Racial Disparities in Durham County Public Elementary Education: A Picture that is more than Black and White

Abstract

This study examines the correlation between race and fifth-grade End-of-Grade exam performance within Durham County public elementary schools. Initial empirical results reveal that scores are linked with race: Whites outperform minorities, in some cases by very significant margins. However, when other factors are taken into account, exam performance is determined primarily by the level of students receiving reduced and free lunches, and race becomes almost inconsequential. Race is significant only to the extent to which it is correlated with the compensated lunch variable. It seems that racial segregation runs along class lines and creates disparities in educational environments, negatively affecting minority academic performance.

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1. Executive Summary

This study sets out to examine the impact of race on student standardized test performance in Durham County. Specifically, fifth-grade student achievement on the 2006 Reading and Mathematics End-of-Grade exams is compared using linear regression analysis across Durham's twenty-eight public elementary schools, five of which boast magnet programs. Initial empirical results reveal correlations between race and exam scores, with Whites outperforming local minorities. However, the addition of non-race variables to the linear regressions reveals that race is only significant and important to the extent to which it is correlated with other variables which predict student academic performance. Essentially, race masks other variables truly correlated with standardized test score achievement. The variable which is most significant in determining academic success is wealth.

At the school level, wealth is measured using the percentage of students receiving reduced price and free lunches. In the multivariate linear regressions, this variable is significant at the one percent level. However, other factors included in this regression also play significant roles in predicting academic success. The following variables are all included in a single linear regression where Mathematics or Reading EOG percentile rank is the dependent variable: reduced price and free lunch, single-parent

families, adult educational attainment, teacher educational attainment, median household income, and school racial composition. A dummy variable is also created to capture the disparity between magnet and non-magnet student performance. While reduced price and free lunch, which functions as a proxy for the relative affluence of the public elementary school, is the most critical variable and best indicator of academic achievement, these other factors help to piece together the full landscape of a Durham public education.

Through a thorough examination of regression results, many trends occurring in Durham County public elementary schools are realized. The reason that White students are outperforming Black and Hispanic students is because of class differentials. The initial regressions that only factored in race are driven by the fact that Whites in Durham tend to be from the upper middle or upper classes while Blacks and Hispanics have the highest poverty rates. This wealth differential translates into disparities in academic performance. In scrutinizing other factors, it becomes apparent that single-parent families and adults lacking a formal education beyond college were correlated with the poorer communities. These monetary restrictions translate into less parenting time, fewer adult role models, less child supervision, and fewer books in the home. In many scenarios, money is a direct indicator of the conduciveness of a learning environment. In Durham, Black and Hispanics tend to come from less educated, single-parent families and thus endure the strings attached to that living situation, most importantly: poverty. On the other hand, Whites tend to come from educated, intact families and thus can reap the benefits of having two parents contributing to the household income at employments that probably pay more. These non-wealth factors become significant because of their close connection with class level. In Durham County public education, racial self-segregation is the result of this class segregation.

While standardized test performance disparities are shown to be correlated with wealth disparities, there are some exceptions among this study's empirical results. These outliers reveal the true reality of the institution of public education in Durham. Which schools do not fit the trend? Typically, schools with magnet programs exhibit standard or above-average levels of compensated lunch students yet have enrolled students who outperform their counterparts at non-magnet schools. This exceptional trend is seen most distinctly in the scores of the Hispanic community who thrive in magnet school settings. Why is this the case? Durham County magnet programs boast foreign language instruction, curricula items on other cultures, and sensitivity to diversity. It is this awareness of other cultures, and especially foreign language lessons, which has improved Hispanic exam results. As confirmed by special language programming at a non-magnet school, Hispanic scores are the highest in the county because of its Two-Way Spanish Immersion Program. This outreach to the Hispanic community and crossing of language barriers greatly contributes to Hispanic students' success in the classroom.

Within these case studies, a few other unexpected findings were uncovered. In multivariate linear regressions predicting school-average exam performance, the variable for teachers holding advanced degrees was found to be statistically significant. Most surprisingly, these regressions show that as the number of teachers with advanced degrees at a school increases, the standardized test scores of its enrolled students are expected to decrease. This seems to be violating common sense, what is occurring here? When these multivariate linear regressions are reconstructed with race-specific exam performance as the dependent variable, the situation reveals itself. Where the advanced degree teacher variable is statistically significant, it shows a negative relationship for Blacks and a positive relationship for Whites. Essentially, intellectually elite instructors are beneficial to White learning but seem to inhibit Black learning. The reason for this disparity is not because Blacks have trouble learning from intellectually advanced instructors, but rather, because Blacks are most commonly subjected to an unstable learning environment in which these teachers holding advanced degrees transfer out after a year in the system. This study argues that the most likely candidates for teacher turnover are those holding advanced degrees. Teacher turnover rate is high at most Durham public elementary schools, and especially high at Durham's poorest educational institutions. This finding suggests that schools with large Black populations tend to be poor and hire very qualified instructors who will leave the system at the end of the academic term. On the other hand, schools with large White populations tend to be wealthier and thus experience much lower rates of teacher turnover; they can reap the benefits of hiring superior instructors because those instructors will most likely stay the next year. The class differential which is placing Whites at most elite public institutions allows them access to better instruction and more stable environments while Blacks, who need superior instruction most because of poor home environments, are often subjected to new teachers who may be inexperienced in a classroom setting. Once again, wealth is proven to be critical to obtaining a high-quality education.

Additional outliers reinforce wealth's intimate link with education. In exceptional cases, despite being from low-income households, some students enrolled at non-magnet schools were outperforming their counterparts. What has changed? These students are from areas with high levels of adult educational attainment. Despite below-average incomes, a below-average number of students qualify for compensated lunches. The reasoning: these families with higher levels of education are having fewer children. Often this fertility differential runs along class lines, and these class divisions in Durham are inherently linked with race. Essentially, minorities tend to be less educated than Whites and typically have more children, creating an even greater strain on the family income and increasing the likelihood that their child will qualify for compensated lunch. This higher birthrate which even further thins out an already below-average income for minorities is contributing to subpar minority performance. Students who come from large, poor families have many less resources in the home and less access to educational aids. Essentially, the exceptional case first outlined here points to a solution which would, in a sense, allow a family to maintain more relative wealth: educate minorities so that they have fewer children and family resources are less strained. Again, the consequence of wealth rears its ugly head, making its link with education undeniable.

Durham can improve its education system and change a mediocre forecast for the educational future of minorities. Creation of more magnet schools with foreign language instruction and immersion programs would greatly benefit Hispanic learning. Additionally, building more magnet schools which would retain teachers and compete with Durham's poorest local schools would benefit Black education. Further, educating the minority populations and perhaps holding night courses for adults could potentially lower the rampant poverty among them. The children are the future of Durham and if the face of public education does not progress, neither will Durham.

Within the dataset utilized by this study are some noted limitations. Many of the conclusions obtained by the study were achieved through overly simplistic methods with a very limited dataset. With only five magnet programs in Durham, it is difficult to affirm with a high level of certainty any trends discovered during regression analysis. Additionally, the End-of-Grade exam percentile rank race-specific scores incorporated into this study's linear regressions were only for the 2005-2006 school year and thus form an extremely limited dataset from which to draw concrete findings. Furthermore, the data collected for the level of single parents, median household income, and adult educational attainment were obtained from a 2000 U.S. Census Bureau and are a thus a bit outdated. All variables other than exam performance were held constant over the 2003-2006[2] testing period as the data available were extremely limited.

2. Introduction

Walk into Mangum Elementary in Durham, North Carolina and you will feel like Dorothy fresh from landing in Oz. Why? While the typical Durham County public school has an overwhelmingly large population of Blacks, Mangum is 82 percent White. This extreme example is just one instance of the phenomenon which occurs in Durham County educational environments: *de facto* segregation.

[2] These testing years refer to the year in which the test was administered not academic year (e.g. 2006 refers to the 2005-2006 school year)

This racial sorting is commonly thought to negatively impact minorities' academic achievement. However, it is apparent that there is more at work than simply what meets the eye. Examining Durham data through regression analysis has led to conclusions which are more than skin deep. Although race appears correlated with educational performance in many basic linear regressions, there are many omitted variables being masked by racial classifications.

Some of the underlying factors which this study examines were chosen in response to a *Chronicle* editorial entitled "Three Years Later," written by Duke student Aria Branch. In her submission to the daily, Branch speaks about a Durham County primary education student and paints a picture of his local elementary school[3], an image which some Durhamites may call "the standard":

> I'm saddened because it's unlikely that he'll have the educational advantages I've been afforded. The students at his school are excited because for the first year, the bathrooms in their school have mirrors and the stalls have doors. Who will be the one to tell Malik that because he comes from a low-to middle-class background, he can't become a Blue Devil?[4]

Her words capture a phenomenon not unique to Durham; Branch has confirmed a commonly studied trend: more affluent schools are linked to higher levels of educational success. This seems quite obvious since greater wealth translates into more resources outside of the classroom, extra tutoring, more test prep, and a more stable home environment, as parents do not constantly worry about paying rent or affording food. Branch remarks on the correlation between affluence, education, and race:

> Standardized test scores aren't capable of factoring in a student's socioeconomic background or school. It stands that test scores of students who go to underprivileged schools (disproportionately black and other disadvantaged minority students) will reflect that fact.[5]

Following Branch's lead, this paper seeks to define the dynamics of the above relationship. Yet, this study does not end there. This editorial was the flint which sparked a plethora of questions: to what extent does wealth play a role in educational success? What else influences an academic environment? How can outliers be explained? The empirical study employs regression analysis with the ultimate aim of capturing the full landscape of a Durham education and suggesting changes for improvement.

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[3] The student is identified in the article as Malik, but the school name is not given. Simply, Branch references "his school near East Campus."
[4] Branch, A. Three Years Later. *The Chronicle* (2007, October 30): 15.
[5] Ibid.

3. Background and Data Composition

Capturing Durham quantitatively required the employment of a multitude of diverse resources. As it was posited that certain variables contained within the "race" variable were driving linear regressions, more factors were scrutinized. This paper examines the extent of the influence of these associated variables on Durham academic achievement. Statistical data were gleaned from the following sources: 2006-2007 Average Daily Membership (ADM) report[6]; GreatSchools.net, a small, non-profit organization that amasses statistics from the State Department of Education and the National Center for Educational Statistics (NCES)[7]; and the U.S. Census Bureau during their decennial census in 2000[8]. As with any empirical study, inconsistencies across data sources and the timeframe disparities within the data have the potential to reduce the robustness of any conclusions.

The data which formed the basis of this study are school-level racial composition and fifth-grade student performance on End-of-Grade Reading and Mathematics exams. Data was obtained from twenty-eight public elementary schools in Durham County across a timeframe of 2003-2006. Fifth-grade students were selected as the representative population because it allowed for the largest and most applicable dataset. Selecting above that grade level, and examining Durham middle schools, would have reduced the dataset from twenty-eight schools to nine schools. Although the size of the dataset would have been maintained by selecting beneath that grade level, it was in the best interest of the study to choose fifth-graders because they undergo more specialized learning where the impact of having an educated parent, an intact family, books in the home, and the wealth to afford a tutor arguably weighs heaviest. Additionally, as students acquire more skills in ascending grade levels, greater performance disparities among peers will exist.

For instance, in third grade, mathematics classes may be segregated between those who can multiply and divide with ease, and those who can only perform those functions with assistance and prompting. However, as one passes to the next grade level, a greater number of math classes would be required to accommodate each individual. At the fifth-grade level, mathematics tracts may be separated as follows: those who depend on the aid of an instructor for dividing, multiplying, and computing ratios and percentages; students who can perform one of the aforementioned mathematical functions but not the

[6] Demographics/Enrollment Data: 2006-07. (2007, October 16). *Durham Public Schools District Webpage*. Durham County Public Schools. http://www.dpsnc.net/images/stories/06-07ADM.pdf. (2007, November 7).
[7] The Parents Guide to K-12 Success. (2007) *Great Schools*. GreatSchools.net. http://www.greatschools.net/ (2007, November 5).
[8] U.S. Census Bureau Decennial Census. (2007) *American FactFinder*. U.S. Census Bureau. http://www.census.gov/ (2007, November 5).

other; and children who excel. The same breakdown occurs in reading abilities, although the differences are less well-defined.

Because classes are less tailored to the individual in upper elementary grade levels, and because learning is continuous (addition is taught in kindergarten and applied every year after in mathematical studies), students who perform below average are likely to fall into a downward spiral. Underperformance is magnified at higher grade levels. Children who do not master required skills in third grade will be unable to apply those skills in fifth grade. This trend will continue throughout their primary education. This study attempts to validate the observation that skill level disparities mirror class segregation in local Durham, as posited by Aria Branch.

While the empirical results of this study will be most applicable to what is occurring at the fifth grade level, I believe from the above discussion that such a subset would be a magnified representation of the entire school. Additionally, I believe that this selected fifth grade population adequately captures county level trends. In this study, the following variables were statistically examined to account for disparities in academic achievement as measured by EOG percentile rank scores: race, reduced and free lunch students, teachers with advanced degrees, median household income, single-parent families, and adult educational attainment[9].

The justification for the inclusion of the above-stated variables comes primarily from a New York Times article published six years ago that set out to examine and explain the disparities in test scores across New York public schools. Their reported statistics show that there is a correlation between race and test performance: "white and Asian students do much better than black and Hispanic students in English and mathematics."[10] However, through its examination of outliers, this article arrives at the same conclusion that is reached early on by this paper: race masks other variables truly correlated with standardized test achievement. The article posits that income level, rather than race, is a possible explanatory variable: "there are individual schools that defy the pattern, where black, white and Hispanic students achieve at high levels. These schools tend to be in more middle-class neighborhoods."[11] This finding led to the inclusion of an income variable as an explanatory variable in the multivariate

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[9] "Adult" educational attainment is referenced here because it is the closest to capturing the educational attainment level of the parents in the region. Parents could not be isolated from the general adult body given the constraints of the data used.

[10] Hartocollis, A. (2002). Racial Gap in Test Scores Found Across New York. *New York Times* (2002, March 28): pp A1. http://query.nytimes.com/gst/fullpage.html?res=9904E5DC1E3BF93BA15750C0A9649C8B63&sec=&spon=&pagewanted=1 (2008, February 28).

[11] Ibid.

regressions conducted in this study in which EOG exam score was the dependent variable. School-relevant and region-relevant income variables are used: reduced and free lunch and median household income, respectively. Further emphasizing the impact of wealth on test performance, a dean from a New York public school holds income level disparity accountable for the large disparity in test scores among blacks and whites: "the school had children from 'million-dollar houses and homeless shelters'."[12] Dr. Ferguson, a researcher who conducts studies on suburban public schools, also seems to be in accord with the theory that race masks a multitude of other variables which are correlated with test performance; according to him, income level is not the only explanatory variable: "many more black children live with one parent or neither parent, more white parents have college and advanced degrees, white parents have attended better colleges, and white families have more generations in the middle-class."[13] This statement led to the inclusion of the single-parent families and adult educational attainment level variables. Further, the state education commissioner, Richard P. Mills concludes from the New York statistics that "the higher the concentration of black and Hispanic students in a school…the more likely that teachers will not have majored in the subjects they are teaching and will not have state certification."[14] While the empirical studies in this paper do not deal with the number of teachers certified per public elementary school, they do explore the impact of instructors who hold advanced degrees on the educational environment. The subsequent paragraphs explain the constraints on these variables and their data sources.

Statistical data on school racial composition were obtained from a Durham County Public Schools District publication: the Average Daily Membership (ADM) survey. This report tallies the number of students at local elementary schools who are present after a 20-day enrollment period and who self-identify with one of the following six race categories: Hispanic, Asian, American-Indian, Multiracial, White, and Black. While these narrow subfields are not satisfactory to everyone, especially those who identify themselves under the blanket term "American," they are still valid categories for assessing trends in social groups. However, it is important to note that these categories are subjective "sociopolitical constructs" rather than objective findings[15]. In this study and extensions therein, the reader must be aware that "race" is an ambiguous term and that all racial data are the result of subjective assessment.

Specifically, I examine racial composition by school as reported by the 2006-2007 ADM survey. This year was selected as the most accurate representation of the school's racial population. It was assumed that this composition did not change much over the previous four years of End-of-Grade testing.

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[12] Ibid.
[13] Ibid.
[14] Ibid.
[15] State and County QuickFacts. (2007). *USA QuickFacts*. U.S. Census Bureau. http://quickfacts.census.gov/qfd/meta/long_68184.htm (2007, December 2).

Additionally, I employ statistics on the racial composition of the *entire* school rather than only at the grade level to account for the fact that students are not isolated by year, but rather come into contact with almost everyone at school. Thus, each student contributes to the academic environment and such influence should be accounted for in statistical measures by modeling the entire school population. Both the race percentage variable and the self-segregation/clustering index were created from these data.

In this model, race is employed as a possible explanatory variable for the trends in End-of-Grade exam performance; race is correlated with many other variables that are empirically tested in this study with the intent of determining the principle variables which are predictors of EOG exam scores. EOG exams are multiple choice standardized tests administered throughout North Carolina as a means of assessing adequate yearly progress (AYP) in compliance with Title I of the No Child Left Behind Act of 2001.[16] All elementary school students must sit for two EOG exams: Reading and Mathematics. On the Reading exam, students are allotted 115 minutes to complete fifty questions divided among eight sections, each with a unique literary passage used to measure cognition, interpretation, critical stance, and connections[17]. The Mathematics test is divided into two sections: fifty-four calculator questions and twenty-eight non-calculator questions[18]. Students have no time constraints in completing the Math exam, with the majority spending 135 minutes to complete the calculator section and sixty minutes to complete the non-calculator section[19]. In the spring of 2006, a new End-of-Grade Mathematics exam was administered to elementary school students for the first time. As explained by the Wake County Public School District: "The new math test was designed by the state so that it would be much harder to pass than the old test, which had been used since 2001. On the old math test, about 90 percent of students statewide got at least a Level III score, which is the state's definition of "passing". In order to push students and schools to do better, the state decided to set the statewide passing rate on this new test at about 65 percent."[20] Results from these exams are reported back to the students in the form of a raw score, developmental scale score, achievement level, and percentile rank[21]. This paper examines percentile rank data for fifth graders in Durham County public elementary schools during the timeframe of 2003-2006 because of its availability and ability to act as a uniform measure to capture student academic achievement. Percentile rank compares a single student's test performance with that of all the other North Carolina students who took the test during the "normalizing year," which is usually the first year the test

[16] Understanding the Individual Student Report for the North Carolina End-of-Grade Tests –Grades 3, 4, and 5. (2007, July 26). *North Carolina Public Schools*. http://www.education.com/reference/article/Ref_Individual_Student/ (2007, November 5).
[17] Ibid.
[18] Ibid.
[19] Ibid.
[20] 11 WCPSS Schools Earn State Recognition as Schools of Excellence. (2007). *Wake County Public School System Webpage*. Wake County Public School System. http://www.wcpss.net/news/2006_abcs/ (2007, December 2).
[21] Understanding the Individual Student Report for the North Carolina End-of-Grade Tests – Grades 3, 4, and 5.

is administered[22]. Percentiles range from 1 to 99 and indicate that the student performed equally or better than this stated percentage of students[23]. For instance, being in the 70th percentile means that the raw score obtained by that student is higher than 70 percent of the scores of those who took the test (in its norming year). It is measure of relative achievement rather than absolute achievement. The data obtained for this study were collected from GreatSchools.net which amasses information from the State Board of Education and the National Center for Educational Statistics.

Upon initial empirical testing, it appears that trends relating racial composition to variance in EOG percentile rank levels were coding for omitted variables that were actually driving the regressions. It was necessary to employ multivariate models to examine the significance of race as a predictor of academic success. Additionally, these multivariate regressions were useful in sifting out factors, that may also be linked to race, influencing the academic environment. As previously mentioned, the following additional variables were introduced to explain variations in EOG scores across schools: reduced and free lunch students, student-to-teacher ratio, median household income, single-parent families, and educational attainment. Motivated by Branch's article, I first examine the relationship between reduced and free lunch and academic achievement. Student eligibility for free and reduced lunches is determined by USDA standards. Children from families with household incomes at or below 130 percent of the poverty level qualify for free lunch, whereas those with household incomes between 130 percent and 185 percent of the poverty level qualify for reduced-price lunches[24]. The number of reduced and free lunch students is introduced to capture the effects of wealth on academic achievement since it is a valid measure of the relative poverty of the school's population. In my opinion, it is a quantitative measure that reflects not simply lunchtime meals but rather the school climate as a whole. In this vein, schools with a greater percentage of reduced and free lunch students tend to indicate a surrounding neighborhood composition of low-income households and thus, perhaps, less books and less parental aid to supplement classroom learning as parents spend more time on the job than in the home.

Another variable examined on campus grounds is the number of teachers who hold advanced degrees. "Advanced degree" data include all instructors who have received a level of formal education beyond college. These data were collected from the 2006-2007 North Carolina School Report Cards[25]. The rationale for the use of all these school data is that school environment, beyond simply racial

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[22] Ibid.
[23] Ibid.
[24] Free and Reduced Lunch: 2006-07. (28 August 2007). *Durham Public Schools District Webpage.* Durham County Public Schools. http://www.dpsnc.net/index.php?option=com_content&task=view&id=1827&Itemid=504 (2007, November 7).
[25] NC School Report Cards. (2008). *NC Schools Report Cards Webpage*. Education First North Carolina School Report Cards. (2008). Education First. http://www.ncschoolreportcards.net/src/ (2008, February 29).

composition in the classroom, contributes to academic achievement. However, this measure fails to capture whether the teachers with advanced degrees specialized in the subjects that they are teaching. It also fails to control for whether these intellectually superior faculty are utilized only to further the education of the academic upper echelon or whether they are distributed evenly throughout. The first case posited could cause the high scores of these individuals to mask the lower scores of the students who did not have the benefit of being taught by teachers with advanced degrees.

Outside of the classroom, median household income is commonly thought to be correlated with educational success. Median household income, defined as the income level at which half of households have incomes above that level and the other half have incomes below that level, is captured using 1999 tract-level statistical data obtained from the U.S. Bureau of the Census' decennial census. Household income is measured by combining the pre-tax money receipts of all residents over the age of 15.[26] While income is generally thought of as salary or wages, it is not confined to such a strict measure, but rather includes other income variants, such as: retirement program payments, medical and educational costs, and subsidized housing[27]. Median household income is preferable to mean income as a measure reflecting the average income because it is minimally affected by dramatic outliers.

