Am I Rich Enough to do Well in Math?
Math Test Scores and Socio-Economic Status

A Thesis

By

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I have examined the final copy of this Thesis for form and content and recommend that it be accepted for the degree of Master of Arts with a major in Sociology.

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We have read this Thesis and recommend its acceptance.

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ABSTRACT

This study investigated the relationship between math test scores and social economic status (SES). The model for this study was separated into three parts: student role performance (SRP), school, and family model segments. SES was divided into three categories: low, mid, and high SES. This study used the data from the Educational Longitudinal Study of 2002 (ELS). It was found that students with a higher SES have higher math test scores. It was also found that for large families of low and mid SES, students scored lower on their math test scores. Further study is needed to determine which aspects of SES have the greatest effect on math test scores.

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1. Introduction

In 2002, President Bush signed the No Child Left Behind (NCLB) Act into law (U.S Department of Education, 2002). NCLB instituted new rules of accountability for the academic achievement of students broken down into state, district, school, and individual student levels. Through greater accountability, states are hoping to close the achievement gaps and ensure all students, including disadvantaged students, attain academic achievement. The measure of accountability is yearly testing by each state (U.S Department of Education, 2002). Testing determines how school boards allocate funds, how well individual teachers teach, and how well the students are learning. Higher test scores and parental socio-economic status (SES) determines a student's access to better and more prestigious schools and greater opportunities for education while lower test scores and low SES restrict students to less prestigious institutions. If SES has an impact on access to learning institutions and a student's chances for success, does it have an affect on a students test scores? In particular, does SES have a significant effect on math test scores? To illustrate the importance of math test scores consider Turner and Bowen (1999) findings that students' who major in engineering, mathematics, and physical sciences as opposed to other fields, have higher SAT math scores and that students are more likely to major in humanities if they score high on the verbal section of the SAT and low on the math section. This has a strikingly apparent effect when looking at the income after the first year of employment of students graduating with a bachelor's degree in engineering as compared to a student graduating with a degree in education. Those students who graduate with an engineering degree earn 40 percent more than those with an education degree (National Center for Educational Statistics, NCES, 1991). This highlights the importance of math test scores on future income.

The literature review will focus on three main areas affecting math test scores: student role performance (SRP), school structure, and family structure. The SRP section will look at gender, race, homework, extra curricular activities, the number and type of math courses a student takes, student disabilities, and at-risk behavior. The school section covers class size, teacher quality, public versus private schools, low-income schools, and curriculum differentiation. Finally, the family section will cover one versus two-parent households, parental education, Family SES, cultural capital, family size, and parental monitoring. The SRP section endeavors to show that the more time a student studies there will be an increase in student math test scores and that the more disabilities a student has will decrease math scores. The school section seeks to show that an increase in college prep classes increases math scores and that students' in private schools have better math scores than those in public schools. It is argued in the family section that an increase in SES increases math scores; and that larger families lower math scores. The data for this study are from the Education Longitudinal Study of 2002 (ELS).

2. Literature Review

2.1 Student Role Performance

Student role performance measures how well students fulfill their obligation in meeting teacher, school, state, and national government expectations. Test scores usually measure student role performance, but SRP also includes gender, race, homework, extra curricular activities, the number and type of math courses a student takes, student disabilities, and at-risk behavior.

Ramos (1996) found that in the elementary and early middle school years that there is no difference between boys and girls on standardized tests, but that girls may be slightly better in mathematics. During these school years, boys and girls attitudes towards math are roughly the same ("Gender Gap," 1993; Sheehan and Gray, 1992). It is not until late middle school and high school years that girls' attitudes become more negative towards mathematics. At this time a math test achievement gap begins to appear where boys do better than girls. This difference in test scores is not seen in their classroom work ("Gender Gap," 1993; Sheehan and Gray, 1992).

Mathematics performance differs between different racial groups. Asian students do better than all other groups followed by white/Caucasians, then Hispanics (Kimball, 1996), and African Americans last (Lockhead, Thorpe, Brooks-Gunn, Casserly, and McAloon, 1985). Campbell, Hombo, and Mazzeo in the 1999 *National Assessment of Educational Progress* (NAEP) report note that the overall achievement gap for whites and blacks has closed though whites still outperform blacks. They also noted that whites do better than Hispanics in each subject area of the NAEP, while in math tests Hispanics have been narrowing the achievement gap (Campell, Hombo, and Mazzeo, 2000). In comparison, the gender gap is smaller than the racial/ethnic gap (Campell, Hombo, and Mazzeo, 2000).

The 1999 NAEP found that for older students anytime spent on homework has a positive achievement outcome; this is not found for younger students (Black, 1996). For both thirteen and seventeen year olds studied in the NAEP, it is found that any time spent on homework increases reading test scores; specifically, students who spend two hours did better than those who spend one hour or less on homework. In seventeen year olds, the more time spent on math homework increased math test scores (Campell, Hombo, and Mazzeo, 2000).

Extracurricular activities also affect how well students achieve in school. Broh (2002) found that participation in high school athletics had positive affects on students' achievements and on standardized math tests. Broh also found that different types of sports activity have different affects on student academic achievement. He found that interscholastic sports had the greatest positive effects on achievement, followed by music participation. Academic benefits from student government, drama clubs, and journalism had limited effect on achievement, whereas some extracurricular activities can have negative effects on achievement (e.g., intramural sports and vocational clubs). Broh argues that students who participate in interscholastic sports receive the greatest benefit by enlarging their social network and developing skills that promote educational success (Broh, 2002). He further states that other extra curricular activities might increase achievement outside of high school (Broh, 2002). Activities outside of school and school-related activities have an effect on scholastic performance. While not studied in the context of math test scores, it has been shown that students who read for fun, show general increase in reading test scores across all ages (Campell, Hombo, and Mazzeo, 2000).

