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*Black Dads Matter!* Analyzing Ambition, Parent Education, and High Math Achievement

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**Abstract**

The African American Success Foundation called for research on academic brilliance in the STEM fields among African American students. The project was launched to examine the psychosocial composition that predicted African American excellence in mathematics and linked these predictors to social status. Inspired by the Wisconsin model of status attainment, the current study examines the capacity for parental and student academic ambitions to predict exceptional math achievement among African American students. We employ Logistic Regression Models to analyze a sample of 1,058 African American students from the Education Longitudinal Study conducted by the National Center for Education Statistics. Results indicate that (1) student ambitions predict exceptional math achievement, (2) student and parent ambitions have synergistic effects, and (3) these synergistic effects are moderated by the father's education, while the mother's education is less significant. When student ambitions, parent ambitions, and father's education are highest, students were 17 times more likely to score in the highest math quartile than when student ambitions are low, parent ambitions are low and father's education is low. In conclusion, Black students continue to display academic brilliance even in the face of socioeconomic disadvantages. These findings provide some support for the status attainment theory. Moreover, these findings suggest that educating fathers and fostering higher student ambitions are essential to continuing mathematics excellence among Black students.

*Key words:* Black Success, Math achievement, Academic ambitions, Race, Fathers

### **Acknowledgements**

The authors would like to thank the African American Success Foundation and the Lydia Donaldson Tutt-Jones Memorial Research Grant for funding this research project and endorsing the science of African American Success. The Foundation's Board of Directors have displayed remarkable encouragement and unyielding commitment to this cause, and it has inspired Mr. Johnson to devote his life to Black science and champion this vein of research.

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### ***Black Dads Matter! Analyzing Ambition, Parent Education, and High Math Achievement***

Education has been long acknowledged as a key institutional mechanism of social stratification and inequality. The quantity and quality of education are linked to several factors affecting the quality of life for individuals, families, communities, and social classes. Several scholars have linked education to occupation, and thus income and other resources affecting life chances. For instance, Sewell, Haller, and Portes (1969) suggest that academic achievement is linked to the selection of significant others and to educational and occupational aspirations, which are linked to educational and occupational attainment. Because education has become highly important to occupational attainment in modern America, education directly and indirectly affects a host of other outcomes such as health and life expectancy. American society accentuates educational attainment yet is characterized by widespread, historical, and systemic social inequalities; therefore, understanding educational resilience is paramount. Though education is recognized as a key pathway to social mobility, the conditions and destinations of these pathways are not uniform for all people. There are social psychological as well as social structural antecedents to academic achievement (Sewell et al., 1969) that illuminate the inner and hidden mechanisms of educational resiliency. These antecedents place some students at risk of academic failure while protecting others. Yet despite seemingly insurmountable odds, many disadvantaged students continue to obtain academic excellence.

Though education is recognized as a key pathway of social mobility, the conditions and destinations of these pathways are not homogenous for all people. Blau and Duncan (1967) highlighted the importance of class origin in estimating educational attainment. Their work was extended to include the underlying social psychological processes through which social class influences educational attainment (Morgan, 2005). The influence of class is felt both directly and

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indirectly, through its affect on academic achievement –via parental expectations, peer’s educational plans, and interactions with teachers— and academic aspirations. Students internalize messages about the practicality of college from parents, teachers, and peers.

### **Background**

#### **Black Success**

There is a gross deficit of research on high achieving African American students, especially among children who have endured childhood adversity. The African American Success Foundation continues to call for investigations of African American high achievers and the social psychosocial processes behind their brilliance and resilience. African American students continue to challenge the normative deficit characterizations and achieve academic excellence (McGee & Pearman, 2014). The influence of parents and peers on academic achievement, engagement, and achievement values of youth have been examined in White populations while less attention has focused on Black populations (Darensbourg & Blake, 2014). African American youth negotiate dynamic and situational risk and protective factors within multiple contexts to achieve success in the classroom (McGee & Pearman, 2014). It is especially important to study math ability. From grade promotion requirements to the SAT and GRE, mathematics ability is a key *toll* on the roadway to educational attainment, access to higher education, and thus social mobility in modern society. Moreover, college access represents an even more vital opportunity to lift one’s social status. To illuminate the social processes behind educational attainment, scholars must not only focus on test scores, GPA, and other academic outcomes, but also on the orientations that breed these outcomes (Bohon, Johnson, & Gorman, 2006).