Another influencing factor beyond school walls is family structure. The number of single-parent households is incorporated into this study using tract-level statistical data from the U.S. Census Bureau's decennial census in 2000. The justification for this variable is that home environment has an impact on student academic performance. It is commonly thought that intact families provide a better environment for children than do single-parent families. While I cannot explain with complete confidence the reasoning behind this common conception, I can posit that this bias is due to the fact that an intact household is usually able to reap the benefit of two incomes whereas a single-parent household is limited to a single income and has many financial limitations. These monetary restrictions translate into less parenting time, fewer adult role models, less child supervision, and fewer books in the home. In many scenarios, money is a direct indicator of the conduciveness of a learning environment.

The final variable incorporated into the dataset is adult educational attainment. In this study, the percent of individuals in the surrounding area who have received a college degree or higher are accounted for using tract-level statistical data from the U.S. Census Bureau's decennial census in 2000; the statistics

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[26] Webster, B.H. & Bishaw, A. (2007, August). Income, Earnings, and Poverty Data from the 2006 American Community Survey. *American Community Survey Report*, pp. 1-3. Washington D.C.: U.S. Department of Commerce Economics and Statistics Administration. http://www.census.gov/prod/2007pubs/acs-08.pdf (2007, November 2).
[27] Ibid.

are taken from the same tract as the school. Thus, there may be some disparity between the data being employed and the actual traits of the families whose children attend the school since not all of the enrolled students live in the same census tract as the school and not all of the students in the census tract attend that school. The reasoning behind the usage of this measure is that the educational environment and academic level within the home has been widely thought to be positively correlated with student performance. It is likely that, on average, a parent with a bachelor's degree or higher is more likely to have books in the home and a job with higher income than those who lack such education.

All of the variables employed in this study are used as a means of assessing the overall role of race, as exhibited by self-segregation and clustering, in Durham primary education institutions. Variables employed beyond school racial composition were added to supplement the initial findings and account for the unexplained variance in EOG scores and to reduce the bias of the racial composition variable, as it is correlated with these other factors. The limited amount of data available determined which variables were integrated into the model. Creating a larger model allowed subsequent multivariate regressions to more accurately reveal the extent of *de facto* segregation's effect on academic success in comparison with other correlated factors.

4. Data Issues

The two greatest issues that arose in this study are assumptions and inconsistencies within the data caused by the limited availability of pertinent information. In addition to specifics, there are broader assumptions inherent in this study. While these issues may contribute to the reduced robustness of empirical findings, they are not significant enough to greatly alter the outcome of this study.

The assumptions built into the dataset apply to information included beyond the scope of 2006. Although Durham County public schools publish their EOG test results annually, there is no easily accessible, comprehensive archive that tracks specific test information, such as a racial breakdown of scores, across various years. Thus, some of the empirical tests performed in this study are restricted to the 2006 school year. While other tests sacrificed some robustness in order to capture Durham across a wider timeframe.

However, in attempting to capture the overall trends in Durham, simply examining the 2006 school year is not sufficient. Thus, in an effort to integrate data from 2003-2005 and expand the dataset, many assumptions were forced to be drawn. Since the U.S. Census Bureau's most current information dates from 2000, factors in this study which use data from that source were fixed across the years 2003-2006.

These include: median household income, single-parent families, and educational attainment. Additionally, due to the limited availability of published school statistics during this timeframe, it was in the best interest of the study to fix the other independent variables as well: reduced and free lunch students and school racial composition. Essentially, the only data changing across years are EOG exam scores.

Although the fixing of these independent variables increased the assumptions incorporated in this study, it was necessary in order to produce the largest dataset possible. In effect, this study regresses EOG for different years against time-invariant explanatory variables. If the dataset were to include reduced and free lunch statistics from the 2004 and the 2005 school year, then school composition would likewise have to be altered to conform to those years. However, because data are not available for these variables in the years 2003 and 2004, EOG exam result statistics in that timeframe could not be employed in the study. Thus, while not fixing certain independent variables across years would have reduced the number of assumptions, it would have also greatly reduced the dataset. Fixing these independent variables across the timeframe of the study resulted in a reduced influence of 2006 outliers on the dataset. To reap the profit of a larger dataset, these additional assumptions were born into this empirical study.

Despite assumptions, overall results do not seem to be significantly impacted. Fixing the percentage of reduced and free lunch students and school racial composition implies the assumption that these factors remain unchanged across years. It is very likely that these factors are highly correlated from year to year, or have an inconsequential amount of variance. The reasoning behind this assumption is that reduced and free lunch students represent the poverty makeup of the surrounding population which is not likely to significantly change across three years. Additionally, fluctuations in school race populations are likely to be minimal. However, this comes with a caveat: the Hispanic population has been growing in Durham and especially in the schools since 2000. Despite this influx, it seems that the relative proportions of Whites and minorities at public schools have stayed the same. Furthermore, this study examines race percentages rather than the explicit number of people; thus, one percentage point could mean a larger influx than simply the increased enrollment of Hispanics by one individual. Since the variables reliant on U.S. Census Bureau’s 2000 data were fixed across this study, it was in the best interest of this study to fix all of the independent variables and thus produce the overall effect of having the EOG scores “normalized” across years. “Normalized” is used here in the sense that the effects of outliers would be minimized and results would better reflect school trends rather than isolated cases.

While the above assumptions were produced through the manipulation of the dataset, there were others inherent in its compilation. One of these broad assumptions is that EOG is, in fact, a measure of academic achievement and can be used as a valid tool to assess student educational performance. Even Durham County Public Schools admonish that "test scores should always be considered along with *all* other available information provided about your child"[28]. Furthermore, assumed in the regressions which employ these data is that every student accounted for in the 20-day enrollment ADM report took the EOG exams. Additionally, the reader must bear in mind that the census data are taken from 2000, whereas the this study captures the timeframe of 2003-2006; the reasoning behind these year gaps is that adequate tract-level census data was most recently published in the U.S. Census Bureau's 2000 census. Dummy variables were employed in this study to capture the differences between select groups of data. Dummy variables were created for the EOG exam testing years in order to highlight the disparities between testing years. Additionally, a magnet variable was introduced to capture the difference between magnet school student exam performance and non-magnet performance.

5. Calculations and Graphs

A. Self-Segregation/Clustering Index

(i) Mathematical calculation

In measuring the correlation between educational achievement and racial composition in local Durham public elementary schools, a valid index was created to assess the extent to which a certain race clusters at a specific school.[29] Such a measure was composed using school-specific race data in comparison with the overall composition of the twenty-eight public elementary schools examined in this study. The index employs percentage data because that is a relative measure that can be compared across schools, whereas comparing actual numbers would lead to inaccurate conclusions. Since the index employs percentage data, the relative percentages of the different races in each school in the dataset were first calculated using the following equation:

$$R_{ij} = r_{ij} / P_j \qquad i \in [1,6],\ j \in [1,28] \quad \text{where}$$
$$P_j = \sum_{i=1}^{6} r_{ij} \qquad j \in [1,28]$$

Where r_{ij} denotes the race population at school j of race i, classified within the set [1,6] where {1: White, 2:Black, 3: American-Indian, 4:Asian, 5: Hispanic, 6: Multiracial}; P_j is the total population enrolled at school j; and R_{ij} is the percentage of race i in the total population of school j. Figure 1 shows the relative

[28] Understanding the Individual Student Report for the North Carolina End-of-Grade Tests –Grades 3, 4, and 5.
[29] "Clustering" as termed here may be referred to later as self-segregation. For the purposes of this paper, these terms are synonymous unless otherwise noted.

racial compositions of the twenty-eight schools examined in this study. Additionally, total enrollment percentage breakdown by race was computed using the following the equation:

$R_i = r_i / P \qquad i \in [1,6]$ where
$r_i = \sum^{28}_{j=1} r_{ij} \qquad i \in [1,6]$ and
$P = \sum^{28}_{j=1} P_j$

Where r_i denotes the total race population for race i among the twenty-eight schools examined; P is the total population of the twenty-eight schools examined; and R_i is the total percentage of race i in the set examined. I confined R_i to the set of schools examined because it would most accurately capture the public school-bound population. If R_i were to reflect the entire racial composition of Durham County, that would be an inaccurate depiction of the amount of segregation present in schools because not everyone in Durham County attends a public elementary school. Yet this draws the question: why not establish a compromise and have R_i reflect the entire school-bound population rather than restrict it to only those attending the public schools examined in this study? While this is a valid measure, it is not relevant here. Because the focus of this study is the correlation between school performance and segregation, there needs to be an index across schools for which there is EOG exam data. In Durham, while it would be a valid study to examine the relative academic achievement of private and public school students since such divisions often lie along racial lines, there is no tool that can be used to measure private school student performance. Limited by these restrictions, the clustering index employed is a measure of the relative dominance of a certain race in a specific public school:

$I_j = R_{ij} / R_i \qquad i \in [1,6], j \in [1,28]$

Where R_{ij} is the percentage of race i at school j, R_i is the total percentage of race i in the twenty-eight schools examined, and I_j is the relative level of self-segregation by race i at school j. In essence, this index determines how closely a race's population at a chosen school matches that race's distribution in the entire school enrolled population. The index begins at 0 but really has no cap because these percentages can become infinitesimally small and thus cause the index to become infinitely large. An index measure of 1 indicates that neither clustering nor dispersion of that specific race is occurring. However, $0 < I_j < 1$, indicates that there is flight of that race away from those institutions, what will be termed in this paper as an "under-presence." Similarly, $I_j > 1$ indicates that clustering is occurring; the extent of that agglomeration is captured by the size of the index, with a larger index corresponding to greater clustering.

This index is realized in Figure 2, with the dotted line indicating a baseline (index value =1, no clustering).

(ii) Theoretical interpretation

While this index does not directly measure *de facto* segregation between races, it is a valid indicator of the extent to which certain races self-segregate. For instance, an index of 1.5 for Blacks at a certain public elementary school translates numerically as that school having fifty percent more Blacks than the average county distribution. With Blacks making up about fifty percent of the public school bound population, an index of 1.5 would translate into a school that was composed of seventy-five percent Blacks, indicating a clear concentration of Blacks at that school. Additionally, an index of 0.7 would indicate the opposite; this calculation means that thirty percent less than the average county distribution of this racial group are enrolled in this institution. In essence, values between 0 and 1 capture the extent to which a certain race's population disfavors a specific school, with lower values corresponding to least preference.

The term "disfavor" is used lightly here. This self-segregating phenomenon is more than simply a "choice with one's feet." Rather, the region in which one resides, the determinant of one's elementary school in all cases excepting magnet, charter, and private schools, is correlated with many factors beyond simply personal preference. While there is a "preference" at work, one must bear in mind that there are also some limitations. For instance, a poor Black family will not be able to purchase a home in a rich, White neighborhood and thus is unlikely to attend the public school in that zone.

However, while this index is a valid measure for race-specific clustering, it only depicts "first-generation segregation," defined as students of different races attending separate schools[30]. This index fails to capture "second-generation segregation" which means that "students are segregated by race within a desegregated school because they are taught in racially identifiable ability groups or academic tracks"[31]. Thus, while both forms of segregation have an impact on academic achievement, only the former is captured empirically in this study.

Despite the above caveat, this index is immensely important in painting a picture of the student body enrolled in Durham schools and the characteristics which accompany the clustering of specific

[30] Mickelson, R. A Blow to Equal Opportunity Education. (2001, October 26). *The News and Observer (Raleigh, NC).* http://64.233.169.104/search?q=cache:ZX5u5OM73IkJ:epicpolicy.org/files/epru-0110-107.doc+A+Blow+to+Equal+Opportunity+Education&hl=en&ct=clnk&cd=1&gl=us (2007, November 2).

[31] Ibid.

races. Additionally, this index lends itself very easily to the creation of dummy variables which capture the difference in academic achievement between race-specific clustered regions and non-clustered regions. These dummy variables code for the clustered regions and thus take on the value of zero when the index for a selected race is <1 and took on a value of one when the index is between 0 and 1.[32] By controlling for clustering, this allows the regression analysis to reveal the impact of race-specific agglomerations on academic performance and the significance of such phenomena in the overall picture of Durham education.

(iii) Application: inclusion in linear regressions

Trends in Durham primary education are revealed through the employment of this race-specific clustering index dummy in linear regression analysis. This study examines the disparities in EOG exam performance between regions of race-specific clustering and regions of race-specific under-presence. In order to maximize the number of data points, I used EOG percentile rank data from 2003-2006[33]. This dataset comes with the assumption that the same index value for a school is maintained across all four years. Furthermore, I implemented additional dummy variables to capture the variance in EOG percentile rank across years: Dummy2006, Dummy2005, Dummy2004. Dummy2006 takes on the value of 1 for EOG percentile rank scores in 2006, and it takes a value of 0 for all other years, etc. These dummy variables capture the variance between a specific testing year and, in this case, 2003. With all the dummy variables in place, EOG percentile rank in Reading (READEOG) and Math (MATHEOG) is regressed against a race-specific clustering indices dummy, where Wcluster and Hcluster represent the dummy variables controlling for the clustering of the White and Hispanic populations, respectively[34]:

Table 1: Race clustering and Reading EOG exam performance

READEOG	**"R-sq" = 0.3136**			**READEOG**	**"R-sq" = 0.3045**		
	Coefficient	t	P > |t|		Coefficient	t	P > |t|
Wcluster	0.1048	6.37	0.000	Hcluster	-0.0952	-6.32	0.000
Dummy2006	-0.0156	-0.74	0.463	Dummy2006	-0.0147	-0.69	0.491
Dummy2005	0.0037	0.17	0.862	Dummy2005	0.0046	0.21	0.831
Dummy2004	0.3740	1.75	0.083	Dummy2004	0.0374	1.74	0.085
cons	0.7919			cons	0.8723		

Table 2: Race clustering and Math EOG exam performance

[32] No index took on the value of exactly one, so these ranges were appropriate.

[33] As noted before, these years refer to the year in which the test was administered not the school year (e.g. 2006 refers to the results at the end of the 2005-2006 school year).

[34] 110 observations were conducted in each of the successive tests. In this regression and in subsequent, only the White, Black, and Hispanic populations are examined because there are not significant amounts of data for other races' populations.

MATHEOG	"R-sq" = 0.7641			MATHEOG	"R-sq" = 0.7304		
	Coefficient	t	P > | t |		Coefficient	t	P > | t |
Wcluster	0.1060	5.76	0.000	Hcluster	-0.0725	3.99	0.000
Dummy2006	-0.3483	-14.49	0.000	Dummy2006	-0.3470	-13.50	0.000
Dummy2005	-0.0401	-1.67	0.098	Dummy2005	-0.0388	-1.51	0.134
Dummy2004	0.1778	0.73	0.465	Dummy2004	0.0178	0.69	0.495
cons	0.8567			cons	0.9257		

The above regressions reveal the extent to which *de facto* segregated areas of specific race populations fare better or worse than their counterparts at schools with less concentrated populations. The self-segregation or clustering coefficients are negative for the Hispanic populations, while they take on a positive value for Whites. However, the value of the coefficient for Hcluster in both the Math and Reading EOG regressions is very small. By contrast, Wcluster has a positive coefficient (0.1048 for READEOG and 0.1060 for MATHEOG) which takes on twice the value of the minority coefficients. Because the Hispanic and White populations compose similar percentages of the overall school's population, these regressions indicate that the impact of White clustering on outstanding exam performance is more significant than the impact of Hispanic clustering on negative exam performance. The high r-squared value, especially for the MATHEOG regressions, indicates that this is a significant trend. These regressions tell one piece of the story of a Durham education.

Additional regressions involving a different race variable corroborate the above results. While Wcluster and Hcluster capture variations between high concentration and low concentration areas for a given race, they fail to quantify the influence of race-specific population fluctuations on expected exam score. Replacing the clustering dummy variables with race percentages in the previous regressions allows for the determination of coefficients which capture the degree to which student exam scores will fluctuate as that selected race population changes; these regressions yield the following:

Table 3: School-specific Racial Composition and Reading EOG exam performance

READEOG	"R-sq" = 0.3508			READEOG	"R-sq" = 0.3691		
	Coefficient	t	P > | t |		Coefficient	t	P > | t |
perW	0.2380	7.09	0.000	perHandB	-0.2350	-7.40	0.000
Dummy2006	-0.0149	-0.72	0.472	Dummy2006	-0.0153	-0.75	0.452
Dummy2005	0.0044	0.22	0.830	Dummy2005	0.0039	0.20	0.845
Dummy2004	0.0374	1.80	0.074	Dummy2004	0.0374	1.83	0.070

cons	0.7770	cons	0.9957

Table 4: School-specific Racial Composition and Math EOG exam performance

MATHEOG	"R-sq" = 0.7752			MATHEOG	"R-sq" = 0.7829		
	Coefficient	t	P > | t		Coefficient	t	P > | t
perW	0.2421	6.33	0.000	perHandB	-0.2424	-6.72	0.000
Dummy2006	-0.3476	-14.81	0.000	Dummy2006	-0.3481	-15.09	0.000
Dummy2005	0.0394	-1.68	0.097	Dummy2005	-0.0399	-1.73	0.087
Dummy2004	0.0178	0.75	0.455	Dummy2004	0.0178	0.76	0.447
cons	0.8414			cons	1.0664		

Where perHandB is the percent of the student body composed of Hispanics and Blacks, perW is the percent of the study body that self-identified as White. These regressions are revealed in Figures 13 and 14. The r-squared is high, especially for the regressions involving MATHEOG. The correlation coefficient is positive for perW and negative for perHandB, revealing that both an increase in percent White at a school and a decrease in percent Hispanic and Black results in an expected increase in average exam score at that school.

However, the above results draw many questions still unexplained by the model: why do schools which exhibit White clustering fare better than schools with minority clustering? Is there simply a larger population of Whites with high standardized test scores raising the average and masking the mediocre performance of minorities at those same institutions? Or are there equal parts minority and White populations contributing to the overall improved school performance? What are the differences between academic environments which may be contributing to academic performance disparities between White and minority populations?

B. Regression Analysis of Durham County Public Fifth-Grade Education

(i) Explanation of scoring trends on Reading and Mathematics EOG exams from 2003-2006

The big picture of Durham County public elementary education is captured in Figures 3-12. Figure 3 and 4 realize the trends in Math and Reading EOG exam percentile rank for fifth graders in Durham County public elementary schools across the timeframe 2003-2006. The Math EOG exam results for 2006 are substantially lower than for any other testing year because the EOG test changed for the 2006 school year. The extent of this difference is captured by the Dummy2006 variable in regressions involving MATHEOG. It is my conclusion that MATHEOG regressions have higher r-squared values because of the impact of the new test in 2006. The new test magnified the environments in which Math programs were below adequate. Additionally, it spotlighted the environments in which students were truly outperforming their peers.

(ii) EOG exam performance broken down by race

Figures 5, 6, and 7 display a racial breakdown of percentile rank deviation from the county average on the Math and Reading EOG exams. By comparison, it is evident that Whites, regardless of school environment, are outperforming other test takers by a strong margin in Math and by a fair margin in Reading. Figures 6 and 7 display minority trends, indicating that minorities tend to perform below average. Percentile rank averages across races are summarized in Figures 8 and 9. Since it is apparent that Whites are not simply born smarter than Blacks and Hispanics, there must be some traits that are linked with the White population that are causing those scores to be higher; the reverse logic applies to minority populations: there must be some traits which are linked with minorities in Durham which are causing their standardized exam scores to be lower than those of Whites. Only multivariate regressions can capture which variables are statistically significant determinants of academic performance.

While the final set of graphs within this selected series does not provide an answer to the musings in the above paragraph, the graphs do provide an examination of trends among specific race populations in Durham. These graphs are Figures 10, 11, and 12. Specifically, they display a selected race's deviation in EOG exam percentile rank from the average score obtained by that race population within Durham County. This allows for extreme cases to be pinpointed and for the subsequent identification of variables involved in such disparities which can be incorporated into multivariate regressions. When viewed simultaneously, these graphs construct a specific school's academic performance breakdown across races. For instance, it is evident that E K Powe is an extreme case; with the exception of White performance on the Reading EOG exam, all students significantly underperform in comparison with their counterparts at other local schools. What is making the academic environment less conducive to learning at EK Powe? Is it less affluent? Is there a less educated adult population? Is there a plethora of single-parent families? This paper attempts to answer the above questions in subsequent multivariate linear regressions which employ variables thought to be correlated with academic performance. After these regressions, statistically significant factors are more closely studied through additional regressions.

In an attempt to address the above questions, multivariate regressions involving the race percent variable are run. While bivariate linear regressions are indicative of general trends, they do not tell the full story. However, selected bivariate regressions are incorporated into this study because they reveal certain patterns aimed at explaining questions such as: are Blacks and Hispanics faring better in the predominantly White environments or is the larger concentration of Whites simply raising the average? Do Hispanics perform best in predominantly Hispanic settings? The linear regressions revealed in Figures 30-34 provide an answer, albeit overly simplistic, to these questions. In these graphs, percentile rank achieved by each race on the Mathematics and Reading EOG exams respectively is regressed against the percent of that race's population enrolled at that local Durham elementary school.

The r-squared value for many of these regressions is quite low and the slopes are close to zero, indicating that being around individuals of the same race may not be the only factor contributing to academic achievement. Figure 30 has somewhat significant r-squared values (0.159 for READEOG and 0.120 for MATHEOG), corroborating the trends found in Tables 1 and 2. School populations which tend to perform better academically also exhibit White clustering. However, this analysis does not reveal the full story. The correlation between race and exam performance could reflect class or other variables which were omitted as independent variables in Tables 1 and 2 or which were captured under the "race" variable. For instance, the high-valued slopes in Figures 28 and 29 indicate that minority populations are correlated with a large number of single-parent families; such an atmosphere can mean less income for the family and a less stable home environment, negatively affecting a student's academic career. This observation led to a plethora of queries: what other factors are relevant? What is being masked by the "race" variable? How do races fare in different racial environments?

Figure 30 reveals that Black scores are expected to improve in populations where there is an increased number of Whites. The correlation coefficient is positive and at 0.218 for READEOG and 0.236 for MATHEOG, indicating that any fluctuations in the White population has a fairly significant influence on Black academic success. In Figure 32, the very low r-squared values reveal that a high White concentration is not very highly correlated with White exam performance. The low, positive correlation coefficients indicate that changes in the concentration of Whites have little effect on White exam performance. The intercept for White EOG percentile rank is much higher than for Blacks, especially in Math, indicating that Whites perform better across the board, regardless of racial environment. In examining Figure 30, it can be posited that Black performance on EOG exams is contributing to the higher averages. The above scenario is revisited in multivariate regressions to follow in this paper.