The studies on the effect of television on academic achievement have not come to a definitive conclusion (Paik, 2000). For high school students, some findings indicate a negative correlation between watching TV and academic achievement[1] (Keith et al., 1986; Gaddy, 1986; Potter, 1987, Thompson, 2003). While other studies have found there is a curvilinear effect on academic achievement. That is, a small amount of time

[1] However, Potter findings showed a nonsignificant negative effect of television on academic achievement.

spent watching television increases achievement but at some point as television time increases achievement decreases (Neuman, 1988; Paik, 2000). When Neuman (1988) considered high school students only, there is a negative correlation. While Paik (2000) who only studied high school students found a curvilinear correlation.

Campell, Hombo, and Mazzeo (2000) found for thirteen and seventeen year olds that the type and amount of math courses taken affects the overall math score on the NAEP. For seventeen year olds, there has been an increase in taking math courses and an increase in the highest level of courses taken. This increase of math courses and highest level taken has occurred in whites, blacks, and Hispanics, but whites are taking higher proportions of higher-level math courses.

There are not much data on how students with disabilities perform on standardized math tests (Rousso, 2001), but what data there are show students with disabilities do not perform as well as those without (US Department of Education, 1999). Both gender and race gaps have been found within students with disabilities. White students outperformed students of color, and boys did better than girls (US Department of Education, 1999).

At-risk behavior can affect achievement on math test scores. According to Mandrell, Hill, Carter, and Brandon (2002) there is a significant decrease in academic achievement when students engage in substance use and violence/delinquency than those who had little involvement with those behaviors. In high school students, substance abuse directly affects math scores, while violence/delinquent behavior did not directly affect math scores (Mandrel, et.al., 2002). It has also been shown that students in grades

2 through 5 who do not have discipline problems score significantly higher on both math and reading test scores (Peterson and Howell, 1999).

2.2 School

Schools provide the institutional context in which students perform SRP. These institutionalized contexts can affect SRP either by accelerating achievement or providing barriers. School factors include student-teacher ratio, teacher roles, public versus private schools, school funding, and curriculum differentiation.

Over the past several decades, class size has become an important issue for American schools. The average class size for a U.S. classroom is 25 students (Leonard, 2000). Smaller classes have students who do better academically (Pate-Bain, Achilles, and others, 1992) and have less discipline problems than classes of regular size (Lapsley and Daytner, 2001). Tennessee's Project Star class size reduction initiative defined a small class as 13 – 17 students (Leonard, 2000). The students in small classes did better than those in regular-size classes. Students from impoverished economic backgrounds who are low-achievers have shown the greatest improvement when class size has been reduced (McRobbie and Finn, 1998; Illig, 1996). Research has shown that having reduced class sizes in the early grades leaves lasting benefits to students as they move through their academic careers (Leonard, 2000). In Tennessee, math and reading scores in eighth grade show evidence of the gains of small classes in the early grades (Nye, Hedges and others, 1999). While many studies that support class size reduction there are others that question its effectiveness. Hanushek (1999) illustrates this by examining student-teacher ratios over that last half century and looking at international class size in light of academic achievement. Looking at data from the National Center for Education

Statistics, Hanushek found that there has been a 35% reduction in class from 1950 to 1995. Comparing this to with data found from the NAEP starting at 1970 up to 1996, the performance of 17-year old students showed little difference over this period. Hanushek (1999) examined the effect of class size internationally using the 1995 Third International Mathematics and science study. Hanushek (1999) found a positive relationship between student-teacher ratio among eighth-grade math and science students in 17 nations.

Student performance in private schools versus public school has caught the interest of policy-makers and concerned parents (Coleman, Hoffer, and Kilgore, 1982). Catholic high schools have outperformed public schools in reading, vocabulary, and basic mathematics, even after controlling for differences in family background (Coleman, Hoffer, and Kilgore, 1982). The difference in performance in the Catholic schools is a result of better discipline and better instruction (Coleman, Hoffer, and Kilgore, 1982).

Low-income schools affect student achievement. It has been shown that an increase in spending in specific areas has a positive effect on poor and minority students. Eighty-six percent of forty-nine states have school districts with the greatest concentration of poor children receiving less money per student than districts with the least number of poor students. This was found to be true for districts serving the greatest amount of minority students versus those serving the least amount (Education Trust, 2001). Mathematics scores for students who are not eligible for free/reduced price lunch scored higher than average (Lutkus and Weiner, 2003). The Food Research and Action Center reported that 27.8 million children participate in the National School Lunch Program (NSLP). Of those who participated in the NSLP, 57.5 percent receive free/reduced lunch (FRAC, 2003). MacIver and Epstein report that schools are not as likely to offer programs, such as extensive remedial courses, advanced courses, or programs that promote higher-order learning, if they are serving low-income and minority students (1990).

Curriculum differentiation groups students into classes by ability level. It is sometimes referred to as ability grouping, streaming, or tracking. Terwel (2005) describes curriculum differentiation as a "zero-sum game." Both high and low achieving students were affected by curriculum differentiation. There is a positive effect on high achieving students in the high track and negative effect on low achieving students in the low track (Dar and Resh, 1994; Terwel, 2005).

2.3 Family

The family is where children first begin to learn values and what is expected of them. Children learn either through direct instruction from their parents or from observation of their parents. The family part of the model refers to how the family environment affects a child's achievement. The family environment includes one- or two-parent households, the number of siblings, or socio-economic status to name a few.