### **Student Ambition**

The development of individuals' academic ambitions is largely shaped by the interplay between personal experiences and race, class, and gender socialization (Bohon et al., 2006; Bonilla-Silva, 2004; Hauser & Anderson 1991; Mickelson, 1990; Morgan, 2005). They operate at the school-level (Cater, 1999; for statewide policy effects see Lloyd, Leicht, & Sullivan, 2008), community-level, and family-level (Al-Fadhli & Kersen, 2010; Cater, 1999; Smith-Maddox, 2000). Status attainment theory proposes that academic ambition formation occurs early and is adopted based on family background and social influences that produce a static mental construct, while Bayesian learning theory posits that students mostly adapt their educational expectations to new information about their academic possibilities. Comparing these models, Andrew and Hauser (2011) find that student ambitions are not derived from a static mental construct and nor are they adapted, other than modestly, to large changes in academic performance. This suggests that adolescent educational expectations are not exclusively adopted or adapted, but rather they stabilize early and endure overtime. Bozick and colleagues (2010) posit that family based socialization processes contributed to social reproduction through children's educational expectations, but the process begins much earlier and incorporates factors beyond the scope of the original status attainment models. Some frameworks propose that ambition declines in postsecondary years for disadvantaged youth and those who attend community college, but Alexander and colleagues (2008) find that among disadvantaged students, ambitions are not "cooled out" by college, and two-year college attendance may actually fuel ambition.

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The Wisconsin status attainment model illuminates *student ambition* as a significant process underlining educational attainment. Ambition, whether measured by *aspirations* or *expectations* have notable impact on various measures of academic achievement (Bohon et al., 2006). Studies have shown that student academic ambitions predict student effort and achievement (Domina, Conley & Farkas, 2011). However, some scholars have found evidence of the so-called attitude-attainment paradox among Blacks (Antonio, Buttaro, & Battle, 2010), referring to the gap between student academic ambitions and actual achievement, while others provide evidence that dispute these claims (Downey, Ainsworth, & Qian, 2009). Despite these contentions, considerable evidence suggests that higher student ambitions predict higher achievement (Zhang et al., 2011). Based on this body of research, *we hypothesize that students with high academic ambitions will have a higher likelihood of exceptional math achievement* (Hypothesis 1).

### **Parental Ambitions**

Parenting dynamics are critical factors influencing academic success for African American children, especially those exposed to adversity (Burchinal, Roberts, Zeisel, & Rowley, 2008; Butler-Barnes, Chavous, Hurd, & Varner, 2013). Status attainment theory and recent research has shown that parent academic ambitions for their children influence student performance (Zhang et al., 2011). Thus, *we hypothesize that students whose parents have high academic ambitions for them will have a higher likelihood of exceptional math achievement* (Hypothesis 2).

### **Parent-Student Ambitions**

Understanding the influence of parents is the gateway to understanding the intergenerational connections between cognitive and non-cognitive traits and a student's educational ambitions (Kim, 2012). Kirk and colleagues (2011) found that parental ambitions predict adolescent ambitions, and parents reported high ambitions for their children despite low levels of personal educational attainment (Goyette & Xie, 1999). However, Cheng and Starks (2002) found that the influence of parent and student academic ambitions varied by race and ethnicity.

Zhang and colleagues (2011) suggest that there are reciprocal relationships between parent and adolescent ambitions, and also between parent ambitions and adolescents' academic achievement. Further, several scholars, including Hao and Bonstead-Bruns (1998) found that higher shared (student and parent) ambitions enhance achievement and greater differences suppress achievement. Therefore, *we expect to observe a student-parent interaction in which the positive effect of high student academic ambitions on exceptional math achievement will be amplified for students whose parents have high levels of academic ambitions for them* (Hypothesis 3).

### **Academic Determinants**

Parent education is another well-established predictor of achievement. The mother's education (Gutman, Sameroff, & Eccles, 2002) and father's education (Mastern & Marayan, 2013) have been said to have a distinct positive impact on a student's educational attainment, though further attention needs to be paid to father's education.

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Several other family level factors affect educational outcomes including family income (Mastern & Marayan, 2013; Orr, 2003), family structure, school mobility (Gasper, DeLuca, & Estacion, 2012), and sibling dropout (Gutman et al., 2002). Family income and to a lesser extent wealth, have been studied extensively and consistently found to predict academic achievement (Mastern & Marayan, 2013; Gonzales, Cauce, Friedman, & Mason, 1996; Gutman et al., 2002; Orr, 2003). Likewise, the effects of family composition and marital status vary by SES and context, but remain significant factors (Gonzales et al., 1996; Gutman et al., 2002; Orr, 2003). School or residential mobility, excessive or mild, has significant risk potentials for student achievement (Grigg, 2012). Siblings are a critical component of family level determinants affecting an individual's achievement, with sibling dropout having deleterious effects on the probability of success (Thomas, 2012).