The Hispanic trends observed in these same graphs defy the patterns exhibited by both Blacks and Whites. Figure 31 and 34 indicate that Hispanics are expected to perform poorly at institutions which have a high concentration of Whites or a high concentration of Hispanics. Figure 34 corroborates the results of Table 2, which indicate that schools with a clustering of Hispanics tend to do worse, on average, than schools with a less prominent Hispanic population. The r-squared values indicate the existence of a trend: 0.154 for READEOG and 0.209 for MATHEOG. The correlation coefficients are both negative and high, indicating that fluctuations in the Hispanic populations have a significant influence on Hispanic academic success.

However, Figure 31 is more difficult to interpret. It appears that an increase in the White population at a school would result in an expected decrease in Hispanic exam scores. The r-squared is very low here indicating that this direct, linear correlation may not best describe this relationship. The correlation coefficients are much lower than for Figure 34, indicating that White population fluctuations are less influential determinants in the academic equation than fluctuations in the Hispanic population. It is difficult to interpret why the results depict Hispanics performing poorly in both predominantly White and predominantly Hispanic schools. Since Hispanics do relatively well somewhere, those school environments would have to be either racially balanced or mainly Black schools. Or even, perhaps the language barrier plays a role. In predominantly White schools, Hispanics who do not understand English must struggle through classes with minimal aid from teachers who know only a few words in Spanish. Additionally, in predominantly Hispanic settings, while the language barrier is no longer an issue, there is perhaps another factor contributing to reduced academic success. This study posits that such a factor is the relative affluence of the area. Subsequent multivariate regressions and a closer examination of statistically significant variables through bivariate linear regressions reveal some potential forces motivating these graphs.

(iii) Race variables' inclusion in multivariate linear regressions of race-specific test scores

While overly simplistic trends which capture the influence of one race on another's academic performance are noted in Figures 30-34, the significance of this impact is more critically observed in the following multivariate regressions. However, the subsequent equations come with a caveat. Since only data from the 2006 school year EOG exams were race-specific, these linear regressions are run within the constraints of a very restricted dataset, and thus are predisposed to have a larger margin of error when capturing trends in Durham.[35]

Table 5: Reading EOG exam performance by Race

WRead	"R-sq" = 0.4384

[35] Even though 28 Durham public elementary schools are examined here, there were some that did not have significant populations of a certain race, and thus limited the dataset to less than 28 observations. These restrictions most severely influenced datasets for the Hispanic and White populations. Additionally, as a rule of thumb, the impact of outliers grows as the dataset shrinks.

	Coefficient	t	P > | t |
perW	0.231908	4.86	0.000
percgrad	0.172785	3.76	0.000
singlepar	0.37145	3.60	0.001
medHousY	0.026386	2.43	0.018
redfreeL	0.176586	3.19	0.002
magnetdummy	-0.02917	-1.38	0.172
advteach	0.207132	2.26	0.027
cons	0.41523	4.55	0.000

BRead	**"R-sq" = 0.2741**		
	Coefficient	t	P > | t |
perW	0.044526	0.47	0.638
percgrad	-0.09794	-1.1	0.294
singlepar	0.182659	0.96	0.340
medHousY	0.011257	0.55	0.587
redfreeL	-0.24668	-2.55	0.012
magnetdummy	-0.03135	-0.92	0.361
advteach	-0.3052	-2.29	0.024
cons	0.953985	5.62	0.000

HRead	**"R-sq" = 0.5545**		
	Coefficient	t	P > | t |
perW	-0.33709	-2.2	0.035
percgrad	-0.30673	-3	0.004
singlepar	-0.02238	-0.10	0.918
medHousY	-0.04141	1.76	0.083
redfreeL	-0.19677	-1.97	0.052
magnetdummy	0.20146	5.31	0.000
advteach	-0.30176	-2.16	0.034
cons	0.885015	4.36	0.000

Table 6: Mathematics EOG exam performance by Race

WMath	**"R-sq" = 0.4404**		
	Coefficient	t	P > | t |
perW	0.208572	2.07	0.043
percgrad	0.0849726	0.88	0.384
singlepar	1.014521	4.65	0.000

medHousY	0.1185413	5.15	0.000
redfreeL	0.0788463	0.67	0.503
magnetdummy	0.0880978	1.97	0.053
advteach	-0.0755371	-0.39	0.698
cons	-0.1685273	-0.87	0.386
BMath	**"R-sq" = 0.4033**		
	Coefficient	t	P > | t |
perW	-0.2317505	-2.18	0.031
percgrad	-0.0922569	-0.88	0.380
singlepar	-0.0401487	-0.19	0.852
medHousY	0.0124163	0.53	0.594
redfreeL	-0.4450404	-4.10	0.000
magnetdummy	0.0767571	2.00	0.049
advteach	-0.5162322	-3.44	0.001
cons	0.885495	4.63	0.000
HMath	**"R-sq" = 0.4907**		
	Coefficient	t	P > | t |
perW	-1.032226	-4.84	0.000
percgrad	0.2092383	1.51	0.134
singlepar	0.7044137	2.39	0.020
medHousY	0.0954234	2.98	0.004
redfreeL	-0.2197851	-1.62	0.110
magnetdummy	0.2247269	4.35	0.000
advteach	0.190606	1.00	0.320
cons	0.0281722	0.10	0.919

Where HMath, HRead, BMath, BRead, WMath, and WRead are Math and Reading EOG exam scores, as measured by percentile rank, achieved by Hispanics (H), Blacks (B), and Whites (W) respectively; percgrad is the percent of individuals in the same census tract as the elementary school who have earned at least a college degree; singlepar is the percent of families in the school's census tract which identify as having a single-parent head of household; medHousY is the median household income, given in the tens of thousands, of households within the school's census tract; redfreeL is the percent of students at a specific elementary school who are eligible for reduced-price and free lunch; and variables repeated from earlier equations have the same meaning. These regressions highlight a very noticeable and important trend in Durham that seems to corroborate Branch's theory. Although the classification of race was statistically significant in the linear regressions run in Tables 3 and 4, it becomes apparent that many other factors are influencing the academic environment. For instance, in predicting Black performance on the Reading and Math EOG exams, the most statistically significant factor was the percentage of students with reduced and free lunch. Thus, wealth and the education level of adult role models, rather than race alone, seem to be indicative variables of academic achievement. This theory is again evidenced in Tables 5 and 6 by White exam performance: medHousY is statistically significant in both. However, race cannot be completely dismissed because perW is statistically significant at the five percent level in almost all of the regressions in Tables 5 and 6. So with the inclusion of a multitude of other variables, what is occurring with the perW variable?

C. Explanation of Results in Multivariate Linear Regressions (in Tables 5 and 6) Involving Race-Specific Percentile Rank Scores

(i) School racial composition ("perW")

While race is not the dominating factor in the regressions above, it certainly still bears a statistical significance in our results. It is expected that the coefficient of perW would take on a positive value as seen in the results for WRead and WMath from Tables 5 and 6. Since White students typically come from upper middle class, educated, intact families, it is natural that such a stable home environment and financial situation would lead to higher scores. However, what is unexpected is the results seen for BRead, HRead, and HMath. The perW coefficient is negative and statistically significant in all of these instances. Do Whites really have a negative influence on minority achievement or is something else occurring here? In examining the raw data used to create the BMath regression in Table 6, it is apparent that the opposite trend is at work: there is a positive relationship between percent White and Blacks' exam performance. It seems that perW is linked with other variables included in the regression. Because the percent of college graduates in the census tract has an unexpected negative relationship with Black student performance, it could be influencing the sign of the percent White coefficient. Since Whites are associated with high levels of education, especially among local residents, it seems that this unspoken relationship, unable to be captured empirically, between Whites and adult educational attainment causes these two variables to move together and influence one another. The same logic can be applied to the singlepar variable to explain the negative perW coefficient for Hispanic Mathematics EOG, and the medHousY and singlepar variables' relationship with Whites and unexpected signs in Table 5 can be used to explain the negative perW value for Hispanic Reading EOG. While race still plays a role in these regression results, it does not hold the weight that this study first imagined it did.

(ii) Teacher education ("advtreach")

Another noticeable trend above is observed for Black student performance: the percentage of teachers with advanced degrees is negatively correlated with EOG scores in both Reading and Math. It is unclear why this is occurring. However, there are many possible explanations. First, Durham County public schools have an above-state-average teacher turnover level: 17.03 percent[36]. A teacher with an advanced degree will typically have less in-classroom teaching experience, and a more likely chance of turnover because of dissatisfaction with Durham County public schools. The constant flux of this intellectual population and disruption of academics is perhaps the phenomenon leading to the lower scores. It seems that the teachers being retained by the public school system are the least qualified: "The public, educators and policymakers realize that high quality teachers are essential for children to reach increasingly high standards; however, these teachers remain in short supply, especially in schools serving predominately poor and minority children."[37] Thus, it seems that the negative relationship between the percentage of teachers with advanced degrees and black student performance could be due to either: 1) less classroom experience of these teachers, and thus instructional barriers to student learning 2) high teacher turnover rate, creating unstable educational foundations at schools that are constantly looking to fill positions. Also, the advteach variable is statistically significant and its coefficient takes on a positive value only for White Reading exam performance. This finding indicates that teachers with advanced degrees can, in fact, contribute to improved exam scores. However, it seems that they could be more likely to remain in the public school system if they are teaching a school filled with wealthy, White students in a comfortable environment rather than at a school rampant with poverty. Figure 36 validates this possibility. As the percentage of reduced and free price lunch students increases, so does the rate of teacher turnover. The rate of teacher turnover is defined as "the percentage of teachers employed in a school last year who are no longer employed in the same school this year."[38] At the extremes, W.G. Pearson with 99 percent of the student body with reduced and free price lunch has an 86 percent teacher turnover rate. By comparison, Mangum with a 13 percent reduced and free price lunch statistic has only an 11 percent teacher turnover rate. Those which defy this general trend tend to be teachers at schools located in wealthy census tracts. For instance, Forest View has a 44 percent reduced and free lunch level, but only a 15% teacher turnover rate which can perhaps be explained by the fact that the median income level in that census tract is $78,8763. Again, this reflection on the percentage of teachers with advanced degrees shows that wealth, as it interplays with race, is contributing to the racial disparities in exam performance.

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[36] The Center for Teaching Quality. (2005). Attracting, Supporting and Maintaining New Teachers in Durham Public Schools. *Durham Public Education Network.* Retrieved from The Center for Teaching Quality Web site: http://www.teachingquality.org/pdfs/dpen_recruitretain.pdf (2008, March 8), p.1.
[37] Ibid.
[38] Ibid.

(iii) Magnet schools ("magnetdummy")

In addition to the number of teachers with advanced degrees, the magnet dummy reveals more of the landscape of Durham County public education. It seems that magnetdummy has the largest coefficient value and greatest impact on the exam results of the Hispanic students. Tables 5 and 6 show that magnetdummy for HRead is 0.20146 and for HMath is 0.22473. This means that Hispanic students' scores on EOG exams at magnet schools are 20 percentile points higher than at non-magnet public elementary schools. Why is this the case? It is unclear what traits magnet schools possess which non-magnet schools lack which would be leading to this differential for Hispanic students. After investigating Durham County public school curricula, it seems that the difference in performance is due to foreign language programs and programs intended to expand cultural horizons. Magnet schools publicize these classes on the Durham County Public School Web site under the following headings: "daily instruction in French, Spanish, or Mandarin Chinese" at Burton Elementary; "exploration of diverse cultures" at Club Boulevard Elementary; "series of interesting and challenging topics designed to produce culturally literate students" at R.N. Harris Elementary; and "foreign language instruction" at W.G. Pearson Elementary.[39] It seems that these culturally-sensitive and unique programs are beneficial, especially to Hispanic students. The magnet dummy also seems to positively contribute to both White and Black scores on the Math EOG scores, while it has a negative and weaker impact on White and Black Reading EOG scores. There was no definitive reason for this discrepancy since Durham County magnet programs are not specialized in mathematics. Perhaps mathematics in non-magnet programs is taught by non-specialists, causing the lower scores. There is no sure conclusion that can be drawn from these data because of causality issues and the existence other factors that are omitted or masked in these multivariate linear regressions. However, the greatest concern with drawing a conclusion here is that these data are extraordinarily limited. With only five magnet programs in local Durham elementary schools, the dataset is too small to establish conclusions with certainty.

(iv) Single-parent families ("singlepar")

Another variable exhibiting some interesting patterns is singlepar: the percentage of families in the same census tract as the nearest public elementary school headed by a single-parent. This variable is statistically significant and has a positive coefficient in the cases of Hispanic Mathematics EOG scores and White Reading and Mathematics EOG scores. As noted by Figure 37, the percentage of single parent families is negatively correlated with household income, and therefore, it is curious as to why its coefficient is positive for exam results since wealthier individuals and regions tend to fare better than

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[39] Magnet Programs. (2006). *Durham Public School District Webpage*. Durham County Public Schools. http://www.dpsnc.net/index.php?option=com_content&task=view&id=1779&Itemid=1185 (2008, March 8).

poorer areas because of resources, family structure, etc. Figure 27 adds another piece to this puzzle, indicating that as the percentage of White students at a school increases, the predicted level of single-parent families decreases. Thus, schools with the largest percentage of single-parent children have the largest enrollment numbers for Blacks. What is occurring here? When examining two extreme cases which fit the above description, W.G. Pearson and Burton Elementary, the conclusion is clear. At these schools, there are enormous disparities between White and Black student performance with Whites outperforming Blacks by a large margin. How can such a differential exist? These two schools happen to be magnet schools. W.G. Pearson and Burton Elementary both boast magnet programs and are located in some of the poorest regions in Durham (as indicated by very low median household income levels). Thus, because the single-parent household statistics are drawn from the school's census tract and local school children are districted to these schools, there is a large enrollment of poor, Black students from single-parent families. However, the demographics of White students from outside of the region enrolled in these magnet programs are unable to be captured by these statistics. Thus, it appears that the Whites are achieving high scores because they are probably not the ones coming from single-parent households or low-income families. This hypothesis emphasizes that home environment and personal wealth can perhaps outweigh the classroom environment in terms of impact on academic achievement. For instance, wealthy families who enroll their children in Burton because of its foreign language programming can also afford tutors for math and reading. In examining the singlepar variable in light of its positive relationship with Hispanic performance on the Mathematics EOG exam, a similar conclusion can be reached. For the most part, the schools with the highest percentage of single-parent families are those with magnet programs. This does not indicate the family structure of the students enrolled, but rather, the demographics of the region, at the census tract level, in which the elementary school is located. Thus, this discrepancy makes it difficult to draw conclusions about the impact of family structure on academic performance. The high single-parent statistic is sometime an indicator of the presence a magnet school. Hispanics tend to fare better at institutions which offer magnet programming and thus would fare better in areas correlated with high rates of single-parent families. While the coefficient of singlepar is found to be negative for the Hispanic Reading EOG, it is also not statistically significant in that case. It can be concluded that Durham County schools with magnet programs are typically located in impoverished areas and thus have a high single-parent statistic; also, Whites fare differentially better than Blacks at these institutions.

(v) Adult educational attainment ("percgrad")

Another variable which produced outstanding results is percgrad: the percentage of college graduates in the same census tract as the public elementary school. This variable is statistically significant and exhibits a positive, and expected, relationship in the multivariate linear regression with White Reading EOG score as the dependent variable. However, the anomaly is when this variable takes on a negative value and is statistically significant for the linear regression with Hispanic Reading EOG as the dependent variable. The same reasoning that applied to the anomalous results seen in the singlepar variable can be applied here. Hispanics fare better at magnet schools which tend to be located in some of the poorest regions in Durham (as evidenced by the median household income in that census tract). Figures 35 and 37 indicate that impoverished areas are dominated by single-parent families and those who low levels of education. Thus, these magnet programs which are beneficial to Hispanic education tend to be located in poor census tracts with high levels of single-parents and low levels of college-educated adults. The reason that the percgrad variable is able to take on a positive coefficient for the White Reading EOG score is because White students more often enroll at schools in wealthy areas near their neighborhoods rather than magnet programs, and thus, their local census tract statistics reveal wealthy, educated, intact families. The disparity between census tract data and school level data is one of the largest issues with the datasets in this study.

D. Explanation of Results in Multivariate Linear Regressions (in Tables 7 and 8) Involving Average Percentile Rank Scores on EOG Exams

(i) Multivariate linear regression

It was difficult to draw conclusions using only the extremely limited 2006 dataset, so additional multivariate linear regressions were run which employed 2003-2006 EOG school averages in Math and Reading, respectively, to find the relationship between specific characteristics and academic achievement. The same additional explanatory variables were utilized in these regressions: educational attainment level of those in the surrounding area, median household income, reduced-price and free lunch eligibility, teachers with advanced degrees, and family structure. The race variable is also included in these regressions to validate the finding that its influence is negligible.[40] The multivariate linear regressions produced the following:

Table 7: Average Reading and Mathematics EOG Exam Percentile Rank Score as Predicted by Multiple Variables

READEOG	**"R-sq" = 0.5650**			**MATHEOG**	**"R-sq" = 0.8369**		
	Coefficient	t	P > | t |		Coefficient	t	P > | t |

[40] While the race variable has negligible influence in the linear regression model, there are certain traits associated with specific racial subgroups in Durham which still make those classifications extremely useful in characterizing classroom environments.

perW	-0.0710984	-1.21	0.230	perW	5.92E-05	0.00	0.999
percgrad	-0.1181922	-1.94	0.055	percgrad	-0.02426	-0.28	0.781
singlepar	0.152435	1.30	0.197	singlepar	0.140244	0.84	0.405
medHousY	0.0175113	1.37	0.175	medHousY	0.024179	1.32	0.190
redfreeL	-0.3590807	-5.98	0.000	redfreeL	-0.31105	-3.62	0.000
magnetdummy	-0.0042652	-0.20	0.840	magnetdummy	0.012009	0.40	0.691
advteach	-0.1471973	-1.72	0.089	advteach	-0.25494	-2.08	0.040
dummy2006	-0.0146528	-0.84	0.401	dummy2006	-0.34969	-14.08	0.000
dummy2005	0.0046329	0.27	0.790	dummy2005	-0.34969	-14.08	0.000
dummy2004	0.0374074	2.14	0.035	dummy2004	0.017778	0.71	0.479
cons	1.007629	9.60	0.000	cons	1.001018	6.67	0.000

(ii) Explanation of Results

These results indicate that reduced and free lunch eligibility is a significant variable at the one percent level. Although reduced and free lunch rate was not statistically significant in the linear regression models in Tables 5 and 6, it has been evidenced by Table 7 that the general wealth of a school is a valid indicator of the expected academic achievement of its students. How do we reconcile this discrepancy? Examining Figures 8 and 9, certain races fare worse than others academically, regardless of school, simply because those populations are associated with higher poverty rates. Thus, while wealth will play a large role in determining the overall academic success of a school, it is less of a factor in explaining intra-racial test performance disparities. Additionally the negative relationship between the education level of teachers and the scores of their students can be explained by the high turnover rate of those individuals. These results are very revelatory of the institution of public education in Durham.

E. Impact of Compensated Lunch on EOG Exam Performance

(i) Forecasting school scores (varying numbers of those compensated)

From the above linear regressions, it is apparent that wealth, as coded for by the reduced and free lunch variable, plays a significant role in determining academic achievement. So how important is wealth to education? This study set out to discover an empirical result. While maintaining all the school-specific demographics except the reduced and free lunch price level, this paper predicts student performance outcomes. In the first test, all schools take on statistic of Mangum Elementary: 13% reduced and free lunch. In the second test, all schools take on a 99% reduced price and free lunch level to match that of W.G. Pearson. Upon changing the redfreeL value, the percent increase or decrease, as related to the normal predicted exam performance, was calculated. The following results were obtained:

Table 8: EOG Exam Percentile Rank Predictions if all Schools had 13% of their Student Body with Reduced Price or Free Lunch[41]

	Reading EOG (percentile)			Mathematics EOG (percentile)		
School (% w/compensated lunch)	**Norm**	**Mangum (13%)**	**% increase**	**Norm**	**Mangum (13%)**	**% increase**
Bethesda Elementary (83%)	71.37	96.51	35.22	44.63	66.41	48.78
Burton Elementary (80%)	75.71	99.76	31.78	43.91	64.75	47.46
Eastway Elementary (90%)	75.37	103.02	36.68	45.10	69.05	53.11
Easley Elementary (13%)	93.16	93.16	0.00	69.80	69.80	0.00
Eno Valley Elementary (53%)	82.73	97.10	17.36	57.36	69.80	21.69
Club Blvd Elementary (48%)	84.34	96.91	14.90	56.06	66.94	19.42
Creekside Elementary (33%)	85.56	92.74	8.39	65.16	71.38	9.55
Glenn Elementary (79%)	76.06	99.76	31.16	48.30	68.83	42.51
Hillandale Elementary (40%)	85.49	95.18	11.34	57.93	66.32	14.50
Hope Valley Elementary (33%)	88.75	95.93	8.09	61.83	68.05	10.06
Holt Elementary (58%)	80.37	96.53	20.11	51.83	65.83	27.01
Forest View Elementary (44%)	83.46	94.59	13.34	62.12	71.76	15.52
Lakewood Elementary (78%)	73.70	97.04	31.67	47.53	67.74	42.54
Little River Elementary (20%)	90.73	93.25	2.77	65.94	68.12	3.30
Fayetteville St. Elementary (85%)	76.55	102.40	33.78	45.22	67.61	49.53
George Watts Elementary (81%)	69.29	93.70	35.24	41.96	63.11	50.41
Mangum Elementary (13%)	93.09	93.09	0.00	71.33	71.33	0.00
Merrick-Moore Elementary (73%)	77.61	99.15	27.76	49.14	67.81	37.98
Morehead Montessori (24%)	84.88	88.83	4.65	58.52	61.94	5.85
Oak Grove Elementary (43%)	88.04	98.81	12.24	61.16	70.49	15.26
Parkwood Elementary (48%)	84.13	96.69	14.94	60.66	71.55	17.95
E K Powe Elementary (70%)	73.35	93.82	27.90	43.94	61.67	40.35
Pearsontown Elementary (40%)	86.99	96.69	11.15	60.01	68.41	14.00
R N Harris Elementary (71%)	81.39	102.22	25.59	55.24	73.28	32.66
Southwest Elementary (43%)	83.31	94.09	12.93	60.69	70.02	15.38
CC Spaulding Elementary (83%)	74.82	99.95	33.60	43.64	65.42	49.89
W G Pearson Elementary (99%)	70.43	101.31	43.84	41.38	68.13	64.65
Y E Smith Elementary (68%)	77.32	97.07	25.54	48.64	65.74	35.18

Table 9: EOG Exam Percentile Rank Predictions if all the Schools had 99% of their Student Body with Reduced Price or Free Lunch[42]

	Reading EOG (percentile)	Mathematics EOG (percentile)

[41] "Percentile rank" as it is used here refers to the actual percentile given (e.g. 85th percentile as 85) rather than its notation form as a percent (e.g. 85th percentile as 0.85) [this latter form was used in regression analysis in this paper]. The change is used here because it seemed easier to interpret visually in a table.