Family structure plays an important part of a child's academic achievement, though there is debate among the literature as to how and what role family structure plays. Some have found it plays a significant role in educational outcomes (see Ermisch, and Francesconi, 2001; Case, Lin, and McLanahan, 2001; Everhouse and Reilly, 2004) while others have not (see Björklund and Sunström, 2002). Ginther and Pollak (2004) define two-parent families in two different ways. The traditional nuclear family is where all children are children of both parents and the blended family is made up of stepchildren and/or joint children of both parents. Stepchildren and children from single parent households have lower academic achievement than those from traditional nuclear families (McLanahan and Sandefur, 1994). It is also worth noting that Ginther and Pollack (2004) found that there was not any significant effect on achievement for children living in single-parent homes when income was controlled for. Ginther and Pollack (2004) found that academic achievement between children from traditional nuclear families and stable blended families significantly favor children from traditional nuclear families. The authors suggest several possible explanations for these differences. First, family structure may be a catch all for other unaccounted for factors; second, blended families are more stressful; third, allocation of time and resources, and last, heterogeneity introduced by researchers. They also found that within stable blended families that there was not any difference in achievement between joint children and stepchildren.

Parental educational attainment also affects their children's test scores. In general, the higher a parent's education is results in their children having higher assessment scores than average. Campell, Hombo, and Mazzeo (2000) account for this effect by citing that parents with more education have more ability to help with homework and are more likely to have better attitudes towards education. Children of ages 9 and 13 years old, whose parents have some education after high school, have an overall increase in test scores (Campbell, Hombo, and Mazzeo, 2000).

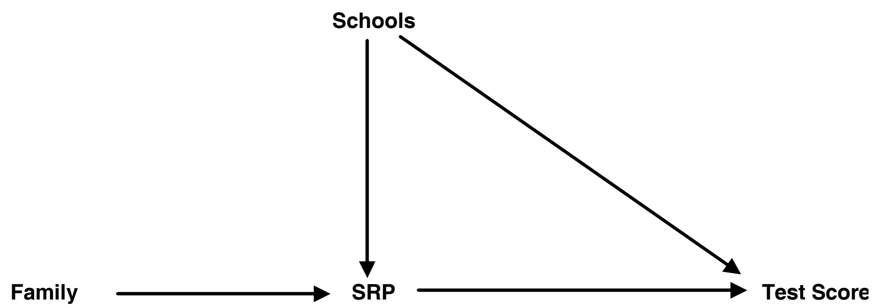
Secada (1992) found that lower-SES students enter school with lower mathematics achievement than middle-SES and upper-SES students. Whether SES is defined in terms of home atmosphere (parents' attitudes towards education, family activities), parental income and occupation, or in terms of the school attended, all correlated with achievement (White, 1982).

The 1996 National Household Education Survey found that 61% of families with children under the age of 18 had used the public library at least once in the last month as opposed to 35 % of adult only households. For the last year, 82% of the households with children under 18 and 54% for those of the adult only households visited public libraries. Of the families with children under 18, 45% of them visited the library for hobbies or enjoyment; 22% to get information for personal use; and 38% for class assignment (Collins and Chandler, 1997).

According to Blake (1989) who studied white families, larger families have an adverse effect on achievement. Specifically, children from larger families are less likely to graduate high school than those from smaller families. The author also found that the effects of larger family size can be somewhat mitigated by strong religious (Catholic and protestant) background, by ethnic identification, high parental SES, or a combination thereof (Blake, 1989). Downey (1995) argues that the disparity in educational attainment between large families and small families is due to parental resource dilution, both economic and interpersonal resources.

Chyung, Darling, and Caldwell (1998) found that children with high parental monitoring are less likely to be involved in delinquent behavior. The same authors also found that children are less likely to be influenced by delinquent peers when they feel obligated to obey their parents' rules.

2.4 Alternative Model



(Adapted from Wright, 2005)

The dependent variable for the alternative model is test scores, in particular math test scores. This paper seeks to answer how math test scores are affected by the SRP, the school structure, and the family.

Student role performance measures how well a student meets the requirements of being a successful student as established by teachers, school administrators, and districts. SRP includes gender, ethnicity, or studying affects. High student role performance leads to higher math test scores. For example, the more studying a student does the better math test scores the student has. School structure contextualizes the demands placed upon the student and affects how the student meets these demands. A student's test scores are affected by teacher quality, money spent per student, and class size. The higher student-teacher ratio, the lower student test scores. Families are where a child begins to learn and shape beliefs about the world and where they belong in it. Whether a child lives in a two-parent home or a single parent home, the family's economic status, or how large the family can affect how well a child performs in school. Students from two parent families have better math test scores than students from single parent or blended families.

This paper investigates the following hypothesis:

1a. Net of other factors, an increase in time studying, increases math test scores.

1b. Net of other factors, students with handicaps have lower the math test scores.

2a. Net of other factors, students in private schools have higher math test scores.

2b. Net of other factors, an increase in the percent of students in college prep will increase math test scores.

3a. Net of other factors, an increase in SES, increases students' math test scores.

3b. Net of other factors, the larger a student's family the lower the student's math test scores.

3. Data and Methodology

3.1 Data

This paper investigates the relationship between SES and math test scores in high school students. The data for this study are from the Education Longitudinal Study of 2002 (ELS). The ELS is produced by the National Center of Education Statistics (NCES). The ELS studies schools that have tenth grade students. At the school level surveys were used to gather data from administrators, library media centers, facilities, and aggregation of student data to school level. Questionnaires and assessment data as well as reports from students, teachers, and parents make up the student-level data (ELS, 2004). The ELS consists of a sample of 17,591 students.

A sample was obtained from selecting only complete student, parent, and school questionnaires, schools that had math and reading test scores for the 2002 school year, and all valid weight scores. The final study sample size is 11,320.

Weights allow generalizations to be made from a sample to a larger population. Generalizations using weights create bias by reducing the sampling error. To control this bias a relative weight was used to preserve the original sample size while allowing the sample to be reflective of the population distribution. The relative weight was calculated by dividing the standard weight by its mean.