At the individual-level, gender and grade retention are critical academic determinants. Female gender is associated with lower achievement (Muller, 1998; Penner & Paret, 2008), particularly math performance. Grade retention has significant, long term negative effects on educational outcomes (Hughes, Kwok, & Im, 2013; Stearns, Moller, Blau & Potochnick, 2007).

### **Ambitions and Parent Education**

The impact of socioeconomic factors on student achievement may vary for different racial or ethnic groups (Kerckhoff 1976; Kerckhoff & Campbell 1977). For instance, research suggests that SES may be less significant (Kerckhoff, 1976) and neighborhood resources may be more significant in influencing achievement outcomes for minority students (Furstenberg, Cook, Eccles, Elder, & Sameroff, 1999; Herman, 2009). Kerckhoff and Campbell (1977) posited that the original Wisconsin model did not fit a sample of black students well and suggested that

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previous school achievement, fatalism, mother's education, and disciplinary records were more central than father's education in predicting attainment among Blacks (also see Herman, 2009). Carpenter (2008) finds that among Latino 12<sup>th</sup> graders of immigrant parents, parental expectations and aspirations were not significant predictors of student achievement after controlling for an index of covariates; neither were student expectations, agreement between student and parent expectations, or student perceptions of parental ambitions.

These contentions require further insight into how significant others' and parent education affect achievement among African Americans. However, due to the substantial amount of research highlighting the importance of parent education, *we expect to observe a three-way interaction in which the synergistic effects of high student and parent academic ambition on math achievement will be amplified for students whose parents have high levels of education* (Hypothesis 4).

### **The Current Study**

Inspired by the Wisconsin model of status attainment, the current study advances the literature by examining the factors that predict exceptional mathematics performance among a national representative sample of African American students, assessing the individual and synergistic effects of student and parent ambitions, and analyzing whether the synergistic effects are moderated by parent education. We anticipate finding that higher student and parent academic ambitions will increase the likelihood of high math achievement, and the impact of student ambitions will be amplified for students whose parents also have high academic ambitions. Lastly, we anticipate finding that the synergistic effects of student and parent ambition on math achievement will be moderated by parent education.

## Methods

### Data and Sample

The larger data collection project, the Education Longitudinal Study (Ingels et al., 2012; Ingels, Pratt, Rogers, Siegel, & Stutts, 2014) conducted by National Center for Education Statistics in 2002, contains a national representative sample of 750 schools and over 15,000 students and their parents. The ELS was designed to provide trend data about critical transitions experienced by students as they proceeded through high school and into higher education or the workforce. The 2002 sophomore cohort was followed throughout secondary and postsecondary years to collect policy-relevant data pertaining to predictors of success in education and the workforce. The weighted response rates were 84% - 89%. In accordance with the grant stipulations from the African American Success Foundation and to address the limitations in the research (Darensbourg & Blake, 2014), we exclusively analyze the subsample of African American or Black students. This study is not concerned with comparing African Americans to other ethnic or racial groups. We analyzed all students who completed the base year questionnaire in their sophomore year, completed the two-year follow-up and had scores on the standardized math assessment. Likewise, we excluded those who did not have scores on the standardized math assessment and whose missing data were un-retrievable. Missing data were managed using multiple imputations and list-wise deletion methods when the nature of missingness was unknown. This inclusion criterion produced a subsample of 1,053 African Americans.

## Measures

**High math achievement.** High math achievement is superior performance on a standardized math assessment, which we define as scoring in the highest quartile. It is operationalized via a dichotomous variable representing students' scores on a standardized math test completed their senior year of high school. It ranges from (0) "Lowest – third quartile" to (1) "Highest quartile".

**Student and parent ambitions.** The key independent variables are student academic ambitions and parent academic ambitions; we refer to these variables as ambitions. *Student ambitions* are also measured via a 4-item ordinal variable. It reports the highest level of education the students think they will obtain. Correspondently, it is treated as a continuous measure ranging from (0) "High school diploma", to (3) "MA, PhD, MD, or other advanced degree". *Parental ambitions* are operationalized via a 4-item ordinal variable that captures the highest level of education the parents want the 10<sup>th</sup> grader to achieve. It ranges from (0) "High school diploma", to (3) "MA, PhD, MD, or other advanced degree".

**Parent education.** Parent education measures the highest level of education attained and it is unbundled into *mother's education* and *father's education*. *Mother's education* is an ordinal variable that is treated as a continuous measure. It is coded (0) High school diploma or less, (1) "Associate of Arts, two year degree, or some college", (2) "BA or four-year college degree", and (3) "MA, PhD, MD or other advanced degree". Likewise, *father's education* is treated as a continuous measure and coded (0) "HS diploma or less", (1) "Associate of Arts, two year degree, or some college", (2) "BA or four-year college degree", and (3) "MA, PhD, MD or other advanced degree".