[42] See footnote 38.

School (% w/compensated lunch)	Norm	W.G. Pearson (99%)	% decrease	Norm	W.G. Pearson (99%)	% decrease
Bethesda Elementary (83%)	71.37	65.63	-8.05	44.63	39.66	-11.15
Burton Elementary (80%)	75.71	68.88	-9.01	43.91	38.00	-13.46
Eastway Elementary (90%)	75.37	72.14	-4.29	45.10	42.30	-6.21
Easley Elementary (13%)	93.16	62.28	-33.15	69.80	43.05	-38.32
Eno Valley Elementary (53%)	82.73	66.22	-19.96	57.36	43.05	-24.95
Club Blvd Elementary (48%)	84.34	66.03	-21.71	56.06	40.19	-28.30
Creekside Elementary (33%)	85.56	61.86	-27.70	65.16	44.63	-31.51
Glenn Elementary (79%)	76.06	68.88	-9.44	48.30	42.08	-12.88
Hillandale Elementary (40%)	85.49	64.30	-24.78	57.93	39.57	-31.68
Hope Valley Elementary (33%)	88.75	65.05	-26.70	61.83	41.30	-33.20
Holt Elementary (58%)	80.37	65.65	-18.32	51.83	39.07	-24.61
Forest View Elementary (44%)	83.46	63.71	-23.66	62.12	45.01	-27.54
Lakewood Elementary (78%)	73.70	66.16	-10.23	47.53	40.99	-13.74
Little River Elementary (20%)	90.73	62.37	-31.26	65.94	41.37	-37.27
Fayetteville St. Elementary (85%)	76.55	71.52	-6.57	45.22	40.86	-9.63
George Watts Elementary (81%)	69.29	62.82	-9.33	41.96	36.36	-13.34
Mangum Elementary (13%)	93.09	62.21	-33.17	71.33	44.58	-37.50
Merrick-Moore Elementary (73%)	77.61	68.27	-12.03	49.14	41.06	-16.46
Morehead Montessori (24%)	84.88	57.95	-31.73	58.52	35.19	-39.87
Oak Grove Elementary (43%)	88.04	67.93	-22.84	61.16	43.74	-28.48
Parkwood Elementary (48%)	84.13	65.81	-21.77	60.66	44.80	-26.15
E K Powe Elementary (70%)	73.35	62.94	-14.20	43.94	34.91	-20.53
Pearsontown Elementary (40%)	86.99	65.80	-24.35	60.01	41.66	-30.58
R N Harris Elementary (71%)	81.39	71.34	-12.35	55.24	46.53	-15.77
Southwest Elementary (43%)	83.31	63.20	-24.14	60.69	43.27	-28.70
CC Spaulding Elementary (83%)	74.82	69.07	-7.68	43.64	38.66	-11.40
W G Pearson Elementary (99%)	70.43	70.43	0.00	41.38	41.38	0.00
Y E Smith Elementary (68%)	77.32	66.19	-14.40	48.64	38.99	-19.83

(ii) Explanation of Results

Analyzing these results, it is apparent that reduced and free lunch plays a large role in determining academic achievement. It seems that the presence of wealth and the lack of wealth can drastically alter exam performance. In examining the extremes, this hypothesis is validated. W.G. Pearson Elementary, which offers reduced price and free lunches to 99% of the student body, exhibits enormous academic improvements when given the 13% reduced price and free lunch level of Mangum Elementary. Looking at Table 8, its students scores change from near the 70^{th} percentile (outperform 70% of those who took the exam) to over 100^{th} (not even a possible percentile) in Reading, and from the 41^{st} to the 68^{th} percentile in Mathematics. The largest percentage increases in percentile rank (one form of scoring on the EOG exams) are exhibited from schools with the lowest reduced price and free lunch levels and lowest initial scores. Table 9 reflects these same results. Students at Mangum who had the highest EOG exam results, with students achieving in the 93rd percentile in Reading and the 71st percentile in Mathematics, suffer drastic decreases. Altering its demographics to reflect the reduced price and free lunch level of W.G. Pearson (99%), these scores drop to the 62nd percentile for Reading and the 45th percentile for Math. These large disparities are the result of changing *only* the level of reduced price and free lunch students. It seems the redfreeL variable, a proxy for school relative poverty, plays a large role in predicting the academic attainment level at Durham County public schools.

(iii) Compensated Lunch Students Broken Down by Race

After noting that reduced price and free lunches have a significant impact on student performance, it seemed only logical to determine the relative prevalence of reduced and free lunch students among certain races. As evidenced by the multivariate regression, reduced and free lunch students is the most statistically significant variable in explaining fluctuations in academic achievement. Unfortunately, no available sources provide a breakdown of reduced and free lunch students by race. Thus, a new regression model is needed to answer our queries:

Table 10: Reduced Price and Free Lunch Levels as Related to School Racial Composition

RedfreeL		**"R-sq" = 0.7683**	
	Coefficient	t	P > | t |
perW	-0.2946	-0.79	0.439
perB	0.5904	1.67	0.107
perH	0.7153	1.98	0.059
cons	0.1651		

Table 11: Effects of Reduced Price and Free Lunch on EOG Exam Performance

READEOG		**"R-sq" = 0.5050**		**MATHEOG**		**"R-sq" = 0.8159**	
	Coefficient	t	P > | t |		Coefficient	t	P > | t |
redfreeL	-0.2594	-9.93	0.000	redfreeL	-0.2621	-8.49	0.000
Dummy2006	-0.0153	-0.85	0.398	Dummy2006	-0.3479	-16.38	0
Dummy2005	0.0004	0.22	0.823	Dummy2005	-0.0398	-1.87	0.064
Dummy2004	0.0374	2.06	0.042	Dummy2004	0.0178	0.83	0.409
cons	0.9729			cons	1.0396		

Table 10 is realized in Figures 15 and 16. As evidenced from this table, the percentage of Hispanics at a school is statistically significant at the 10% level. PerB is somewhat statistically significant, while perW is much less significant. It seems that the Hispanic population is most strongly correlated with the relative amount of reduced and free lunch students. The positive and high-value correlation coefficient of perH indicates that as the percent of Hispanics at a given school increases, the percent of students who have reduced and free lunch is expected to rise. The negative coefficient on perW in Table 10 indicates that as the White population at a school rises, the percentage of students that are eligible for reduced-price and free lunch is expected to decrease. As shown in the above regressions, class divisions certainly lie along racial lines.

In the above regression, redfreeL functions as a proxy for the relative poverty at a specific public school, and consequently, of the students enrolled there, with the exception of magnet and charter schools. Additional bivariate regressions which corroborate the evidence from Table 10 are realized in Figures 17, 18, and 19. These graphs are regressions depicting the correlation between different race population percentages enrolled at a specific Durham public school and the number of reduced and free lunch students. They further highlight the racial composition of the environments in which poverty is most prevalent.

(iv) Class Segregation in Durham

While it may have initially appeared that racial composition of a school is a strong determinant of academic achievement, additional regressions have proven that other factors are involved. An empirical examination reveals that wealth is one of the biggest players in this game of Durham education. To further examine the relation between statistically significant variables, as determined by Table 7, and race populations, more regressions are run. Bivariate linear regressions are run to pinpoint specific relationships. Figures 20, 21, and 22 depict the relationship between different race population percentages and median household income. Figure 23 depicts the regression of percentage reduced and free lunch students and median household income to empirically test the extent to which the students attending the school are representative of the population in its census tract. A third variable which was statistically significant in the multivariate model is the percent of individuals in the census tract with a college degree or higher. Regressions are run to see whether these intellectually affluent areas are correlated with specific race populations. These relationships are revealed in Figures 24, 25, and 26. Additionally, the prevalence of single-parent families in a census tract has proven to be a predictor of academic performance. Figures 27, 28, and 29 reveal the correlation between various race populations and single-parent families. A fourth-grade, W.G. Pearson student, Faith Krone, reflects on the validity and impact of this variable in the study; when asked to describe the atmosphere at her school that has a 99% reduced price and free lunch level, she replied: "…a lot of divorced parents."[43] Figures 35 and 37 reveal the way in which education level and percentage of single-parent families interplays with median household income. It seems that areas of greater poverty are correlated with more single-parent families, which is an obvious find since that would mean only one income, and a lower level of education, since those with advanced degrees typically get paid more. Class segregation which is inherent in race segregation seems to be motivating many of this study's empirical results.

6. Results

This paper all began with a single query: is there empirical truth behind Aria Branch's assertions about Durham? Prompted by her heartstring-plucking editorial, this paper attempts to validate her claim that lower standardized test scores are correlated with two characteristics in local Durham elementary schools: a lack of wealth and a disproportionately large minority population. How do race and wealth relate in Durham County? Are there racial trends linked with relative levels of affluence? And how are these disparities manifested in the classroom setting? What other traits can account for educational achievement disparities among races?

It is evident from Table 7 that the "race" variable employed in the linear regressions in Tables 3 and 4 was, in fact, coding for omitted variables. The multivariate linear regressions in Table 7 allowed the "race" variable to be stripped of those "strings" attached to it. This paper uses the results of these regressions and others, in tandem with unique school characteristics, to paint a picture of each race's general lifestyle in Durham as it relates to the educational front. Then, outliers, which both corroborate theories and defy trends, will be examined in case-study format.

First, it is necessary to provide an overview of Durham public elementary schools in order to better understand the makeup of the classroom and the dynamics from the outside world which penetrate that setting. Figure 1 depicts the racial composition of the twenty-eight local public elementary schools examined in this study. Whites, Blacks, and Hispanics are the predominant populations, and thus, are the only race-specific groups examined here. Figures 3 and 4 which provide an account of academic performance from 2003-2006 indicate that Reading scores have hovered around the 85th percentile while Math achievement has been somewhat higher during that same timeframe. However, there is an outlier: a

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[43] Krone, F. (2007, November 1). [Interview]. Durham, NC.

surprising low county average on the Math End-of-Grade exam in 2006; this score is thirty percentile points beneath the previous averages.

Why the extreme deviation? As mentioned earlier in this paper, the Math EOG exam was changed for the 2006 school year in order to motivate better student performance. The most noticeable feature on Figure 4 is the extreme range of deviations from the average. They fluctuate much more than for the previous exams. What does this indicate? Schools where students are underperforming are magnified in comparison with their counterparts at other local educational institutions. Additionally, the environments in which Math programs are below adequate, or perhaps resources outside of school are not sufficient in supplementing classroom learning, are spotlighted here. The same principle applies in the case when a Duke professor writes a harder exam: the distribution will be more extreme, creating greater disparities in exam score between students who truly know the material and those who are simply passing as mediocre. The next question to be asked is: where are students underperforming? In what environments do they excel? Who is at the head of the class? While it initially appeared that the limitations on race-specific exam data to the year 2006 would handicap this study, such is not the case. Rather, it seems that 2006 Mathematics data are the most indicative of school adequacy trends, and a racial breakdown of scores will be extremely accurate in evaluating race-specific performance.

Figures 5, 6, and 7 realize the deviation between the county average and a specific race's performance on both the Mathematics and the Reading EOG exams. Perhaps the most noticeable trend is that Whites are outperforming their minority counterparts, especially in Mathematics. These graphs are also indicative that there is extreme deviation, even within a single school, between White and minority academic achievement. Thus, it would appear that academic success is linked with race rather than school environment. However, these measures fail to tell whether "second-generation segregation" is occurring within these same schools. By overlaying these graphs, each school's story can be told.

For instance, one extreme case is that of Burton Elementary where Whites are significantly outperforming their minority peers. On average, Whites achieve at or above the 95th percentile on both the Reading and Math EOG tests, while minorities fare fifty percentage points lower. What is driving this disparity? The extraordinarily impressive Whites' scores can be accounted for by the fact that Burton Elementary is a magnet school. This year, because of its outstanding performance as an academic institution, Burton became the first Durham public elementary school to be accepted as an International

Baccalaureate Primary Years Programme (IB PYP) school[44]. Superintendent Carl E. Harris affirms that "this proven course of study has a very strong track record of providing high academic rigor for students"[45]. It is obvious that children who come from White, educated families would enroll in this school and be successful academically. However, the same explanation does not suffice for minorities which are not excelling at the same level.

The explanation: segregation in skill level lines along racial lines and is the offshoot of class segregation between races in Durham County. Figures 20, 21, and 22 reveal that school zones with a higher concentration of Whites are positively correlated with higher median incomes while predominantly minority zones are negatively correlated with wealth. Due to self-segregation and a preference to live among members of one's own race, it is likely that Whites who enroll come from predominantly White areas whereas minorities are from neighborhoods that are highly concentrated with either Blacks or Hispanics. Because Burton is a magnet school, it is likely that rich Whites and poor minorities are enrolling in the same magnet program. The 79 percent reduced and free lunch eligibility rate indicates that these minority populations are in fact coming from poor areas. These results highlight that home environment is a strongly influential contributor in academic success. Students who come from wealthier families have more books in the home and have parental role models who can act as primary resources in their child's education. The impact of wealth on education is revealed in the statistical significance of the reduced and free lunch variable in the multivariate regressions. With the inclusion of both a race variable and a wealth variable, the wealth variable completely overshadowed race as a predictor of exam scores as evidenced by Table 7, where redfreeL was statistically significant at the one percent level.

Additionally, Figures 27, 28, and 29 reinforce the fact that minorities typically come from weaker home environments which are less conducive to learning. Although the r-squared value is low for Hispanics, these graphs highlight that minority populations are positively correlated with the rate of single-parent families, whereas the coefficient for the White linear regression is negative. With primarily minorities coming from broken homes, they are less likely to have parental role models and perhaps are required to spend their time babysitting other siblings rather than doing schoolwork. In a study conducted by The Heritage Foundation's Center for Data Analysis, the interrelation between race, poverty, and divorce is revealed: "Blacks are more than twice as likely to live in poverty than are White children – but

[44] Burton Elementary receives IB. (2006). *Durham Public School District Webpage*. Durham County Public Schools. http://www.dpsnc.net/index.php?option=com_content&task=view&id=5973&Itemid=1111 (2007, November 2).

not because they are “born Black in America”… child poverty rates are driven primarily by single-parent households and dependency on welfare benefits. When these and other, less significant, factors are taken into account, the disparity between Black and White child poverty rates disappears.”[46] Corroborating the findings that White home environments are more conducive to learning are Figures 24, 25, and 26 which reveal that predominantly White populations are positively correlated with educational attainment, whereas minority populations exhibit a negative relationship. Figures 8 and 9 reveal the unparalleled success of Whites on both the Reading and Math EOG exams in 2006, irrespective of institution.

Thus, in returning to the picture of Burton Elementary and attempting to explain the extreme deviation between test performance among races, these puzzle pieces are assembled. There are two separate populations enrolled in the same magnet program at Burton: the fairly affluent Whites who come from educated, intact families and the poor minorities who come from broken homes which are financially unstable and less conducive to learning. The discrepancies in home environments carry over into the classroom. The case of Burton Elementary highlights that class segregation has a presence in Durham, and its ugly head still looms over education, producing negative effects especially on minority populations. The story told at Burton is the same for another magnet school: Club Boulevard.

The thorough analysis of Burton Elementary yielded the supposition that deviations in exam percentile rank in Figures 5, 6, and 7 can be accounted for by differences in home environment characteristics. Most of these home environment traits can be captured under the variable “percent reduced and free lunch eligibility” (redfreeL), which was proven statistically significant in the multivariate regression analysis; the logic: single-parent families with lower educational attainment have lower household incomes, as revealed by Figure 35, and such poverty will be captured by student eligibility for free or reduced lunch. Additionally, through this full analysis of Burton in tandem with the research performed by The Heritage Foundation, it is apparent that the variable indicating race was simply coding for relative levels of affluence, family stability, and home learning environment. It is revealed in the data that class segregation is inherently linked with racial segregation. Thus, in Durham County, the poor tend to be Blacks and Hispanics. In response to Branch’s editorial, I would argue that it has been empirically proven that lower standardized test scores are correlated with less affluent areas, and that the disproportionate prevalence of minority populations at institutions that fare worse is simply a function of those select populations being less wealthy within the geography of this study, Durham County. Figures 15 and 16 which depict linear regressions of reduced price and free lunch student

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[46] Children of Divorce: Poverty. (2007). *Divorce Reform Page*. Americans for Divorce Reform. http://www.divorcereform.org/pov.html (2007, December 2).

eligibility percent with Math and Reading EOG exam performance support this theory. The r-squared value for the Mathematics exam is extraordinarily high, taking on a value of 0.8159, while the r-squared for Reading is 0.5050. The negative correlation coefficient in each Figure 9 indicates the negative relationship between exam performance and poverty. This same relationship is revealed in Table 11.

The self-segregation clustering index corroborates the above phenomenon. One of the most noticeable factors about Figure 2 is that race populations do self-segregate in Durham. Although this index maps the clustering occurring at local public elementary schools, it depicts a phenomenon that extends beyond the classroom. Were natural mixing to occur at these educational institutions, all of the index values would hover around one. However, as evidenced by the graph, such is not the case. Through a thorough analysis of an extreme case, we can investigate money's role in racial clustering. The phenomenon we are witnessing is class clustering.

As noted in Figure 2, school 17, or Mangum Elementary, has an extraordinarily large clustering of Whites at that institution. Mangum is not a magnet school, so the students enrolled are representative of the surrounding population. With reduced and free lunch student eligibility rate at only 11 percent (the lowest among schools examined in the study), Mangum corroborates the theory that highly concentrated White areas tend to be correlated with wealth and academic achievement. Figures 10 and 11 indicate that both Whites and Blacks are outperforming their same race counterparts at other local elementary schools. In examining Mangum through the lens of Figures 5 and 6, the story of wealth plays out again. White and Black students at Mangum fare above average in both Reading and Math standardized tests. However, Whites at Mangum are still outperforming Blacks, indicating that certain factors linked with the Black population are dragging down its average. Those factors can be directly related to the reduced and free lunch statistic.

With a Black population of only 15 percent and a Hispanic population of 3 percent at Mangum, it is likely that the entire Hispanic population is captured by the compensated lunch statistic while some of the Black population is likewise captured. Table 10, which captures the regression of reduced and free price lunch with various race variables, reveals a positive correlation between subsidized lunch and the level of minorities as well as a negative relationship between reduced and free lunch eligibility and percent White. Furthermore, Table 10 indicates that the Hispanic population is the best predictor of the percent of compensated lunch students at a school: the race variable perH was statistically significant at the ten percent level. Furthermore, the coefficient on the perH variable is quite large at 0.7153, indicating that fluctuations in the Hispanic population significantly influence the expected level of reduced and free price lunch eligibility. Additionally, a lower-value and less statistically significant, positive coefficient on perB explains why Blacks, on average, fare worse than Whites at Burton but still fare better than the county average. Figures 17, 18, and 19 reveal individual bivariate regressions between race populations and subsidized lunch eligibility. In examining empirics, it is likely that the neighborhoods surrounding Mangum are composed primarily of wealthy, White families with some affluent Black neighborhoods and small pockets of poor minorities, especially Hispanics. However, in examining Durham, it is apparent that it does indeed boast a large Black upper middle class. How can one reconcile this fact with poor Black performance?

There are two possibilities that are most obvious. First, the children of this affluent population could attend private schools and thus their academic achievement is not factored into this study. More likely though, "fertility differentials by education and class within the Black community are probably huge."[47] Thus, more Black children tend to be born to poor, less educated, single mothers. National statistics confirms this supposition: "68.8 percent of black American children were born out of wedlock in 1999, compared to 26.7 percent for white children."[48] While these statistics may be slightly outdated, the phenomenon is not. With the majority of Black children being born to single parents, they are extremely likely to be born into poverty. Therefore, the presence of a large upper middle class of Blacks is masked, because of the fertility differential along class lines, by an overwhelming majority of poor Blacks; this phenomenon is reflected in the low achievement on EOG exams by Black students, which may not be seen in the upper echelon of the Black population. The difference in fertility rates among races also explains the academic performance disparities. According to national statistics: "black children are more than twice as likely to live in poverty than are white children."[49] This statistical truth is the reality in Durham. More White children are born to wealthy, educated, intact families, and that stable home environment is reflected as higher scores on the EOG exams. It seems that wealth and parents' education play a much greater role in determining academic success than first imagined by this study.

The correlation between education, wealth, and race is again corroborated in Figure 4 by Mangum's performance on the new Mathematics test in 2006, which can be seen by a peaked spike extremely high above the county average. It is wealth's connection with the White population that is motivating such outstanding results. This same relationship is seen numerically in Tables 1 and 2 in which areas of White clustering fare better academically than areas of minority clustering. Wcluster has

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47 Becker, C. (2008). [Notes and Suggestions].

48 Children of Divorce: Poverty. http://www.divorcereform.org/pov.html.

49 Ibid.

the highest-valued coefficient (0.1048 for Reading and 0.1060 for Math) of all the race populations, indicating that, of all the segregation measures, the level of White clustering is the most influential in determining the academic success of a school. The regressions depicted in Figures 30 and 32 follow in this vein, indicating with positive coefficients in the linear regression that both White and Black populations fare better in schools with a higher percentage of Whites. However, Figure 31, although the correlation is extremely low, defies this trend, indicating that a higher clustering of Whites negatively impacts Hispanic academic performance. Why is this the case? In predominantly White schools, Hispanics who do not understand English must struggle through classes with minimal aid from teachers who know only a few words in Spanish. In addition, speaking Spanish in the home can negatively influence English reading and writing proficiency. Through examining the extreme case of Mangum Elementary, the general trends in Durham education are revealed. The overarching impact of wealth on educational achievement reveals that academic success is more than skin deep.

While wealth is the most significant indicator of academic success, as evidenced by a close examination of extreme cases and regression analysis, it is not the only influential factor. In subsequent discussion, such an assertion will be empirically corroborated. In continuing to examine Figures 2, 5, 6, and 7, another extreme case is selected for close study. Since the Hispanic population has the most significant impact on reduced and free lunch eligibility, as revealed by Table 10, this paper scrutinizes the phenomena occurring at a school with a high-valued Hispanic clustering index: School 8 (as noted in Figure 2), Glenn Elementary. Does exam performance at this school corroborate our above findings and hypotheses?