3.2 Variables

3.2.1 Dependent Variable

The dependent variable is an interval level variable describing standardized math test scores. The NCES developed the math tests, which cover a wide range of mathematical topics. It includes arithmetic, algebra, probability, and advanced topics. The scores range from 19 to 87. For comparison purposes the variable was recoded to a percentile.

3.2.2 Independent Variables

3.2.2.1 Student Role Performance

The student role performance variables used in this study included gender, minority, native language, disabilities, classroom preparation, amount of math homework, deviance, time spent working and participating in extracurricular activities, and hours watching TV. Gender is a nominal-level variable recoded to binary (0, 1) denoting females as 1. It is expected that males generally score better on math exams than females.

The race variable is a nominal-level variable recoded into a binary (0, 1) grouping Asians and non-Hispanic whites together and all other racial groups together. Asians and whites are coded as 0 while all other racial groups as 1. Asians and whites were combined because both groups tend to have equivalent academic achievement. It is expected that Asians and non-Hispanic whites will score better on math exams than minorities.

Native language is a binary (0, 1) variable denoting English (1) as the student's native language. It is expected that students whose native language is English will perform better on math exams that are written in English.

The variable for whether a student has ever been held back a grade is a binary-level (0, 1) variable where a student who has been held back are denoted as 1. It is expected that students who are held back score lower on math exams.

A scale of class preparation is created from variables measuring how often a student went to class without a pencil or pen, textbooks, or complete homework. Class preparation ranges from 1 to 4, where 1 is never prepared for class and 4 is always prepared. The scale has a Cronbach alpha of 0.80. It is expected that students who are more prepared for class do better on math exams.

An index is created for the number of disabilities a student has, counting learning disabilities, speech/language impairment, mental retardation, emotional disturbance, hearing, orthopedic, visual impairments, and other disability. The index is recoded into a binary (0, 1) denoting disability (1). It is expected that students with disabilities score lower on standardized math exams.

The hours a student spends on math homework during the week and on the weekend are both interval-level variables. Taking the sum of these created a new interval-level variable. It is expected that students who spend more time doing math homework will score higher on math exams.

The variables measuring the number of times a student was late, how often the student skipped in class or school altogether, how often they were in trouble, and how many times a student received in-school suspension are coded into an index of deviance.

The higher a students' value on the deviance index, the greater the student's deviance. It is expected that the more deviant a student is, the lower the math test scores will be.

The hours per week the student spent on extracurricular activities is an interval-level variable. The hours a student works during the week and on the weekend are both interval-level variables. Taking the sum of these creates a new interval-level variable. Non-workers were coded as working zero hours. A new variable is created by adding the total hours spent on extracurricular activities and total hours worked. It is expected that the more hours a student works and participates in extracurricular activities, the student's math test scores will be lower. The work/extracurricular activities variable was recoded into a binary-level (0, 1) variable denoting working/extracurricular activity participation as 1. It is expected that students who work and/or participate in extracurricular activities will score lower on math exams.

The sum of hours a week a student spends watching TV and DVDs is used to create a variable measuring time spent watching TV/movies. It is the expected that the students who spend more time watching TV will score lower on math exams.

3.2.2.2 School-Level Variables

School-level variables include private schools, school size, percent of students in college prep courses, percent of students participating in a free lunch program, percent of students in remedial math courses, problems in the school, school rules, and negative school environment. The variable for whether a student attends private schools is a nominal-level variable coded into a binary-level (0, 1) variable denoting private schools. Students who attend private schools do better on math exams than those who are not.

School size is recoded from a nominal-level variable into an interval-level variable. It is expected that students' from smaller schools will have better test scores.

The percent of 10^{th} graders in college prep programs is an interval-level variable. Students who are in college prep courses are expected to have higher math scores.

The percent of students participating in the school free lunch program is coded as an interval-level variable. It is expected that schools with greater percent students in free lunch programs will have students that score lower on math tests.

The percent of students in a school participating in remedial math courses is an interval-level variable. It is expected that the greater the percent of a schools population in remedial math courses the lower the student test scores.

An index is coded for school problems, which include tardiness, absenteeism, use of alcohol, class cutting, physical conflicts, robbery/theft, vandalism, use of alcohol, use of illegal drugs, sale of drugs, weapon possession, physical and verbal abuse of teachers, racial tension, bullying, classroom disorder, disrespect of teachers, gang activity, and cult/extremist activity. The index had a range from one to five where one is a problem never occurs and five problems happen daily. It is expected the schools that have more problems will have students who score lower on math exams.

An index of school rules is created to include building and ground access, use of metal detectors, closed lunches, narcotics dog checks, contraband, drug testing, school uniforms, strict dress code, clear or no book bags, IDs/badges for students and faculty/staff, and security cameras. It is expected that schools with more rules have students who perform better on math exams.

A scale is coded for school environment. It includes conditions of the buildings, the lighting, the air, the heating, science labs, fine art facilities, library, vocational and technical equipment and facilities. It further includes the lack of space, text and supplies, computers, multi-media, and discipline/safety. The scale has a Cronbach alpha of 0.91. It is expected that the poorer a school's environment results in students performing poorer on math exams.

3.2.2.3 Family-Level Variables

Family-level variables include single-parent families, number of siblings, locality of school, measures of SES, parental communication with children, parental involvement with child's school, and parental rules. Family composition is recoded into a binary-level variable (0, 1) denoting single-parent families. It is expected that children from single-parent families will have lower math exam scores. The number of siblings a student has is an interval level variable. It is expected that students who have more siblings will have lower math exam scores.

The school location variable is a nominal-level variable that will be recoded into binary-level (0, 1) variable denoting whether the school is rural. It is expected that students in a rural setting will perform better than those who are not.

Socioeconomic status is a composite variable created by NCES using standardized measures of parent's education, occupation, and family income. The SES variable ranges from -1.97 to 1.98. The more negative the score the lower the family's SES is while the more positive the higher the family's SES. The SES variable is used to create a tritile, a quintile, and a percentile of SES. It is expected that students from families with higher SES will have higher math test scores.