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**Academic determinants.** We control for four family-level variables that influence student achievement, including family income, family composition, school mobility, and sibling dropout. *Family income* is a 13-item ordinal variable that we treat as a continuous measure. It ranges from (0) “no income” to (13) “200,001 and more”. *Family composition* is a dichotomous variable that ranges from (0) “two parents or guardians”, to (1) “a single parent or guardian”. *Family/school mobility* is a dichotomous variable that reports the number of times the student changed schools in the past two years. It is coded (0) “0-1”, and (1) “2 or more”. *Sibling dropout* is a dichotomous variable that reports whether or not the student has a sibling who has dropped out of high school. It is coded (0) “no”, and (1) “yes”. In addition to family-level factors, we control for two individual-level demographic variables, gender and grade retention. *Gender* was reported as a dichotomous variable coded (0) “male”, and (1) “female”. Grade retention serves as a proxy for prior achievement. It is operationalized via a dichotomous measure coded (0) “has not repeated a grade from K-10”, and (1) “repeated one or more grades from K-10”.

### **Analytic Strategy**

We estimated descriptive statistics for all variables in the models, including frequencies, means, and standard deviations. We set the alpha level for statistical significance at .05. This means that the p values must be less than .05 to be confident that the findings are not due to chance (Institute for Digital Research and Education, 2007). We estimated cross tabulations and chi square tests to analyze bivariate relationships, conduct pre-estimation diagnostics, and describe the population. Then, we estimated multivariate logistic regression models to test the hypotheses. Logistic regression estimates an odds ratio (OR), which is a measure of association between an exposure and an outcome, in this case, scoring in the highest math quartile. The OR

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represents the odds that an outcome will occur given a particular exposure, compared to the odds of the outcome occurring in the absence of that particular exposure (Szumilas, 2010; for help interpreting odds ratios, see the Institute for Digital Research and Education, 2007). In order to interpret the product-term models, we estimated the marginal odds of each interaction, converted the marginal odds to odds ratios, and plotted the odds ratios to graphically illustrate the findings.

## Results

### Descriptive Statistics

In analyzing the prevalence of adversity, we find that 25% of the sample was raised in low-income households (M= \$25,001- \$35,000) and 44% lived in single parent households. Moreover, 25% changed schools three or more times (39% changed schools two or more times), 16% had a sibling who dropped out of high school, and 15% repeated a grade. About 20% of the students had one or more parents without a high school diploma and 60% had parents without a college education. Despite these levels of socioeconomic adversity, outstandingly, nearly 60% of parents aspired for their child to obtain an advanced degree while less than 6% wanted their child to obtain less than a college degree. Roughly 85% of students expected to obtain a college degree and 43% of them expected to go on to obtain an MA, PhD, MD, or some other advanced degree. About 10% of the sample scored in the highest quartile on 12th grade math achievement and 52% of the students were female. See Table 1 on page 26 for the descriptive statistics for all variables in the sample.

### **Multivariate Logistic Models**

The results from five multivariate logistic regression models predicted the probability of scoring in the highest quartile on math assessments in 12th grade are shown in Table 2 on page 27. Model 1 estimates math achievement by parent education while controlling for academic determinants ( $F= 8, 93; p < .001$ ). Father's education ( $OR= 1.45; P < .01$ ), family income, ( $OR= 1.24; P < .01$ ), school mobility ( $OR= .59; P < .05$ ), female ( $OR= .61; P < .05$ ), and grade retention ( $OR= .08; P < .05$ ) predicted math achievement, while unexpectedly the mother's education, family structure, and sibling dropout had no effect. For a 1-unit increase in the father's education, on average students were 1.5 times more likely to score in the highest quartile on the 12th grade math assessment; and when the father's highest education level is an advanced degree, they are three times more likely to score in the highest quartile than when the father's highest education level is high school or less.

Model 2 of Table 2 estimates the effects of student and parent ambitions in 10th grade and the likelihood of scoring in the highest quartile on math achievement in 12th grade while considering academic determinants and demographic variables ( $F= 10, 113; p < .001$ ). Father's education ( $OR= 1.37; p < .01$ ), family income ( $OR= 1.21; p < .01$ ), school mobility ( $OR= .60; p < .05$ ), gender ( $OR= .48; p < .01$ ) and grade retention ( $OR= .09; p < .05$ ) remain statistically significant. Student academic ambitions significantly predicted the probability of high math achievement ( $OR= 2.09; p < .001$ ), while parent ambitions for the student had no effect. For a one-unit increase in student ambitions in 10th grade, on average, students were two times more likely to score in highest quartile on the 12th grade math assessment; when the student ambitions to obtain an advanced degree, they are nearly six times more likely to score in the highest quartile than when their highest academic ambition is for a high school diploma or less.