Both Blacks and Hispanics at Glenn Elementary performed far below the county average on the Math and Reading EOG exams in 2006. Figures 6 and 7 depict these findings, while Figure 4 shows Glenn as being one of the worst-performing schools on the new Mathematics exam, as evidenced by a sharp downward peak, jetting well below the county average. As mentioned earlier in this paper, this new exam functions to magnify academic achievement at the school level. While the wealth hypothesis holds in this instance, such is not the case for all schools. Figures 10, 11, and 12 were created in order to examine extreme cases within specific racial subgroups. These graphs break down student performance on EOG exams by race, and compare it to that race's county average. The purpose of such a figure to pinpoint where students are faring better or worse than their counterparts at other institutions. An examination of outliers will reveal which characteristics, independent from race, foster an environment of academic excellence.

One of the extreme cases which this paper examines is Pearsontown Elementary. Figures 10, 11, and 12 reveal that Whites, Blacks, and Hispanics are all faring better, especially in Mathematics, than their racially equivalent counterparts enrolled at other local public Durham Elementary schools. Although Hispanics at Pearsontown are outperforming Hispanics at other schools, they are still performing well below the county average. This indicates that although there is an improvement in Hispanic academic achievement at this school, the underlying wealth factors which are correlated with lower Hispanic standardized test scores are likely still at work. However, rather than revealing additional characteristics, this example simply fits into the wealth hypothesis – wealth is correlated with academic excellence. Perhaps Hispanics are faring better than their counterparts at peer institutions because this region is relatively more affluent than others. The level of reduced and free lunch eligibility is at only 36%, twenty percentage points below the county average. Additionally, the median household income is at $51,000 which is $7,000 above the county average. Figure 2 reveals that there is significant Black clustering in this region. In reviewing tract-specific statistics, 51% of individuals in this census tract have obtained a college degree or above; that is over ten percentage points above the county average. Piecing the landscape of this region together, it is apparent that an educated and affluent minority population, composed predominantly of Blacks, inhabits this region. While this outlier does defy the stereotype that minority populations in Durham are poor, it supports the initial hypothesis posited by this paper that wealth is the primary factor indicative of educational success.

Can extreme cases in which students excel always be attributed to disproportionate wealth? In Durham, since minority students, especially Hispanics, are associated with poverty, a comprehensive study of the relative affluence levels of schools in which minority students are faring better than their counterparts addresses the above question. These cases in which the significant minority populations fare well above their race's county average are: R.N. Harris, Morehead, Eno Valley, and Southwest elementary schools.

Upon initial observation, data from R.N. Harris defy the hypothesis that affluent areas are correlated with academic success. While each race's respective population is certainly ahead of the curve at R.N. Harris, the school still has a 71 percent reduced free lunch rate. While both the educational attainment level in that region and median household income are below average, they are not as valid in this example since R.N. Harris is an Integrated Arts/Core Knowledge Magnet School, and students who attend are not exclusively inhabitants of its census tract. So why the success?

There are two explanatory theories. The first is that R.N. Harris, as a magnet school, offers a curriculum that supplements the standard classes taught in other public elementary schools, positively affecting student performance. The second is that students who inhabit wealthier regions are enrolled at R.N. Harris. The first theory is more likely the correct one since the subsidized lunch statistic is so high. Additionally, Figures 6 and 7 indicate that Hispanics at R.N. Harris are not only outperforming their own race, but also are faring better than the average Durham public elementary school student. According to the district website, R.N. Harris claims to "teach reading, writing, math, and science skills through exciting, comprehensive units based on the Core Knowledge curriculum developed by Ed Hirsch and fused with the North Carolina Standard Course of Study."[50] In addition to teaching standard skills as required by the state, R.N. Harris uses a supplementary curriculum to improve student learning. The above evidence indicates that the strength of the magnet program overshadows the level of wealth in determining the academic success at this school. In addition to the supplemental curriculum, R.N. Harris students reap the benefit of donations in the form of "time, expertise, materials, and financial resources" from a plethora of organizations, including: Durham Technical Community College, North Carolina Central University, Duke University, Chamber of Commerce Education Top Priority Group, Blue Marble Children's Center for Design and Invention, Greek organizations, and the Ackland Art Museum.[51] Perhaps wealth does play a role in that this extraordinary amount of resources is positively influencing the educational achievement of elementary school students. Nonetheless, in examining this magnet school, wealth is no longer viewed as the definitive indicator of academic excellence.

Morehead is another example of a magnet school. Does the strength of this school lie in its curriculum or the wealth of resources in the home environment of its students? Although the median household income level in its census tract is $40,000, which is slightly below the county average, its 20% eligibility level for reduced and free is much lower than at other public elementary schools. There are two possible explanations for the discrepancy here. First, one possibility is that many of the students enrolled at Morehead are coming from wealthier geographic regions outside of its census tract and do not qualify for reduced price or free lunches. A second possibility is that the families in this census tract have only a few children and do not qualify for compensated lunches. For instance, the HHS Poverty Guidelines in 2006 defined the poverty level for a family of four as $20,000.[52] According to Durham County, household income must be between 130 percent and 185 percent of the poverty level to qualify for reduced lunches and under 130 percent of that level to have a free lunch. This would mean a maximum income of $37,000

[50] R.N. Harris Elementary School. (2006). *Durham Public School District Webpage*. Durham County Public Schools. http://www.dpsnc.net/index.php?option=com_content&task=blogcategory&id=508&Itemid=1517 (2007, December 2).
[51] Ibid.
[52] The 2006 HHS Poverty Guidelines. (2007). U.S. Department of Health and Human Services. http://aspe.hhs.gov/poverty/06poverty.shtml (2008, March 13).

for a child of a family of four to qualify for a reduced price lunch. The possibility of this district having fewer children than other school districts is quite plausible since college education level and number of children has a negative relationship. A 1997 study by the National Center for Health Statistics affirms: "the highest birth rates [occur] among women with the lowest educational attainment."[53] In keeping with this theory, this census tract has one of the highest levels of adults with a college education or above: 57.7 percent. This large number of intellectuals in the surrounding area could also explain the extraordinarily impressive performance of both Blacks and Whites on the EOG exams, especially Reading. Despite coming from educated, middle income families, perhaps the school's teaching style has a positive effect on education. According to the district's website, Morehead's "instructional delivery is based in the philosophy and work of Maria Montessori. Montessori trained teacher-facilitators match children's developmental needs with appropriate materials and activities in multi-age, multi-grade classes."[54] Additionally, classroom success could be attributed to the fact that the school is supported by Duke University donations, making the class environment one that promotes both personal growth and learning. In examining Morehead and R.N. Harris, wealth has become a blurred predicator of the academic excellence at a specific school. It is unclear whether these special programs, the accompanying outside funding or stable home environments are contributing to minorities' success here.

Additional case studies of outliers have hinted that there is more at play contributing to academic achievement than simply income level. Eno Valley Elementary is such an example. Each racial subgroup is faring better than the county average and better than their respective racial subgroup at a comparative institution. At first glance, it is immediate impulse to claim that the wealth of this area is the main motivator behind its higher scores. While the median household income of Eno Valley is the highest in this study, $61,500, the reduced and free lunch eligibility rate, at 56%, indicates that not all of the wealth in this region is being absorbed by Eno Valley Elementary students. So, if higher incomes are not necessarily a contributing factor, what else is occurring here that is positively impacting student learning? Looping. Defined by Eno Valley Elementary on the Durham County Public Schools webpage, looping is "a teacher moving to the next grade with the same students."[55] According to the same source, such a program "has been successful at both the primary and intermediate levels."[56] Additionally, students also receive EOG tutoring, which could explain the comparatively higher scores.[57] This case study highlights

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[53] Mother's Educational Level Influences Birth Rate. (1997). National Center for Health Statistics. *U.S. Department of Health and Human Services*. http://www.cdc.gov/nchs/pressroom/97facts/edu2birt.htm. (2008, March 13).
[54] Morehead Montessori School. (2006). *Durham Public School District Webpage.* Durham County Public Schools. http://www.dpsnc.net/index.php?option=com_content&task=blogcategory&id=508&Itemid=1517 (2007, December 2).
[55] Eno Valley Elementary School. (2006). *Durham Public School District Webpage*. Durham County Public Schools. http://www.dpsnc.net/index.php?option=com_content&task=blogcategory&id=492&Itemid=1500 (2007, December 1).
[56] Ibid.
[57] Ibid.

another general trend in education. Wealth is only a significant indicator of an environment of academic excellence in that greater wealth usually indicates a higher education level, an intact family, and increased resources. Thus, while this study stripped wealth from the race variable, it seems that many other omitted factors, which cannot be quantified, are inherently linked to the wealth variable, motivating these results.

A similar logic can be applied to the phenomenon occurring at Southwest Elementary. This school is one of the few in which Hispanics are performing significantly above the county average in Math and marginally above-average in Reading. What is occurring in this environment which is making it more conducive to Hispanic learning? Southwest's Two-Way Language Immersion Program.[58] Southwest offers an English-Spanish immersion program in which instruction during the day is divided equally between English and Spanish. This program accounts for the comparatively higher math scores and generally average reading scores of Hispanics. Since math classes are taught in Spanish, it is much easier for Hispanics to learn and absorb the information. However, their reading level still hovers around average since English is not spoken throughout the day. Matthew Schewel, Southwest Director of the Two-Way Program and Teacher, says: "our program has been successful due to the combined efforts of students, parents, and teachers. The students enjoy learning and responding in the minority language, and are walking advertisements of our success."[59] It is not surprising that such a program would arise at this elementary school. Compared to the other elementary schools' census tracts, this one has the highest percent of individuals with a college degree or above. This case study has proven that success in the classroom is based on the quantity and quality of resources available to students *at school*. While the previous results of this study have been inclined to note that disparities in educational achievement are due to disparities *in the home*, this case study defies that notion. While wealth and the educational attainment level of residents in the school zone carry over from the home environment and establish the dynamics in the classroom, certain additional variables, exclusive to learning institutions and thus independent of household characteristics, are contributing to academic success.

While these case studies have certainly proved useful tools in understanding the educational environment in Durham and the factors which contribute to academic success, there is still much more to be examined beyond this study. One of the outliers, Oak Grove Elementary, is the only school in which Whites are faring below the county average. However, household median income, reduced and free lunch eligibility, and relative number of single parent families all hover around the average. The only variable

[58] Two-Way Language Immersion Program. (2007). *Southwest Elementary School Webpage.* Durham County Public Schools. http://www.southwest.dpsnc.net/dualimmersion.html (2007, December 1).
[59] Schewel, M. (2007). Southwest Elementary Two-Way Immersion Program. *Center for Applied Linguistics.* http://www.cal.org/jsp/TWI/SchoolView.jsp (2007, December 2).

which may be contributing to lower scores is the below-average level of educational attainment of individuals in the same census tract. However, this pattern is not present in other White populations in comparable areas. It seems that there is a certain unidentifiable factor at work here yet to be discovered. Additionally, a racial breakdown of reduced price and free lunch data would lead to more comprehensive examination of outliers in those bivariate linear regressions. Despite desires to conduct more empirical studies, there is much to be gleaned from this paper in terms of improving Durham education.

In capturing the image of a Durham education, it has become starkly obvious that class divisions in Durham County run along racial lines, and this class segregation by race is mirrored in the academic achievement disparities among races' populations. This empirical study has validated Aria Branch's initial assertions that underprivileged schools in Durham tend to have disproportionately high levels of minorities, and these same schools fare disproportionately worse academically. Upon identifying these general trends, the next step is to seek an answer to the following: how can Durham close the achievement gap?

While wealth will continue to be a barrier to educational success, as it defines the dynamics of the environment both within and outside of the classroom, it is the not the sole determinant of academic excellence. It has been evidenced from the case studies examined in this paper that magnet programs and special language immersion programs tailored to Hispanics have led to high levels of achievement in the classroom, especially among minorities. Durham education would benefit enormously from the implementation of more language immersion programs, and the creation of additional magnet and charter schools which employ instructional techniques that have proven successful in Durham, such as multi-age, multi-grade classrooms and a curriculum which supplements the North Carolina Standard Course of Study. Due to the increased poverty levels among minorities in Durham County, it seems that programs which cater to those resource-deficient populations will raise the academic achievement level of Durham as a whole.

However, in a less physical sense, perhaps the minority populations in Durham need to renew their confidence in their own talents, and regain the belief that they can truly excel on the academic front. In the words of Adam Cooper and Bill Collage, "You don't need fancy highbrow traditions or money to really learn. You just need people with the desire to better themselves."[60] While *de facto* racial segregation among income levels in Durham County has manifested itself in the classroom setting, some public primary education institutions are already turning the tide and diminishing wealth's influence on

[60] Cooper, A. & Collage, B. (2006). Quotations by Subject. *The Quotations Page*. http://www.quotationspage.com/ (2007, December 4).

the learning process. These special programs which effect positive changes today will create an improved, more equitable education system of the future. Even more importantly, these transformations within the classroom extend well beyond the schools' walls: the future of Durham education is truly the future of Durham itself.

7. Acknowledgements

I would like to profusely thank Dr. Charles Becker for his sincere efforts in making this paper worthy of being read both within and beyond the classroom. His guidance and support have been invaluable. I would also like to acknowledge Frederick Ghansah for his tutorial on STATA, a data analysis and statistical software program.