A scale is created out of the families' home capital. It has a Cronbach alpha of 0.85. Home capital includes receiving a daily newspaper, magazine subscriptions, having a computer, internet access, DVD player, electric dishwasher, clothes dryer, more than 50 books, fax machine, and student has own room. It is expected that students with higher values of home capital will have higher test scores.

The frequency of parental discussion with the student is coded into a scale with a Cronbach alpha of 0.84. The scale ranges from parents never having discussions to often having discussions. The discussions include school courses and activities, what was studied in class, grades, transferring, ACT/SAT, college plans, current events, and troubling things. It is expected that the more discussions parents have with their children will result in higher math test scores.

An index of parental rules included rules about homework, grades, whereabouts, school night curfews, maintaining grade point average, household chores, and TV. It is expected that students whose parents have more rules have higher math exam scores.

3.3 Methods

Univariate analysis will be performed on all interval- and binary-level variables to obtained mean and standard deviations for the full sample as well for low, middle, and high SES students. Analysis of variance (ANOVA) will be performed to determine the differences between different levels of SES. An Ordinary least square (OLS) regression will be used to make comparisons of the independent variables to math test scores net of other factors, as well as to determine the variation explained by each model segment.

4. Results

4.1 Univariate and Bivariate Results

Table 1 shows the univariate and bivariate results for the full sample as well as divided into three levels of SES (low, mid, high). Low SES students were more likely to have low math test scores than middle and high SES (46.09 vs. 50.84 vs. 55.88). People with low SES were more likely to be minorities than middle and high SES (49% vs. 30% vs. 18%), have been held back a grade (20% vs. 11% vs. 7%), and watch more television (7.46 vs. 7.11 vs. 6.51). Individuals of Low SES are less likely to speak English as their native language (78% vs. 92% vs. 94%) and less likely to participate in extracurricular activities and work (15.20 vs. 17.52 vs. 17.18). High SES individuals are less handicapped than low and mid SES (12% vs. 11% vs. 8%), and are less deviant (9.57 vs. 9.19 vs. 7.62). Among the variables measuring gender, amount of time spent doing math homework, and amount of class preparation no significance difference was found between the three levels of SES.

For the school-level variables, low SES students were less likely than mid SES and high SES to attend private schools (2.6% vs. 6.3% vs. 16%), and to attend college prep classes (50% vs. 58% vs. 67%). Low SES students are more likely to be in free lunch programs (36% vs. 24% vs. 17%), and attend schools with greater negative school environments (1.79 vs. 1.74 vs. 1.68). Low SES students are more likely than high SES students to attend schools with more rules. The size of the school is significantly different for high SES but not to compared to low and mid SES (1,225 vs. 1,245 vs. 1,327), as well as for the percent of students in remedial math courses (7% vs. 7% vs. 5%) and the number of school problems (2.30 vs. 2.28 vs. 2.26).

For family-level variables, all levels of SES were significantly different for single parent families (33% vs. 23% vs. 14%), family size (2.65 vs. 2.32 vs. 2.00), the cultural capital of the home (5.12 vs. 6.83 vs. 7.76), parental discussion with their children (1.68 vs. 1.85 vs. 2.01), and parents involved in schools (0.52 vs. 0.63 vs. 0.78). The percent of students in rural schools is significantly different for high SES but not for low or mid SES (23% vs. 22% vs. 17%). The number a parental rules a student has is significantly mid SES but not low or high SES (6.86 vs. 6.95 vs. 6.87).

4.2 Multivariate Results

Table 2 examines the ordinary least squares (OLS) regression results for the entire sample as well for each level of SES. The adjusted R-square for the full sample model is 0.428 ($p<0.001$), indicating that 42% of the variation of math test scores are explained by the included factors. Net of all factors, SES results in a 0.08 ($p<0.001$) increase in test scores. The standardized beta for SES is 0.241. This is the greatest standardized beta value in the whole study. Thus, SES has the greatest effect on test scores.

In the SRP model in **Table 2**, net of other factors gender, minority status, ever been held back, has a disability, and deviance show independent and significant effects on student math test scores. Females score lower than males across all levels of SES (-1.930 vs. -1.958 vs. -2.424). Being a minority has a negative effect on math test scores; greatest among Mid SES, then Low SES, and the least effect for High SES (-4.099 vs. -4.450 vs. -4.115). Held back students score lower on math test scores for students in high SES (-4.853 vs. -5.364 vs. -5.889). Student disability has a negative effect on math test scores; it has more effect on Mid SES, then low SES, and the least for high SES

(-6.950 vs. -7.456 vs. -6.820). Deviance has a negative effect on math scores; the greatest effect among high SES, and the least among low SES (-0.082 vs. -0.118 vs. -0.121). There is a significant difference in effect on math test scores between mid and high SES; the more hours of TV watched the lower math test scores between mid and high SES (-0.066 vs. -0.213 vs. -0.447). Native English speakers score better on math test scores than non-native English speakers for low and mid SES (1.804 vs. 1.220 vs. 0.730). The number of hours spent on homework has a negative significant effect for low SES but not mid or high SES (-0.057 vs. 0.028 vs. -0.005). The number of hours spent working and participating in extracurricular activities had a significant positive effect for low SES, but not for high or mid SES (0.028 vs. 0.004 vs. 0.006). Class preparation does not show significant effect on math test scores.