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The estimated product-term models, estimating two-way and three-way multiplicative interactions between student's ambitions, parent ambitions and parent education, are displayed in Models 3 through Model 5. In Model 3, the two-way interaction between student and parent ambition was significant ( $F= 11, 118, p < .001$ ;  $OR=1.79, p < .01$ ), indicating that student ambitions are moderated by parent ambitions; when both are high, they have synergistic effects on achievement. Students with high ambitions are nearly twice as likely to obtain exceptional math achievement when their parent ambitions are highest than when their parent ambitions are lowest. We converted the marginal odds to odds ratio, by dividing the marginal odds by the baseline (the baseline values are the student and parent ambitions at the lowest level), then used a bar graph to visually display the odds ratios (see Figure 1 on page 28).

In Model 4, the three-way interactions between student ambition, parent ambition and mother's education had no effect on achievement. However, in Model 5, the three-way interaction between student ambition, parent ambition, and father's education was significant ( $F= 11, 126, p < .001$ ;  $OR=1.18, p < .001$ ), indicating that the synergistic effects of student and parent ambitions are moderated by father's education. We plotted the marginal odds in Figure 2 on page 29, converted the odds to odds ratio (dividing marginal odds by the baseline), and then used bar graphs to display the odds ratios (See Figure 3 on page 30). When student ambitions, parent ambitions and father's education are highest, the probability of high math achievement is 2.6 times more likely than when ambitions are high and father's education is lowest, and 17 times more likely than when ambitions and father's education are lowest. See Figure 1 on page 28 for graphic illustrations of the significant interaction effects.

### **Conclusion**

The purpose of this study was to provide further insight into African American exceptional math achievement. We analyzed the prevalence of adversity, and the capacity for individual and parental academic ambitions to predict exceptional math performance among African American high school seniors.

Despite relatively high levels of adversity, students and their parents had high academic ambitions for their academic future. Rather than questioning the sincerity and rationality of Black students' academic ambitions, as insinuated in the 'attitude-achievement paradox' arguments, researchers should venture beyond the individual-level to examine institutional effects such as the 'school-to-prison pipeline' and how schools divert young Black students away from high rates of academic ambition to high rates of incarceration. Also, further research must investigate the early academic consequences of race-based mass incarceration and disproportionate minority contact with law enforcement (the black skin-to-prison pipeline and the poverty-to-prison pipeline). These factors are critical for understanding how Black ambition may be disrupted.

We argue that Black academic ambition at the individual and parental-level would yield a higher likelihood of exceptional math performance, and when student and parent ambitions are both high, it would yield synergistic effects. We find that students with ambitions to obtain an advantaged degree are five times more likely to have exceptional math scores than students with ambitions to graduate from high school. Parent ambitions had no main effects on math achievement. However, when student ambitions are high and their parent ambitions are high, they are 1.5 times more likely to score in the highest math quartile than when student ambitions

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are high and their parent ambitions are low. These results provide some support for the Wisconsin models, but further research is required to examine the underlining processes.

We also hypothesized that the synergistic effects of parent-student interaction would be amplified for students whose parents had high levels of education. Because of the centrality of women in the Black communality, we anticipated that the mother's education would have a more potent effect than the father's. Unexpectedly, the evidence suggests mother's education did not moderate the individual or the synergistic effects of student and parent ambitions on math achievement. However, we find that father's education significantly moderated the individual and combined effects of student and parent ambition on math performance, amplifying the effect when fathers have a higher level of education. When student ambition, parent ambition, and father's education is highest, the likelihood of exceptional math achievement is 2.6 times more likely than when student and parent ambitions are high but father's education is lowest. Likewise, when student ambitions, parent ambitions, and father's education are highest, students are 17 times more likely to score in the highest math quartile than when student ambitions are low, parent ambitions are low and father's education is low. Plainly stated, the results of these analyses suggest Black dads matter! Whether they are present in the household or not, when it comes to math performance, father's education significantly influences the student's likelihood of exceptional math performance. Despite the centrality and immeasurable influence of Black mothers, when it comes to exceptional math performance, the data presented in this study suggest that Black father's are critical.

These findings draw closer attention to the role of institutional racism (Bonilla-Silva, 2004), particularly in schools and the criminal justice system that fuels the disproportionate incarceration of Black males (Alexander, 2010). These racial injustices and pipelines to prison

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may have intergenerational effects, impacting fathers and daughters, and so on because they diminish a child's life chances by withdrawing the father's role in fostering Black brilliance in mathematics. Therefore, if NSF desires to promote minority achievement in the STEM fields, perhaps the best route may be to fund the Black Lives Matter movement, and other agendas to combat institutional racism in the criminal justice system.