Figure 1

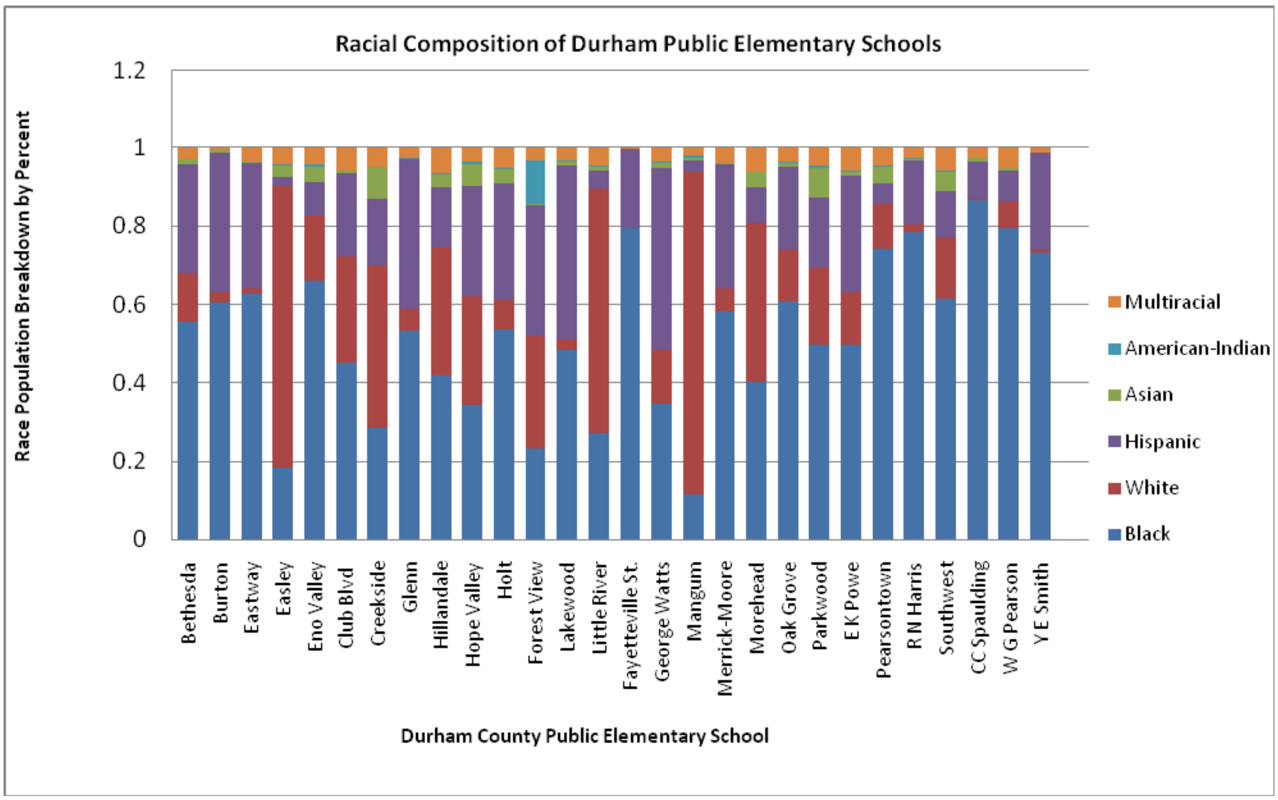


Figure 2

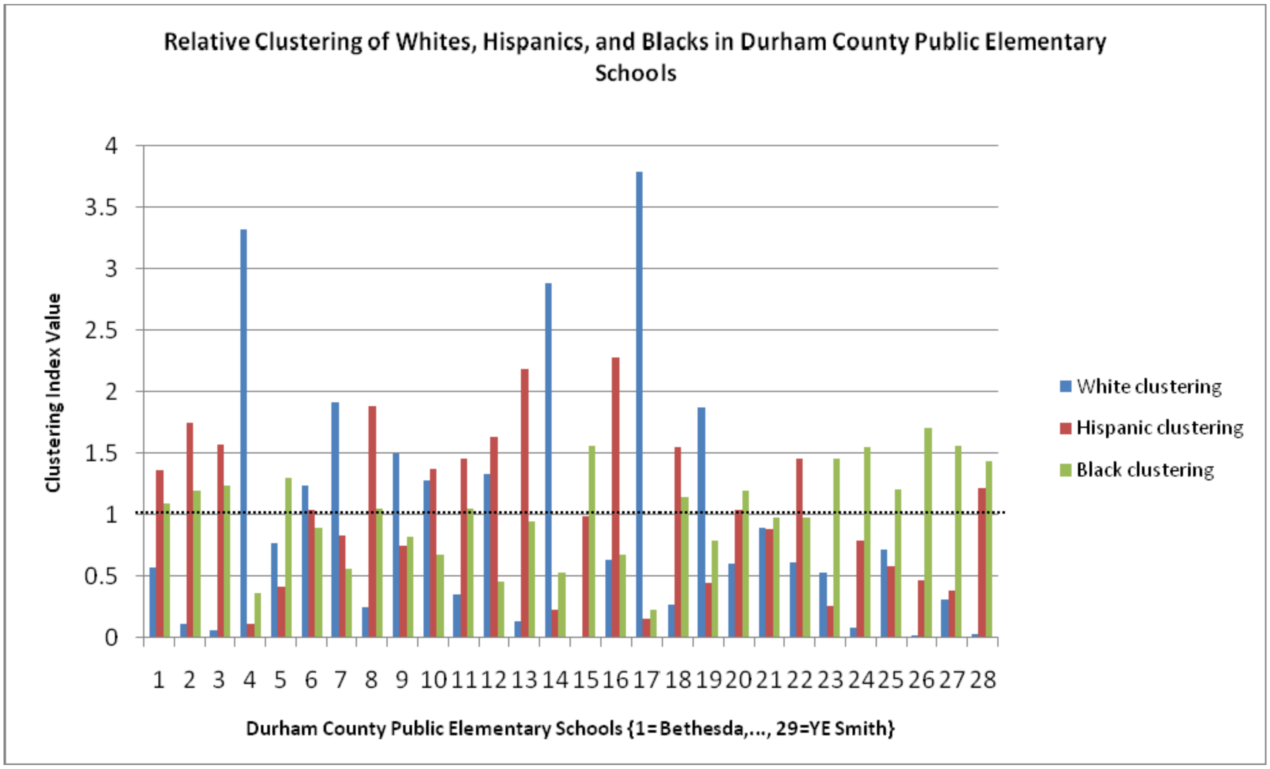


Figure 3

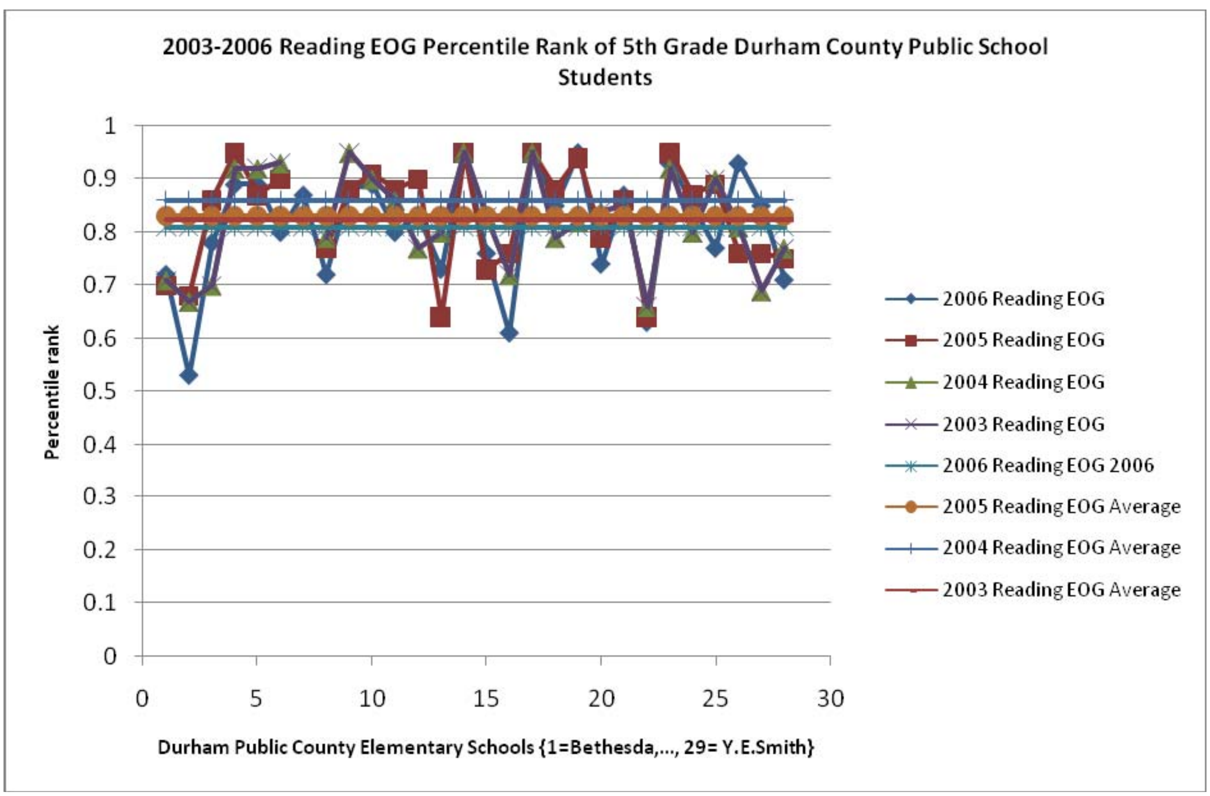


Figure 4

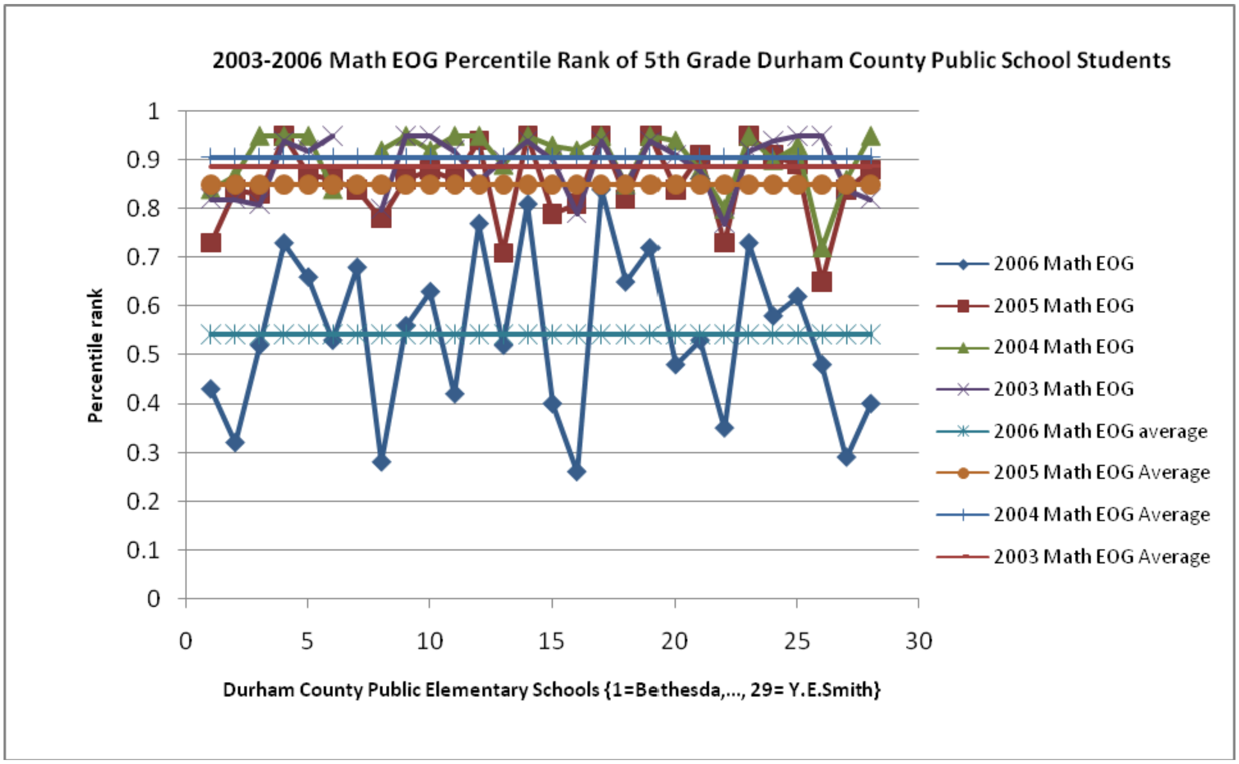
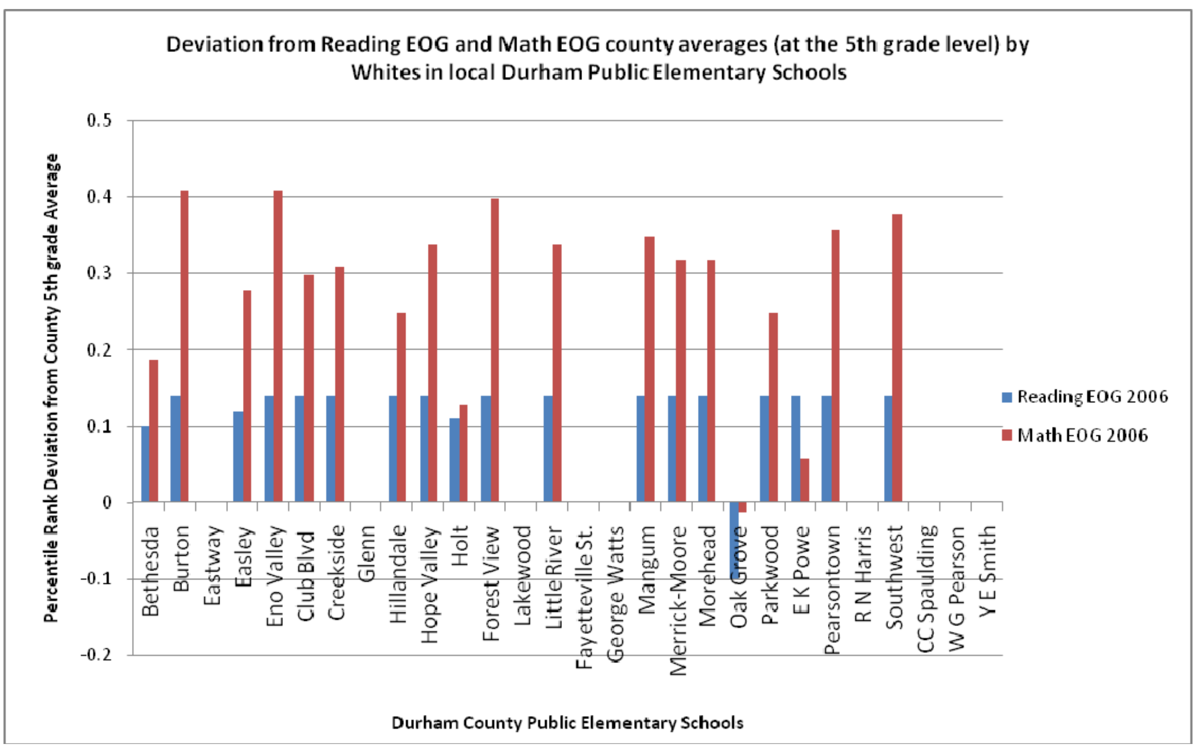


Figure 5[61]



[61] For schools with no graphical results, those exam performance data were not publicly published (e.g. school's population was not statistically significant and it was not posted).