For the school-level model, net of other factors size of school and percent of students in college prep are significant between low and high SES, but not for mid SES. The size of the school has a positive effect on math test scores (0.001 vs. 0.000 vs. 0.001). Schools that offered college prep courses had a positive effect on math scores for low and high SES, which increased as SES increases (0.010 vs. 0.004 vs. 0.024). The greater the percent of the school participating in the free lunch program has a negative significant effect of math test scores for low and mid SES (-0.014 vs. -0.029 vs. -0.011). Negative school environment has a negative significant effect for low and mid SES, but not high SES (-0.475 vs. -0.661 vs. -0.236). The greatest effect is on the mid SES, then high SES, and low SES. The number of school rules has significant negative effect on mid and high SES (-0.074 vs. -0.163 vs. -0.227). Percent of private schools, of students in remedial math, and the number of school problems had no significant effects.

For the family model, net of other factors SES, and parental rules show independent and significant effects on math test scores. SES has positive effect on math test scores for the full sample (0.082). For parental rules, an increase in SES decreases student math test scores (-0.452 vs. -0.761 vs. -0.958). Single parent families have significant negative effect on low and high SES, increasing as SES increases (-0.614 vs. -0.485 vs. -0.784). Family size has a significant negative effect on low and mid SES. As family size increases math tests scores decrease (-0.365 vs. -0.349 vs. -0.097). Cultural capital has a positive effect on math test scores for low and mid SES; increasing as SES increases (0.175 vs. 0.185 vs. 0.101). The amounts of parental discussions increase the students' math test scores for low SES and high SES (1.070 vs. 0.487 vs. 1.289). For high SES, parental involvement with the school had a significant positive effect on math test scores (0.450 vs. -0.102 vs. 1.126). There was no significant effect on math test scores for families living in rural areas versus urban areas.

In **Table 3**, each model segment's variation was examined separately to determine which model explained the most variance. The saturated model explains 42.0% of the variation of math test scores. Removing the SRP model the explained variance drops to 27.7%, a difference of 34.0%. If the school model is removed, the explained variance drops to 41.4%, a 1.4% difference. The variance explained by the family model is 33.9%, for a difference of 19.3%. Therefore, the SRP components are the strongest part of the model in terms of predictive power, followed by the family segment of the model.

5. Discussion

The most important finding of this research is the positive effect of SES on math test scores, net of other factors. This data supports hypothesis (3a) of this study. The high SES students' benefit the most by an increase in math test scores of 0.082. White (1982) found that SES correlated to achievement. Furthermore, when the different levels of SES are compared in **Table 3** with the family model removed high SES has the greatest decrease in variance explained as compared to the other levels of SES. This is to be expected because SES is a component of the family models and high SES students have the most resources available.

The first SRP level hypothesis (1a) predicted that an increase in studying time will increase math test scores, which is not supported by the data. This result does not agree with Campell, Hombo, and Mazzeo (2000) findings that the more time spent on math homework increases math test scores. This may be due to coding of the homework variable for this study. Homework was coded as a interval level variable. This does not take into account that some students can study very little score very well while other students can study for many hours and still perform badly. I believe these effects cancel each other out resulting in non-significance.

The second SRP level hypothesis (1b), students with disabilities have the lower math test scores, are supported by the data for the full model and across all levels of SES. This confirms the findings in the *Twenty-First Annual Report to Congress on the Implementation of the Individuals with Disabilities Act* that students with disabilities do not perform as well as those without (U.S. Department of Education, 1999). High SES disabled students experience the least negative effect on there math test scores. High SES families have greater access to resources that help to minimize the effects of disability.

At the school level, the first hypothesis (2a) predicted that students in private schools had higher math test scores is not supported by the data. Coleman, Hoffer, and Kilgore (1982) found that students in Catholic private schools did better than those in public schools. However, the results of this study show no significant relationship between public and private schools. Coleman, Hoffer, and Kilgore only compared Catholic private schools and public schools while this study compared private schools, without making a distinction between Catholic and non-Catholic private schools, to public schools. The inclusion of non-Catholic schools into private schools may be responsible for the non-significance found in this study. Further, research is needed to compare how math test scores are affected by all three types of schools: Catholic private schools, non-Catholic private schools, and public schools.

The second hypothesis (2b) was an increase in the percent of college prep classes will increase math test scores was supported by the data for the full model, low and high SES models. This result corresponds to findings that an increase in the type and amount of math courses taken increases math test scores (Campell, Hombo, and Mazzeo, 2000). That is, students in college prep math courses have had more math overall and have taken courses covering a greater scope of mathematics, thus helping them to score higher on math tests. Looking at the segregated levels of SES in **Table 2**, only low and high SES were significantly affected by college prep with the greatest effect for high SES.

The second family level hypothesis (3b) was as family size increases, test scores will decrease was supported by the data for the full model, low and mid SES model. Blake (1989) found that in white families, larger families had negative effects on achievement. This agrees with this study's findings. It is important to note that family size is not significant for high SES, which suggests large SES families have greater resources available to overcome the effect of family size.

As with all research, every effort has been made to use the most accurate data possible; however, the ELS data does have limitations. The data did not contain any information about teacher quality or teaching experience. A variable that measures this would allow consideration of teaching experience on test scores. Student-teacher ratio is also not available from the ELS data. Student-teacher ratio would allow the effect individual instruction to be measured. The ELS does not include data on the frequency of student alcohol and drug use, the types of drugs used, school spending per student, and student fertility rates.

It is imperative that programs and policies are developed and implemented to help close the achievement gap between the different levels of SES. School funding in many states is based on property taxes. More affluent neighborhoods pay more taxes, thus have more money to spend on education. A plan to equalize school funding across the state school districts needs to be explored. Second, supplemental math courses should be introduced into schools with low SES students. Students with low math scores would not be segregated from the rest of the student population but attend regular math courses. In addition to attending regular math courses, they would attend supplemental math courses that would offer extra instruction paralleling the regular math courses. Further, a greater effort needs to be made to identify students who need to be placed into supplemental programs. Third, a community-based learning centers need to be provided in low SES neighborhoods. These learning centers would provide basic literacy and mathematics to adults and children and job training opportunities. These centers would help increase the level of SES within a community and the family through education. Last, standardized testing is not always representative of how much a student learns or retains. Alternative means of evaluating learning need to be developed to more accurately measure learning.