From a developmental framework, this study is a flash-forward analysis of how family dynamics shape exceptional student achievement in adolescence. Because these data do not allow us to investigate the preceding processes in early childhood that foster high ambitions in Black families, this study requires prequel analyses to complete the narrative. Further research should examine how increased student ambitions influence achievement growth overtime. A larger sample size could strengthen the study, as well as a multilevel design to examine how ambition is influenced by the institutional and community contexts (see Cater, 1999; Frost, 2007). In the end, we present these results with extreme caution and sensitivity toward diverse family structures and arrangements. In stating "Black dads matter", we do not endorse heteronormative ideologies nor do we profess the particular gender or characteristics of the person occupying these roles; but rather we seek to illuminate the evidence in these data suggesting the importance this role and link these findings to structural forces and social activism.

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## Tables and Figures

Table 1. Descriptive Statistics

Variable	N	Mean	SD	Min	Max
<i>Math achievement in 12<sup>th</sup> grade</i>					
Highest quartile	1,058	.09	.29	0	1
<i>Academic Ambitions</i>					
Parent ambitions	1,058	2.5	.70	0	3
HS diploma or less (2%)					
AA or some college (5%)					
College degree (34%)					
Advanced degree (59%)					
Student ambitions	1,058	2.2	.84	0	3
HS diploma or less (6%)					
AA or some college (10%)					
College degree (41%)					
Advanced degree (43%)					
<i>Family determinants</i>					
Mother's education	1,058	.92	.88	0	3
HS diploma or less (36%)					
AA or some college (42%)					
College degree (15%)					
Advanced degree (7%)					
Father's education	1,058	.90	1.0	0	3
HS diploma or less (45%)					
AA or some college (29%)					
College degree (16%)					
Advanced degree (10%)					
Family income (8= \$35,001-\$50,000)	1,058	8.1	2.6	0	12
Single parent household	1,058	.44	.50	0	1
School mobility	1,058	.39	.49	0	1
Sibling dropout	1,058	.16	.37	0	1
<i>Individual determinants</i>					
Female	1,058	.52	.50	0	1
Repeated a grade K-10	1,058	.15	.35	0	1

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Table 2: Multivariate Logistic Analysis of Academic Determinants, Ambition and Math Achievement Among Black Juveniles.

Highest Math Quartile in 12 <sup>th</sup> Grade	Model 1		Model 2			
	OR	SE	OR	SE		
<i>Academic ambitions</i>						
Student ambitions			2.09***	.42		
Parent ambitions			1.23	.28		
<i>Family determinants</i>						
Mother education	1.24	.17	1.19	.17		
Father education	1.45**	.17	1.37**	.16		
Family income	1.24**	.08	1.21**	.08		
Single parent household	1.00	.26	.98	.26		
School mobility	.59*	.14	.60*	.14		
Sibling dropout	1.77	.58	1.82	.61		
<i>Individual determinants</i>						
Female	.61*	.14	.48**	.11		
Repeated a grade K-10	.08*	.08	.09*	.09		
Constant	.00***		.00***	.00		
Chi-square	(8) 93***		(10) 113***			
Log likelihood/Pseudo R <sup>2</sup>	-284/.14		-275/.17			
	Model 3		Model 4		Model 5	
	OR	SE	OR	SE	OR	SE
<i>Interactions</i>						
Student x Parent Ambition	1.79**	.40				
Ambitions x Mother's Educ.			1.06	.05		
Ambitions x Father's Educ.					1.18***	.06
Chi-square	(11) 118***		(11) 114***		(11) 126***	
Log likelihood/Pseudo R <sup>2</sup>	-271/.18		-274/.17		-268/.19	

N= 1,058

Note: \*= p< .05; \*\*= p< .01; \*\*\*= p< .001; OR = odds ratio; SE = standard error.