Figure 6

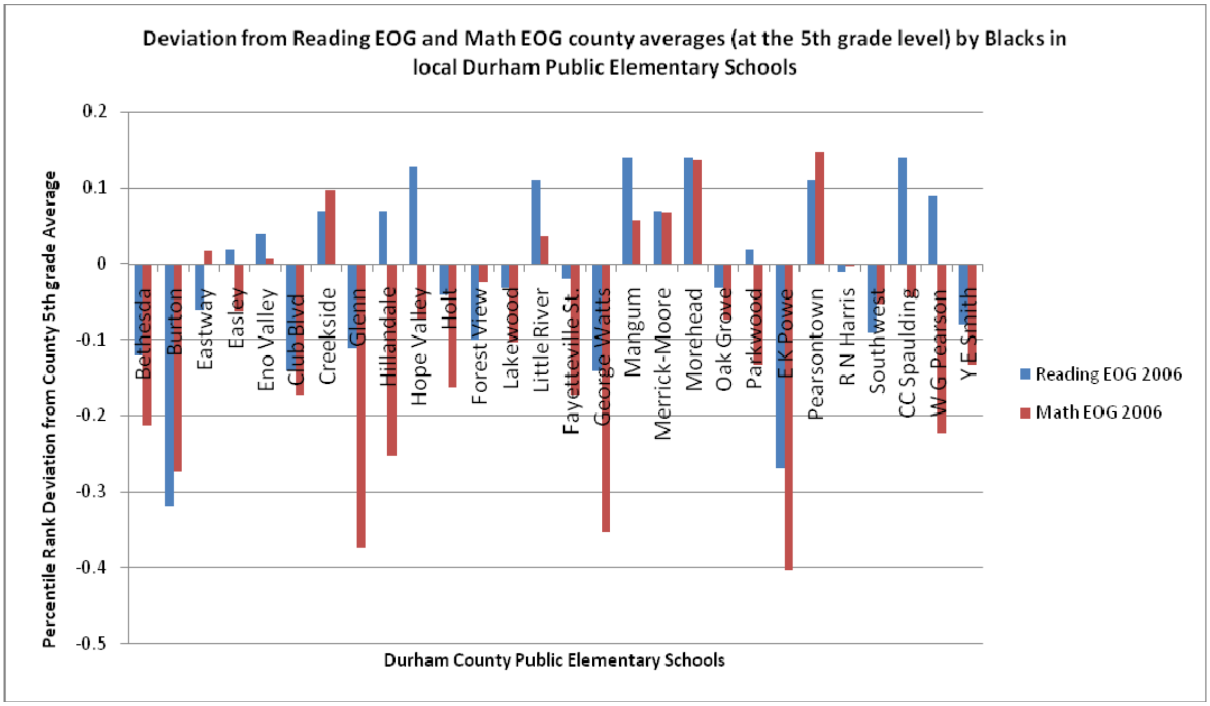


Figure 7

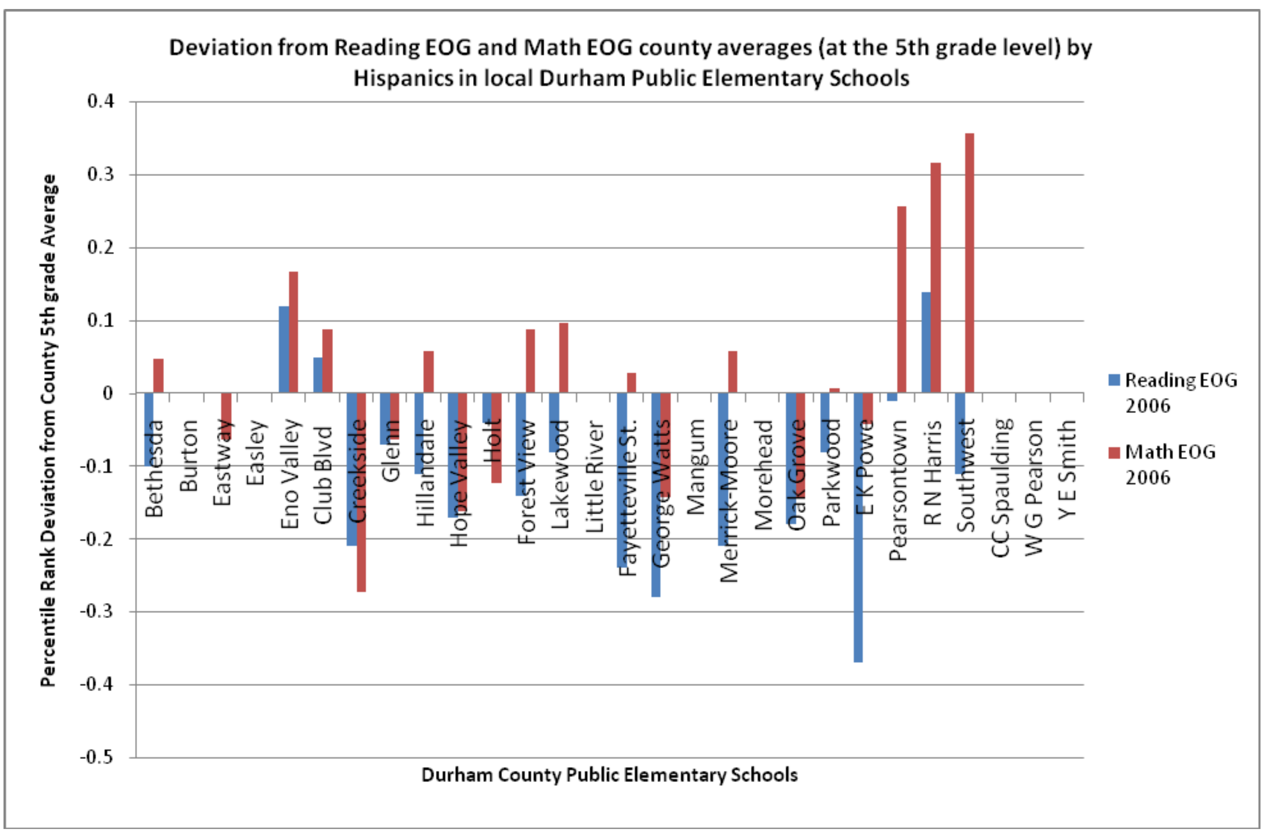


Figure 8

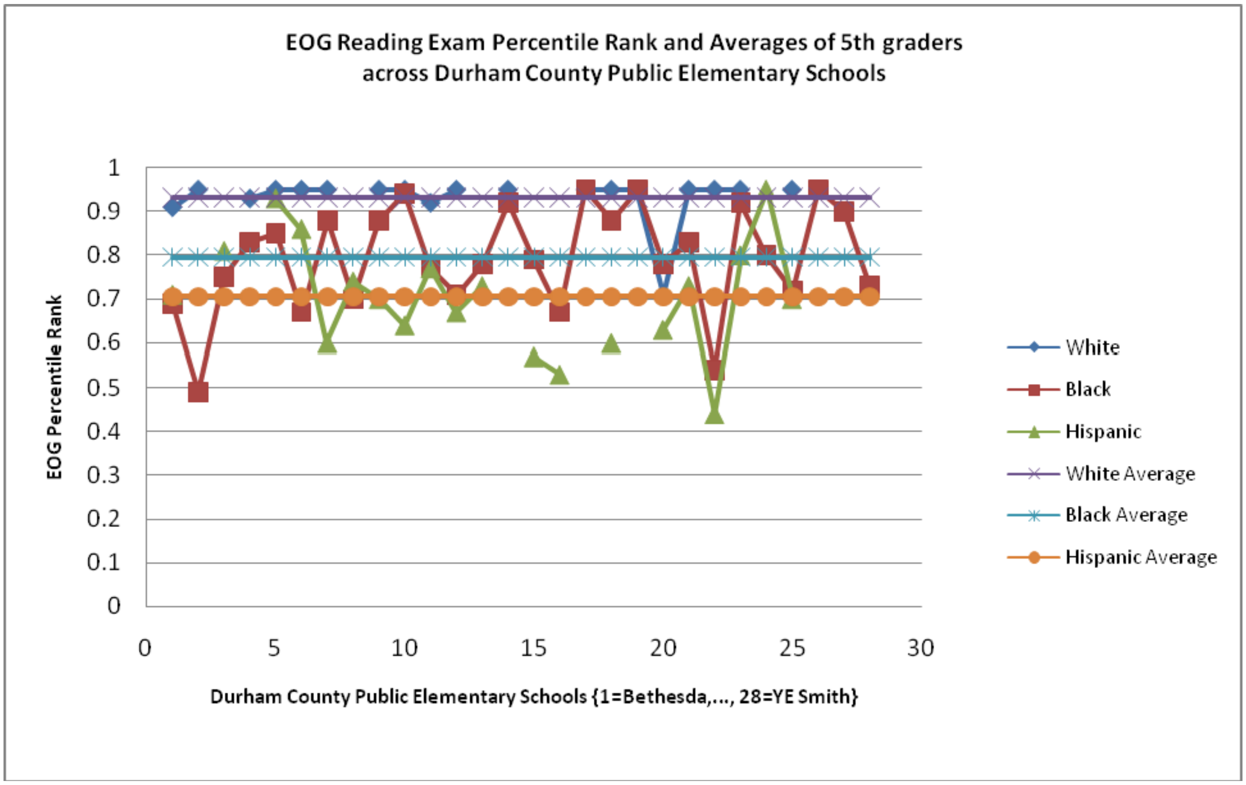


Figure 9

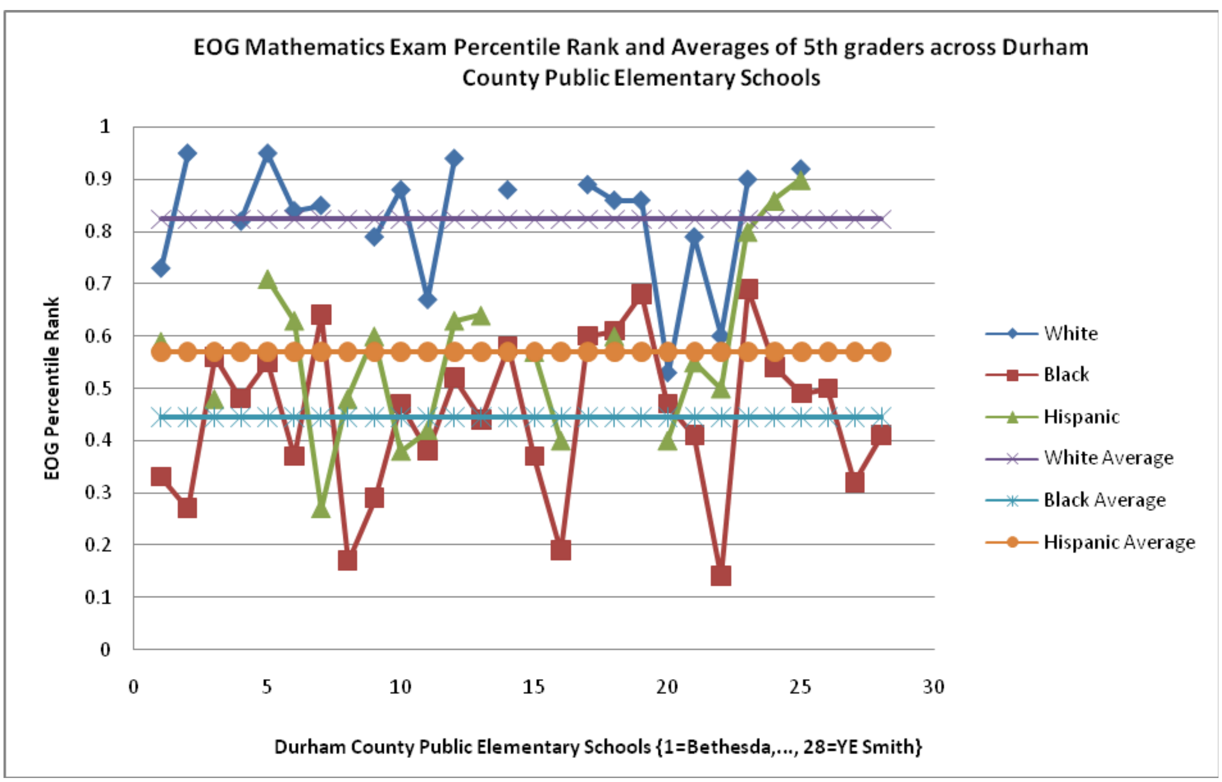


Figure 10

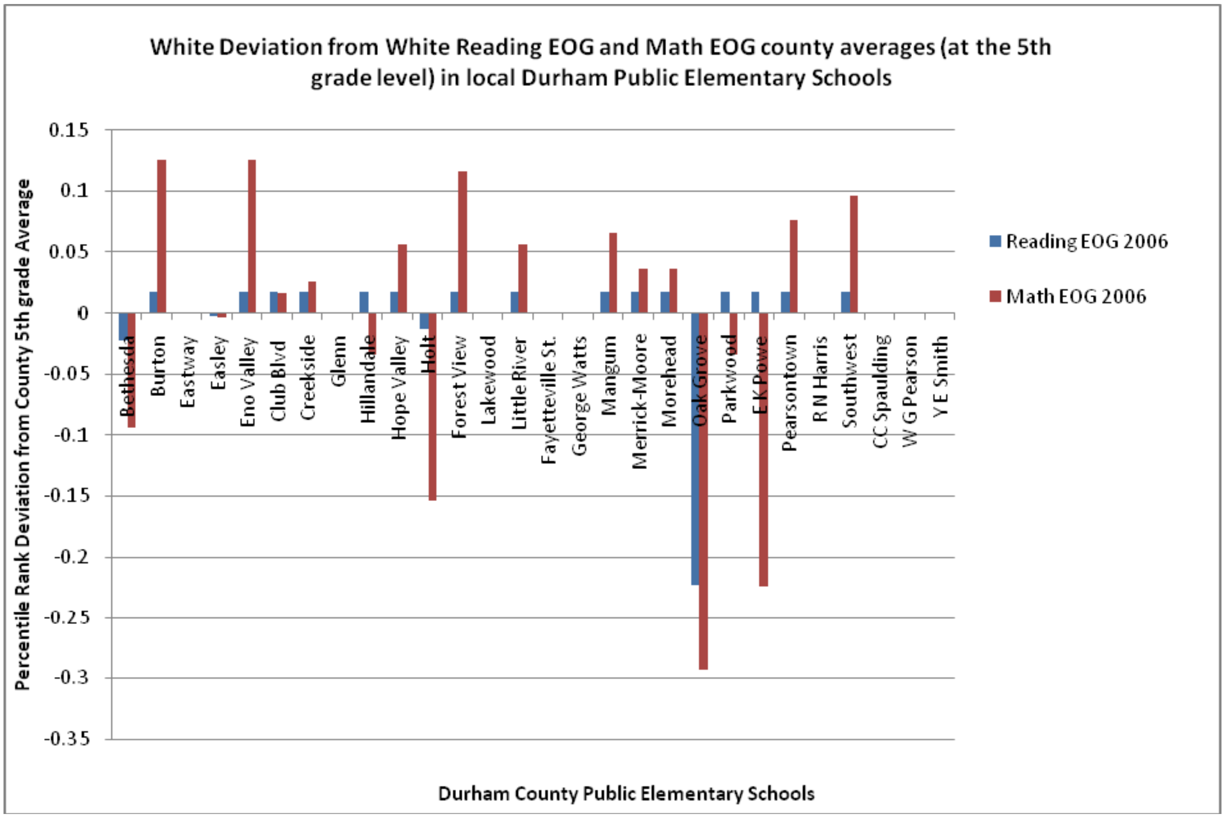


Figure 11

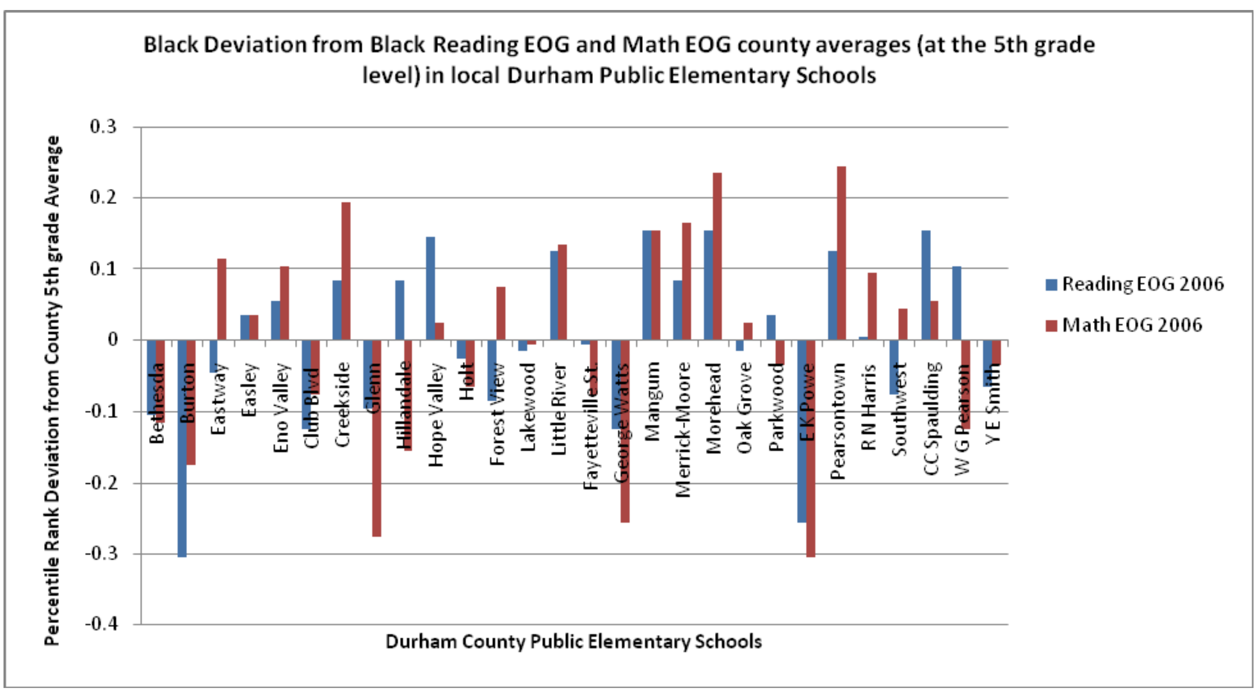


Figure 12

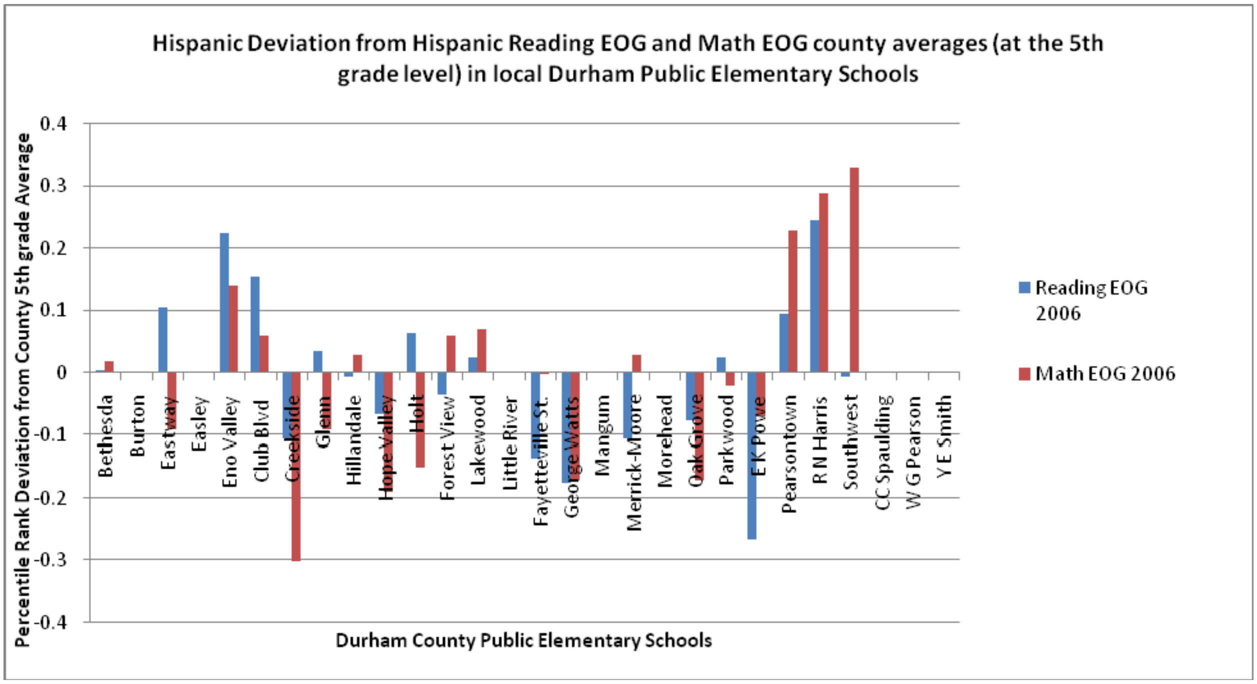


Figure 13

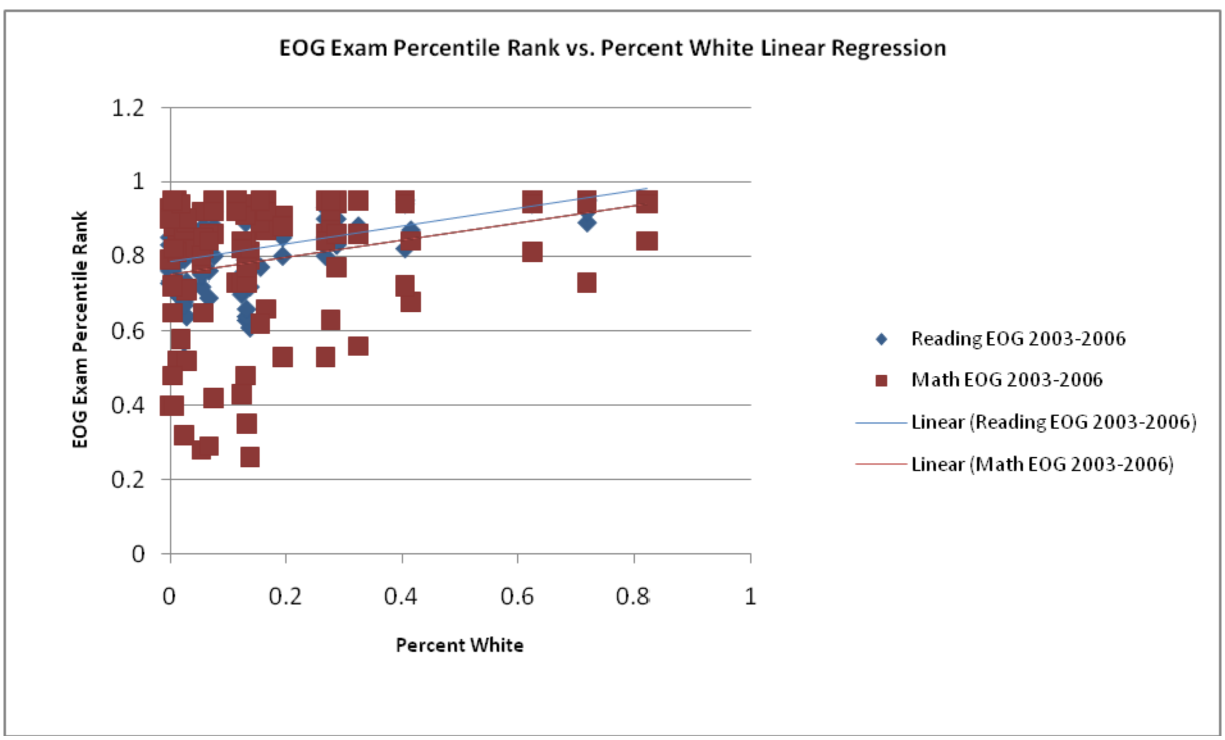


Figure 14

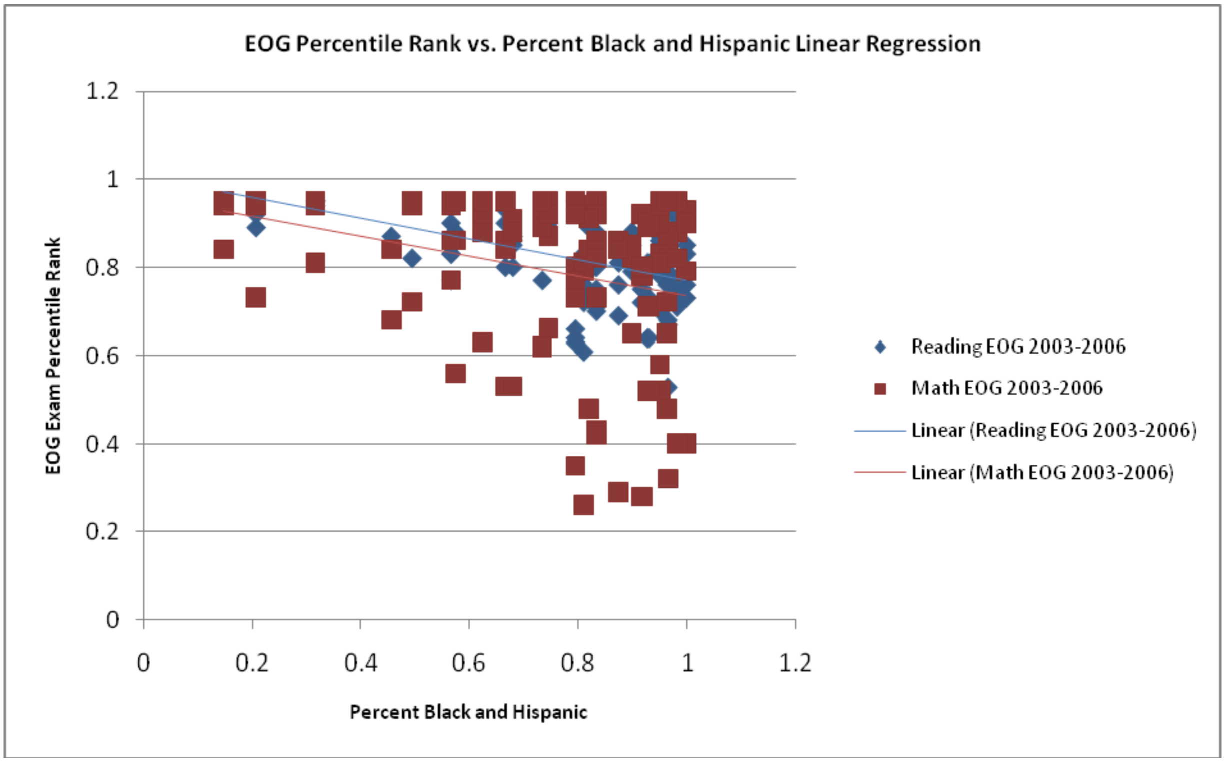


Figure 15

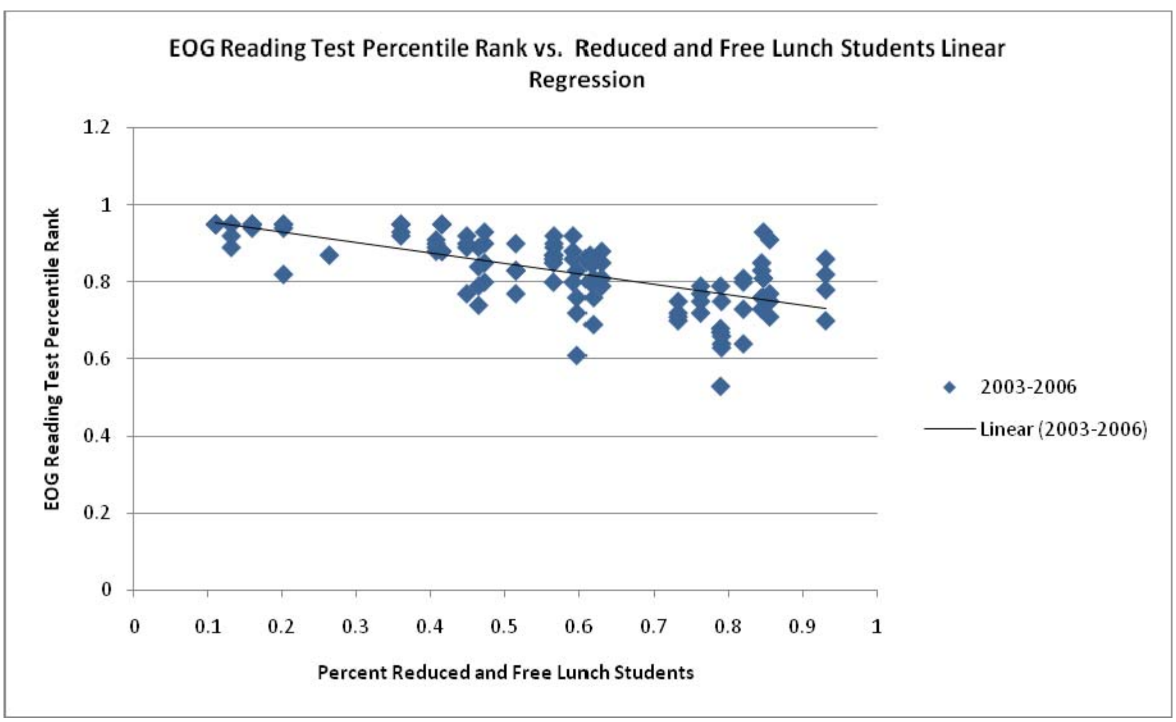


Figure 16

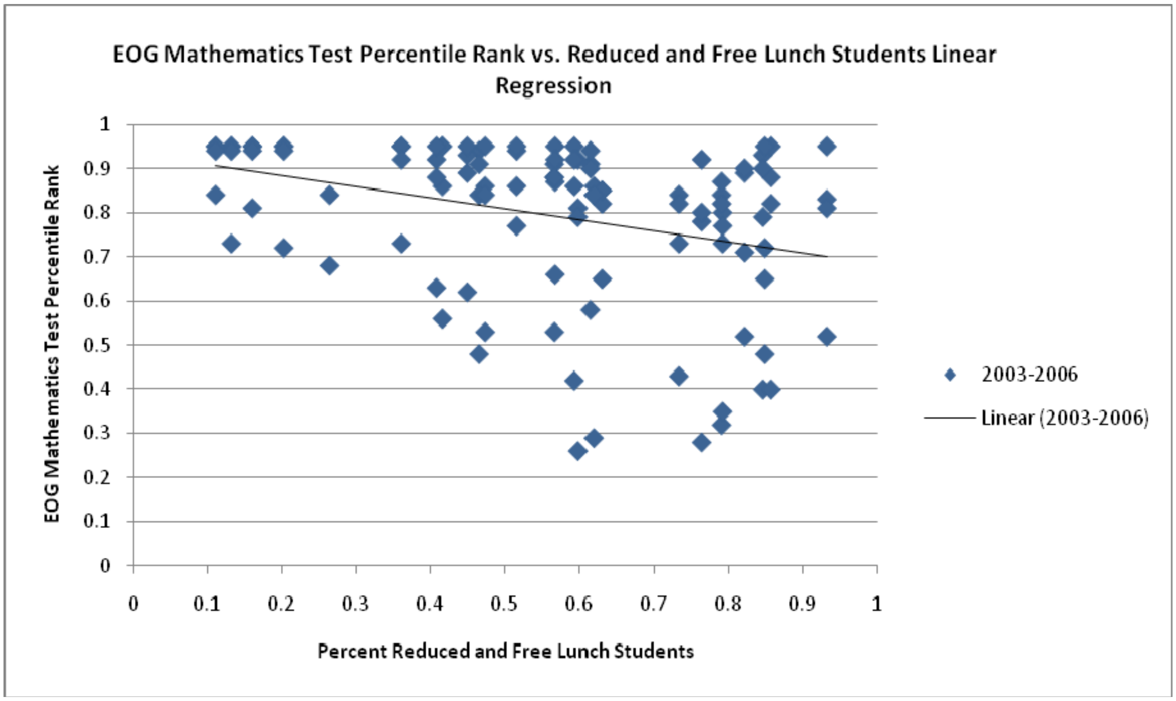

EOG Mathematics Test Percentile Rank vs. Reduced and Free Lunch Students Linear Regression
EOG Mathematics Test Percentile Rank
Percent Reduced and Free Lunch Students
2003-2006
Linear (2003-2006)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

Figure 17

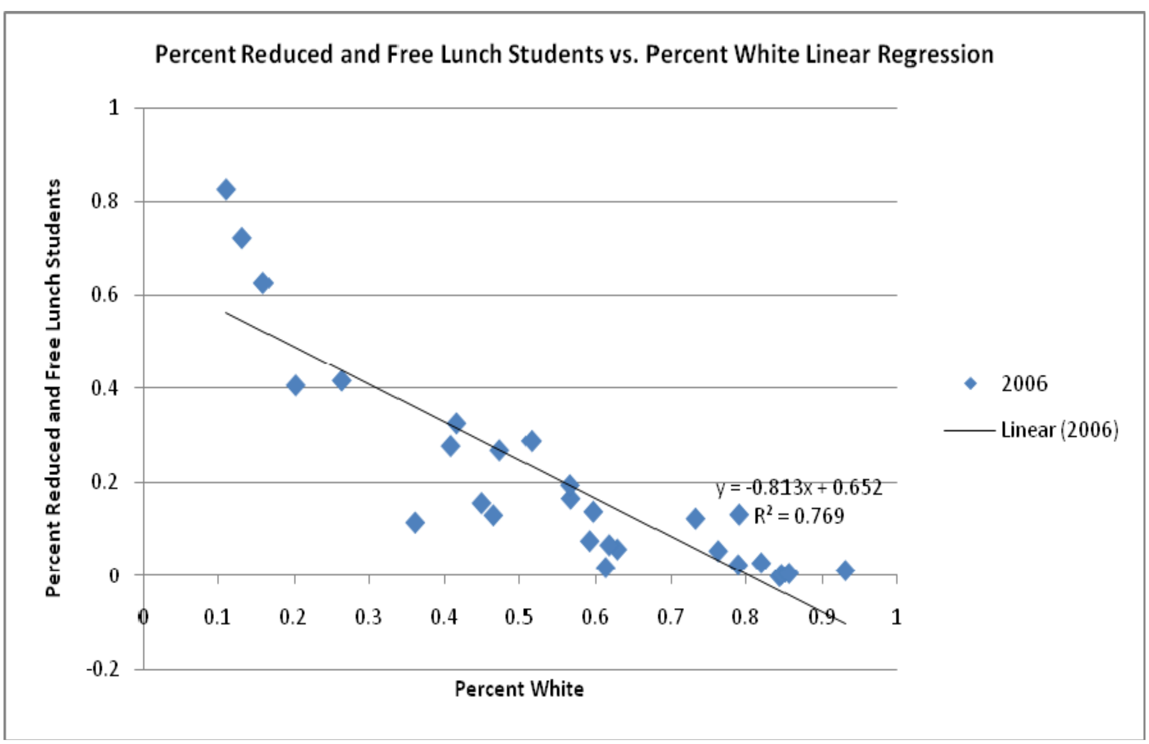

Percent Reduced and Free Lunch Students vs. Percent White Linear Regression
Percent Reduced and Free Lunch Students
Percent White
2006
Linear (2006)
y = -0.813x + 0.652
R² = 0.769
1
0.8
0.6
0.4
0.2
0
-0.2
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