Future research is needed to further explore the link between math test scores and SES. SES is a composite variable. Additional research needs to explore the importance of the individual factors making up SES. In this study, SES is defined as family income, parents' education, and parents' occupation. Which of factors contribute to the most to a child's math test scores? These questions must be addressed, so that we as society can guarantee our children's success academically.

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APPENDICES

7.1 Appendix A

Table 1
Values for Full Sample and by SES

Variables	Full Sample	Low SES [1 2]	Mid SES [1 2]	High SES [1 2]
Dependent Variables				
Math Test Score (Mean):	50.92	46.09*^	50.84*	55.88*^
(stddev):	(9.79)	(9.04)	(9.06)	(8.72)
Independent Variables:				
Student Role Performance Variables:				
% Female (0, 1)	50.6%	51.9%	50.4%	49.6%
	(0.50)	(0.50)	(0.50)	(0.50)
%Minority(0,1)	32.2%	48.9%*^	29.5%*	18.0%*^
	(0.47)	(0.50)	(0.46)	(0.38)
%English(0,1)	88.0%	78.0%*^	92.0%	94.0%
	(0.32)	(0.41)	(0.27)	(0.25)
%Heldback(0,1)	12.5%	20.0%*^	10.9%*	6.6%*^
	(0.33)	(0.40)	(0.31)	(0.25)
% Handicapped (0,1)	10.5%	12.4%	10.7%	8.4%*
	(0.31)	(0.33)	(0.31)	(0.28)
Class Prep (1 - 4=good)	2.32	2.29	2.33	2.34
	(1.00)	(0.99)	(0.99)	(1.02)
# hours on Math Homework	4.89	4.89	4.85	4.92
	(5.06)	(5.76)	(5.02)	(4.28)
Deviant	8.80	9.57	9.19	7.62*^
	(8.12)	(8.47)	(8.64)	(7.03)
# hours on extracur activities and working	16.71	15.20*	17.75	17.18
	(16.17)	(16.63)	(16.36)	(15.38)
#hours watching TV per day	7.03	7.46*^	7.11*	6.51*^
	(3.26)	(3.31)	(3.19)	(3.20)
School-level Variables:				
%private school (0,1)	8.1%	2.6%*^	6.3%*	15.6%*^
	(0.27)	(0.16)	(0.24)	(0.36)
Size of School	1,304	1,284	1,289	1,341*
	(692.67)	(716.34)	(682.91)	(676.76)
% of students in col prep	58.2%	50.0%*	58.0%*	66.8%*
	(31.30)	(30.63)	(30.59)	(30.42)
% of Students getting free lunch	24.6%	33.5%*	23.6%*	16.5%*
	(22.52)	(24.84)	(21.17)	(17.58)
% who have been in Remedial Math	6.2%	6.8%	6.7%	5.0%*
	(8.59)	(9.46)	(8.99)	(7.00)
School problems (1-5=poor)	2.28	2.30	2.29	2.26*
	(0.35)	(0.32)	(0.33)	(0.38)
Negative School Environment (1-4=poor)	1.74	1.79*	1.74*	1.68*
	(0.57)	(0.57)	(0.57)	(0.57)
# of School Rules(0-12)	4.68	4.90*	4.64	4.48*
	(2.21)	(2.26)	(2.18)	(2.18)

Family-Level Variables				
% Single Parent Families (0, 1):	23.5%	33.3% * ^	23.1% *	14.0% * ^
	(0.42)	(0.47)	(0.42)	(0.35)
Family Size	2.32	2.65 * ^	2.32 *	2.00 * ^
	(1.52)	(1.66)	(1.51)	(1.31)
% Rural (0,1)	20.7%	23.4%	21.6%	16.9% *
	(0.40)	(0.42)	(0.41)	(0.37)
Cultural Capital of the Home(0-10)	6.57	5.12 * ^	6.83 *	7.76 * ^
	(2.99)	(3.01)	(2.76)	(2.58)
Parents Discusses(1-3)	1.85	1.68 * ^	1.85 *	2.01 * ^
	(0.55)	(0.55)	(0.53)	(0.52)
Parent involved with school(0-10)	0.64	0.53 * ^	0.63 *	0.78 * ^
	(0.48)	(0.50)	(0.48)	(0.42)
Parental Rules(0-8)	6.89	6.86	6.95 *	6.87
	(1.24)	(1.29)	(1.18)	(1.25)
Sample n (weighted)	11,320	3,777	3,802	3,742
		33%	34%	33%

[1]=*** p<0.001; **p<0.01; *p<0.05;

[2]=d>0.20; each column measures the effect of the previious column of SES

7.2 Appendix B

Table 2
OLS Regression Analysis

Beta values displayed for the full sample and by SES

(Dependent Variable = Math Scores)