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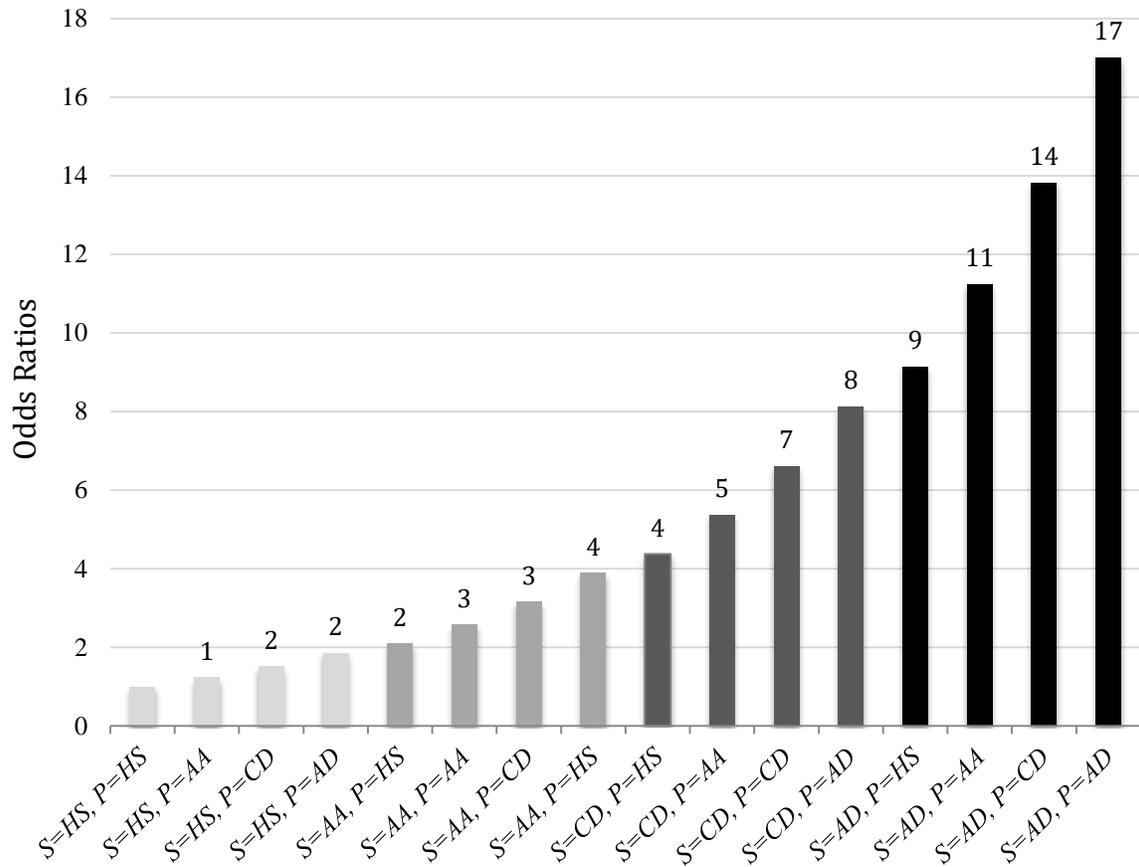


Figure 1. The Odds Ratios of Exceptional Math Achievement for the two-way interaction between student ambitions (S), and parent ambitions (P) while controlling for all predictors in the model. HS= high school, AA= AA degree, CD= college degree, and AD= advanced degree. Students are 17 times more likely to score in the highest math quartile when student and parent ambitions are both highest, than when student ambitions and parent ambitions are both lowest.

