavior, disrespect towards teachers, and gang activity.
Academic Climate (0.88)	Scale of math teacher's attitudes:
	•teachers' expectations for learning
	•teachers' expectations for teaching
	•believes all students can do well
	•makes clear goals to students
	•works hard to make sure all students learn
	•gives up on some students
	•only care about smart students
	•expect very little from students