	Full Sample		Low SES			Mid SES			High SES		
Variables	unstd. [1]	std.	unstd. [1]	std.	[2]	unstd. [1]	std.	[2]	unstd. [1]	std.	[2]
Independent Variables:											
Student Role Performance Variables:											
% Female (0, 1)	-2.076 ***	-0.106	-1.930 ***	-0.107	^	-1.958 ***	-0.108	^	-2.424 ***	-0.139	^
%Minority(0,1)	-4.108 ***	-0.196	-4.099 ***	-0.227	^	-4.450 ***	-0.224	^	-4.115 ***	-0.181	^
%English(0,1)	1.200 ***	0.040	1.804 ***	0.082	^	1.220 **	0.036	^	0.730	0.021	^
%Heldback(0,1)	-4.965 ***	-0.168	-4.853 ***	-0.215	^	-5.364 ***	-0.185	^	-5.889 ***	-0.167	^
% Handicapped (0,1)	-7.196 ***	-0.225	-6.950 ***	-0.253	^	-7.456 ***	-0.254	^	-6.820 ***	-0.217	^
Class Prep (1 - 4=good)	0.003	0.000	-0.077	-0.008		-0.012	-0.001		0.116	0.014	
# hours on Math Homework	-0.015	-0.008	-0.057 **	-0.036		0.028	0.015		-0.005	-0.003	
Deviant	-0.106 ***	-0.088	-0.082 ***	-0.076	^	-0.118 ***	-0.112	^	-0.121 ***	-0.097	^
# hours on extracur activities and working	0.013 **	0.022	0.028 ***	0.052		0.004	0.008		0.006	0.010	
#hours watching TV per day	-0.234 ***	-0.078	-0.066	-0.024		-0.213 ***	-0.075	^	-0.447 ***	-0.164	^
School-level Variables:											
%private school (0,1)	0.251	0.007	0.555	0.010		0.711	0.019		0.045	0.002	
Size of School	0.000 ***	0.035	0.001 **	0.045		0.000	0.025		0.001 *	0.044	
% of students in col prep	0.011 ***	0.034	0.010 *	0.035		0.004	0.014		0.024 ***	0.082	^
% of Students getting free lunch	-0.016 ***	-0.038	-0.014 *	-0.038	^	-0.029 ***	-0.068		-0.011	-0.022	
% who have been in Remedial Math	-0.020 **	-0.018	-0.016	-0.016		-0.020	-0.020		-0.019	-0.015	
School problems (1-5=poor)	-0.005	0.000	-0.748	-0.027		0.543	0.020		0.275	0.012	
Negative School Environment (1-4=poor)	-0.418 ***	-0.024	-0.475 *	-0.030	^	-0.661 **	-0.041		-0.236	-0.016	
# of School Rules	-0.150 ***	-0.034	-0.074	-0.018		-0.163 **	-0.039	^	-0.227 ***	-0.057	
Family-Level Variables											
SES (0 -100)	0.082 ***	0.241									
% Single Parent Families (0, 1)	-0.445 **	-0.019	-0.614 *	-0.032		-0.485	-0.023		-0.784 *	-0.031	^
Family Size	-0.277 ***	-0.043	-0.365 ***	-0.067	^	-0.349 ***	-0.058		-0.097	-0.015	
% Rural (0,1)	-0.190	-0.008	-0.217	-0.010		-0.335	-0.015		-0.283	-0.012	
Cultural Capital of the Home	0.128 ***	0.039	0.175 ***	0.058	^	0.185 ***	0.056		0.101	0.030	
Parents Discusses	0.928 ***	0.052	1.070 **	0.065		0.487	0.029		1.289 ***	0.077	^
Parent involved with school	0.327 *	0.016	0.450	0.025		-0.102	-0.005		1.126 ***	0.054	
Parental Rules	-0.709 ***	-0.090	-0.452 ***	-0.065	^	-0.761 ***	-0.099	^	-0.958 ***	-0.137	^
(Constant)	55.506 ***		54.443. ***			60.773 ***			63.001 ***		
Adjusted R-sq.	0.428 ***		0.315 ***			0.323 ***			0.287 ***		

[1]=*** p<0.001; **p<0.01; *p<0.05;

[2]=z>1.96 or z<-1.96; each column measures the effect of the preceding level of SES

7.3 Appendix C

Table 3
Comparison of Model Segments
By Partitioning of Variance
(Dependent Variable = Math Exam Scores)

Standardedized betas shown.

Variables	Full	w/o SRP	w/o Schl.	w/o Fam.
Independent Variables:				
Student Role Performance Variables:				
% Female (0, 1)	-0.105	x	-0.106	-0.107
%Minority(0,1)	-0.208	x	-0.227	-0.287
%Heldback(0,1)	-0.167	x	-0.170	-0.200
% Handicapped (0,1)	-0.228	x	-0.227	-0.242
Deviant	-0.088	x	-0.088	-0.104
School-level Variables:				
%private school (0,1)	0.004	-0.002	x	0.046
% of students in col prep	0.038	0.043	x	0.075
% of Students getting free lunch	-0.048	-0.095	x	-0.112
School problems (1-5=poor)	0.010	-0.010	x	0.032
Negative School Environment (1-4=poor)	-0.026	-0.031	x	-0.031
# of School Rules	-0.031	-0.053	x	-0.032
Family-Level Variables				
SES (0 - 100)	0.254	0.309	0.273	x
% Single Parent Families (0, 1)	-0.016	-0.054	-0.019	x
Family Size	-0.040	-0.080	-0.043	x
Cultural Capital of the Home	0.046	0.106	0.058	x
Parents Discusses	0.054	0.072	0.052	x
Parent involved with school	0.017	0.025	0.018	x
Parental Rules	-0.090	-0.114	-0.091	x
Adjusted R-sq.*	0.420	0.277	0.414	0.339
Rsq change from Full model		**-0.143**	**-0.006**	**-0.081**
%change in Rsq.		**-34.0%**	**-1.4%**	**-19.3%**
Adjusted R-sq. for Low SES*	0.316	0.140	0.312	0.284
Rsq change from Full model		**-0.176**	**-0.005**	**-0.033**
%change in Rsq.		**-55.7%**	**-1.6%**	**-10.4%**
Adjusted R-sq. for Mid SES*	0.321	0.136	0.310	0.299
Rsq change from Full model		**-0.185**	**-0.012**	**-0.023**
%change in Rsq.		**-57.6%**	**-3.7%**	**-7.2%**
Adjusted R-sq. for High SES*	0.294	0.150	0.285	0.230
Rsq change from Full model		**-0.144**	**-0.010**	**-0.065**
%change in Rsq.		**-49.0%**	**-3.4%**	**-22.1%**

*(All adjusted R-sq values are significant at the 0.000 level)