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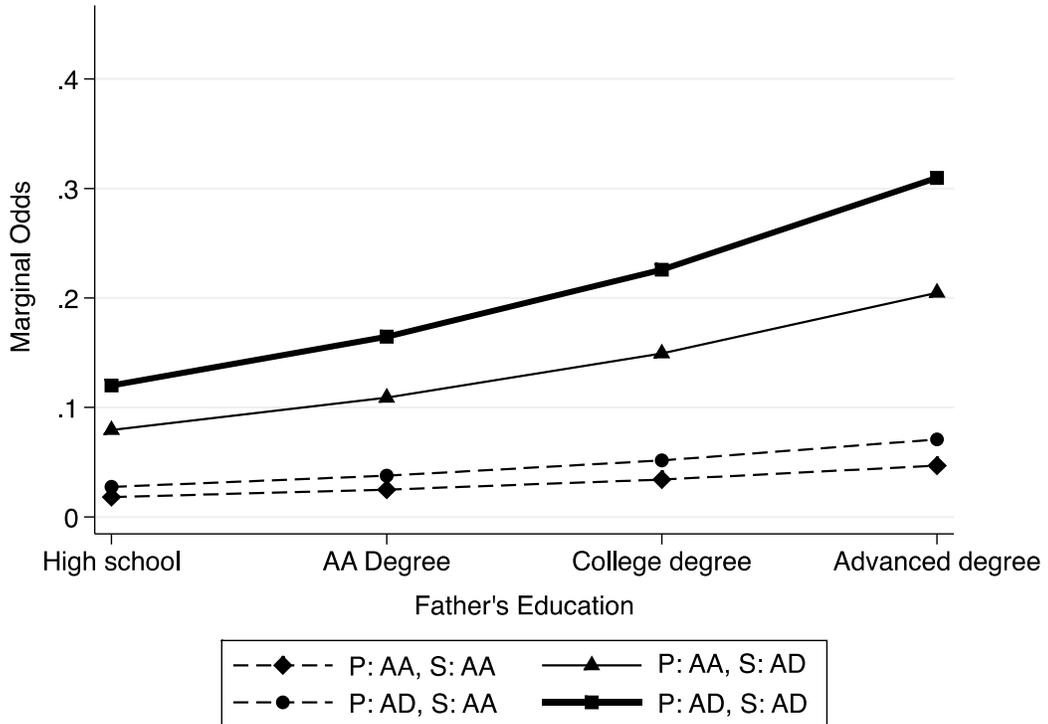
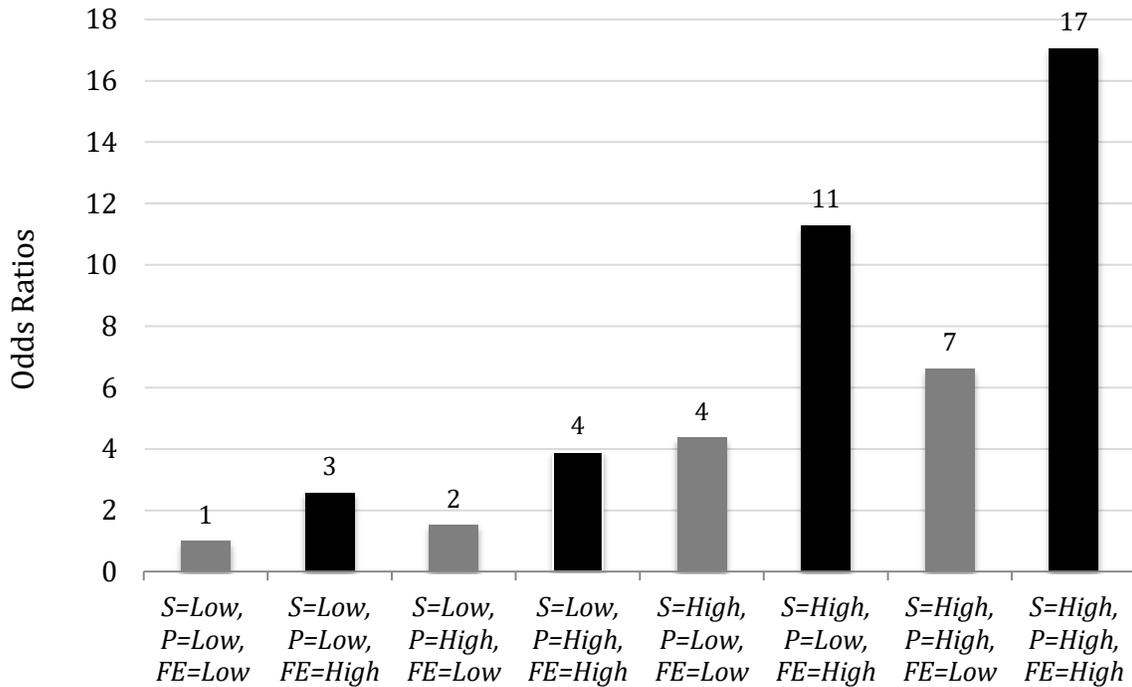


Figure 2. Marginal Odds of Exceptional Math Achievement for the three-way interaction between student ambitions (S), parent ambitions (P), and father's Education (FE) while controlling for all predictors in the model. AA= AA degree or some college, AD= MA, PhD or other advanced degree.



**Three-Way Interaction**  
 Student and Parent Ambitions by Father's Education

Figure 3. Odds Ratios of Exceptional Math Achievement for the three-way interaction between student ambitions (S), parent ambitions (P), and father’s Education (FE) while controlling for all predictors in the model. Low ambitions= AA degree or some college, High Ambitions= MA, PhD or Advanced degree; Low education =High school or less, High Education= MA, PhD or Advanced degree. Students are 17 times more likely to score in the highest math quartile when their ambitions are high, their parent ambitions are high, and their father’s education is high, than when student ambitions, parent ambitions, and father’s education are all low.

Appendix

Table A1. Marginal odds for the three-way interaction between student ambition, parent ambition, and father's education.

	Margin (Odds)	SE	z	P> z	CI	
S=Low, P=Low, FE=Low	.02	.01	2.15	.03	.00	.03
S=Low, P=Low, FE=High	.05	.02	1.95	.05	.00	.09
S=Low, P=High, FE=Low	.03	.01	2.56	.01	.01	.05
S=Low, P=High, FE=High	.07	.03	2.43	.02	.01	.13
S=High, P=Low, FE=Low	.08	.03	2.27	.02	.01	.15
S=High, P=Low, FE=High	.20	.10	2.11	.04	.01	.40
S=High, P=High, FE=Low	.12	.03	4.34	.00	.07	.17
S=High, P=High, FE=High	.31	.07	4.27	.00	.17	.45