Figure 18

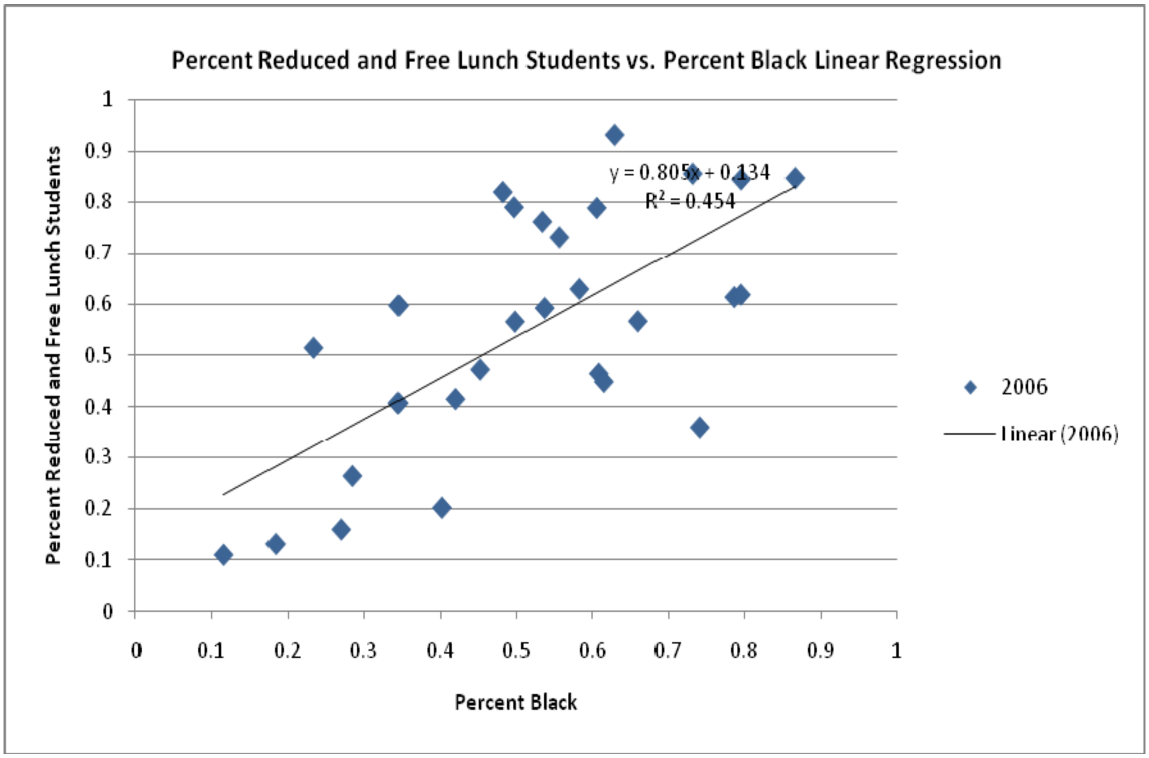


Figure 19

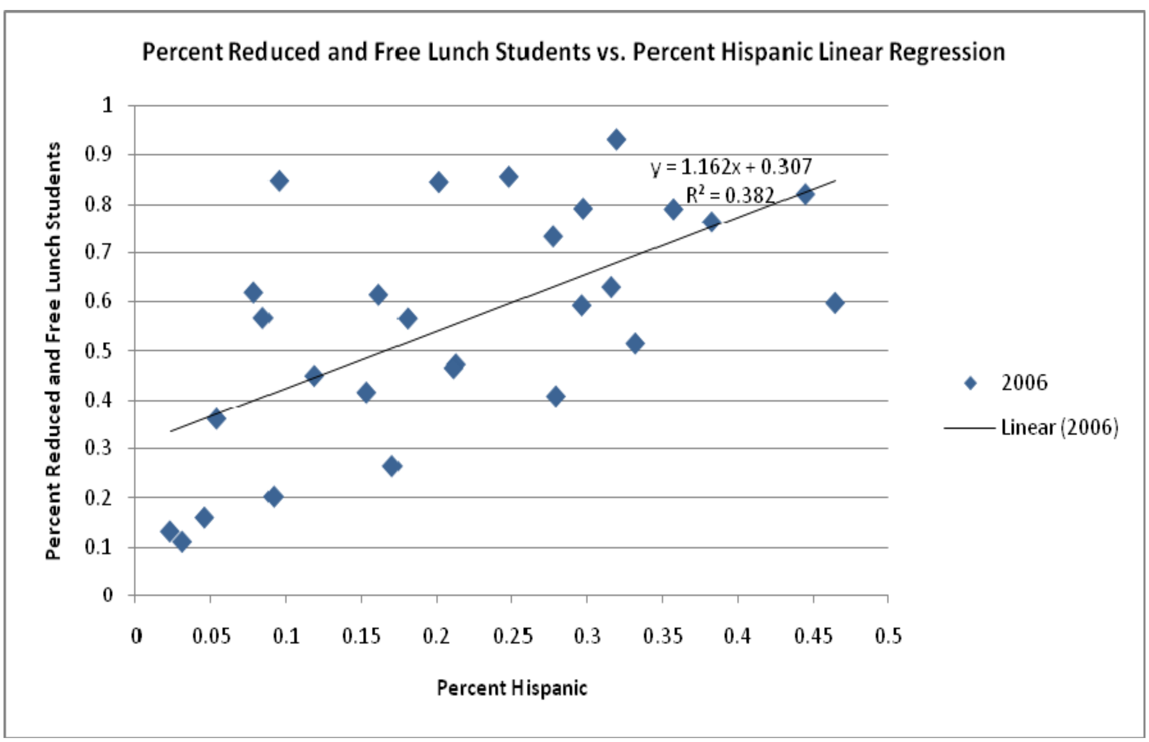


Figure 20

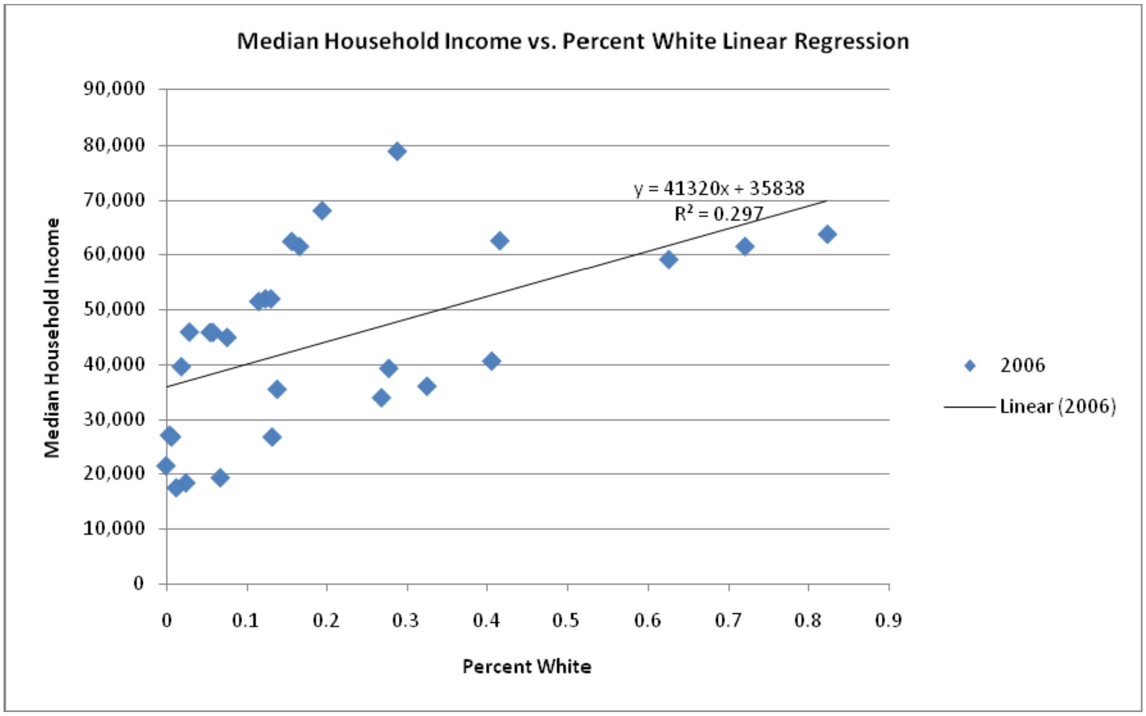


Figure 21

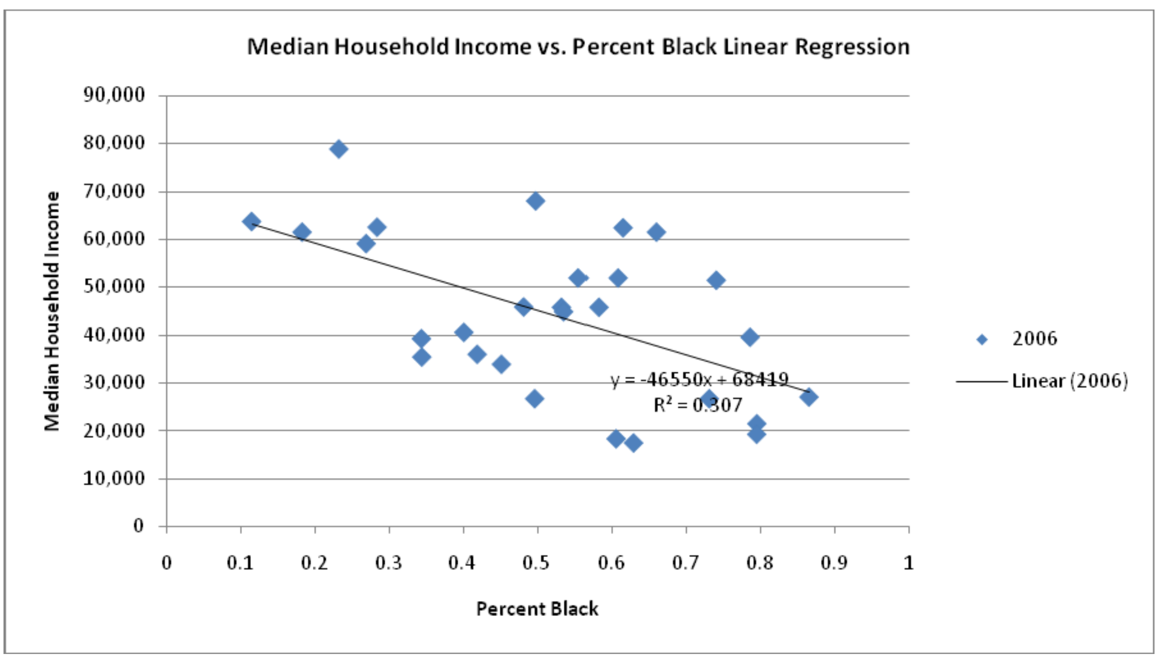


Figure 22

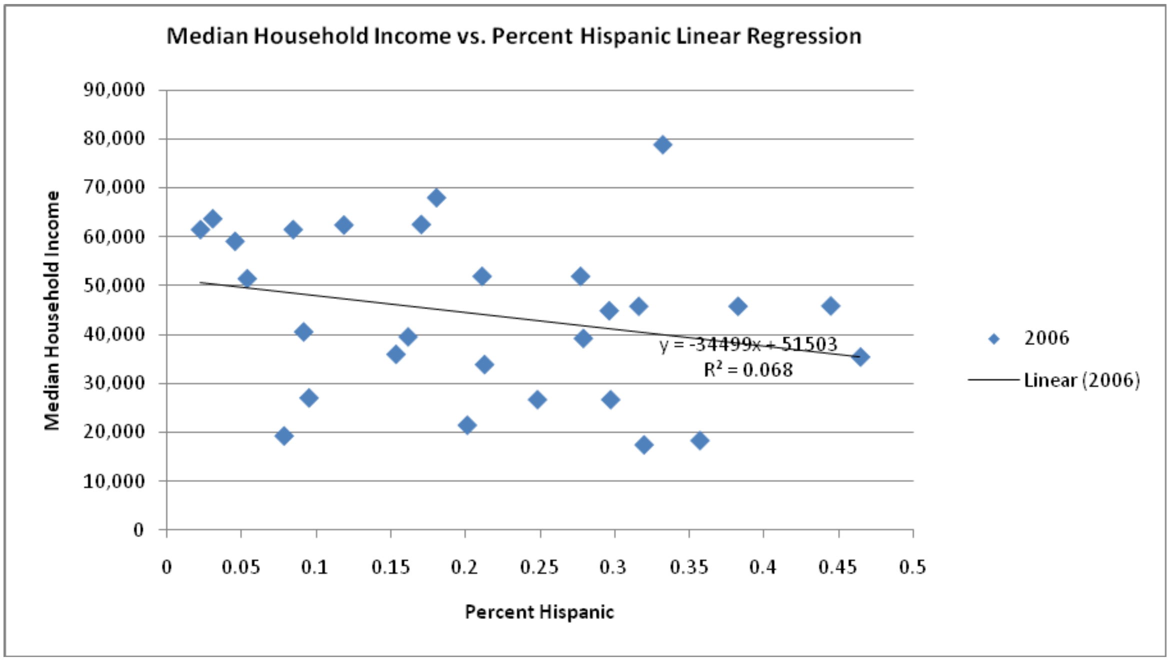


Figure 23

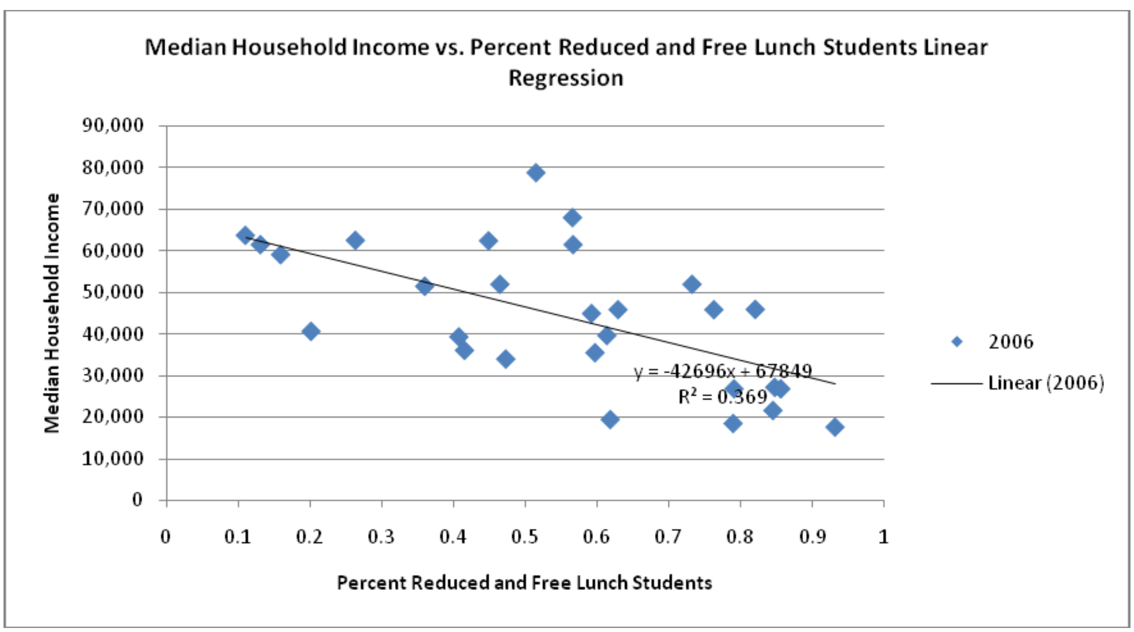


Figure 24

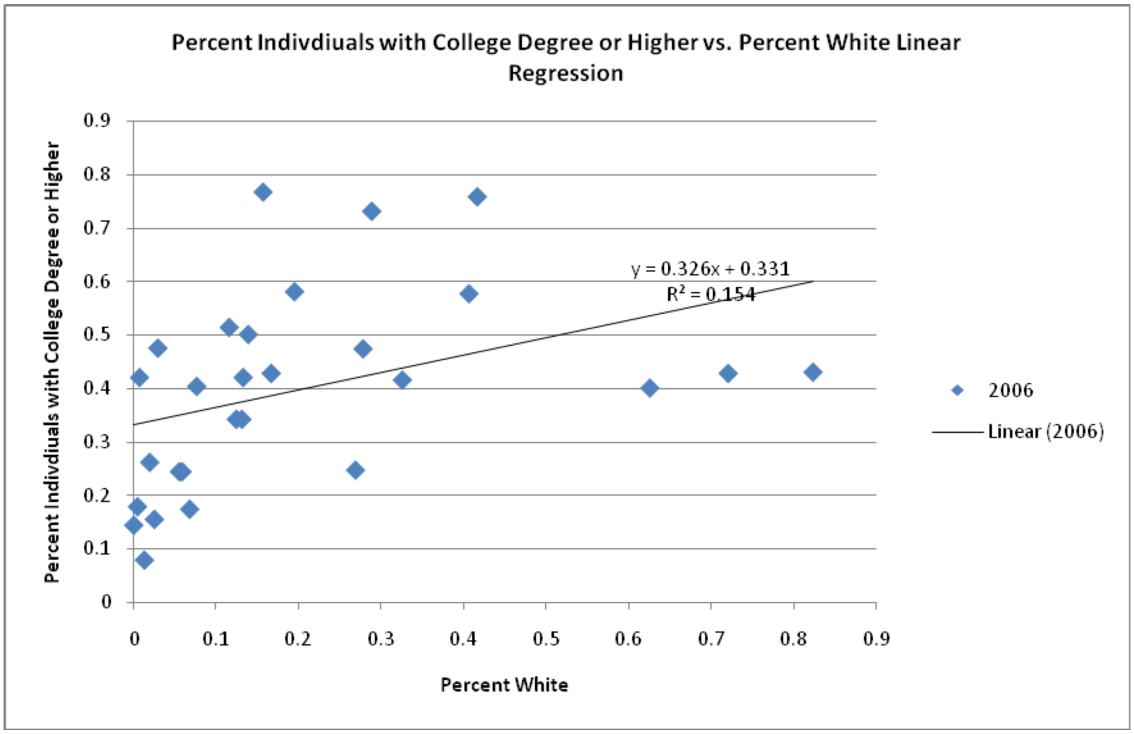


Figure 25

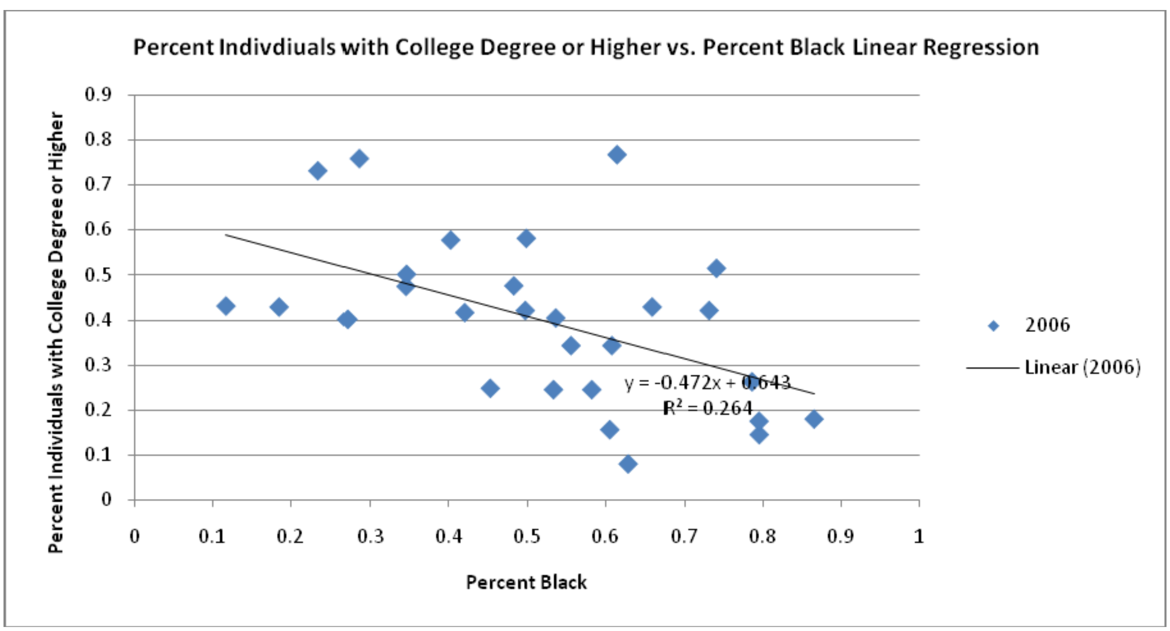


Figure 26

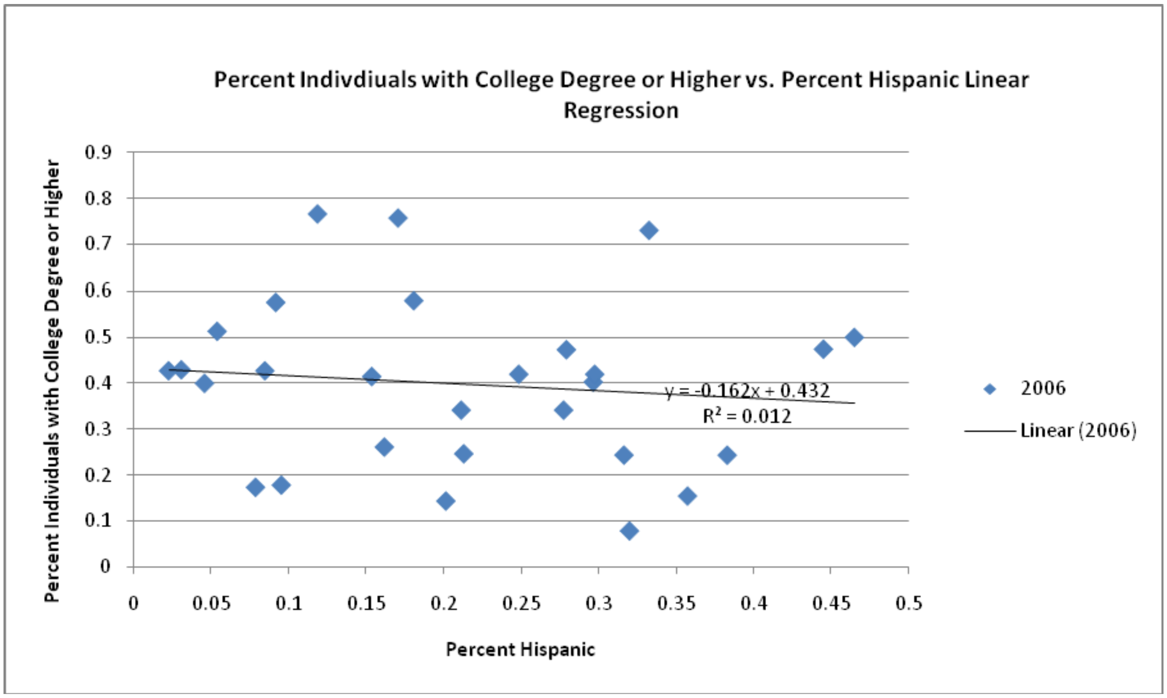


Figure 27

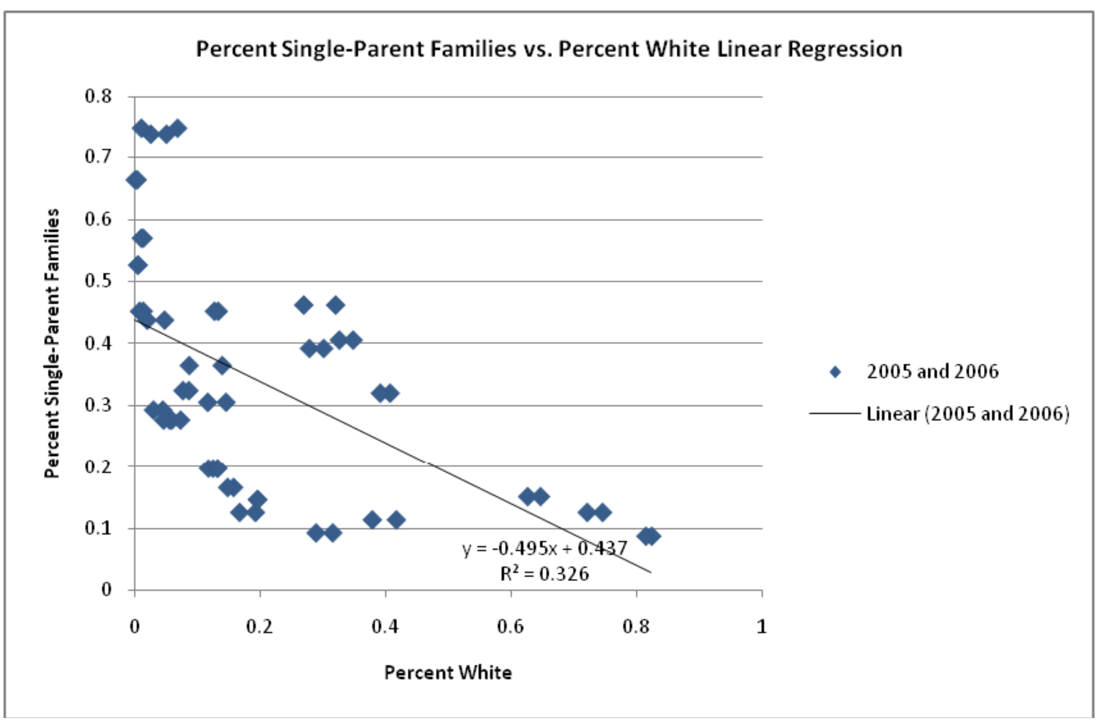


Figure 28

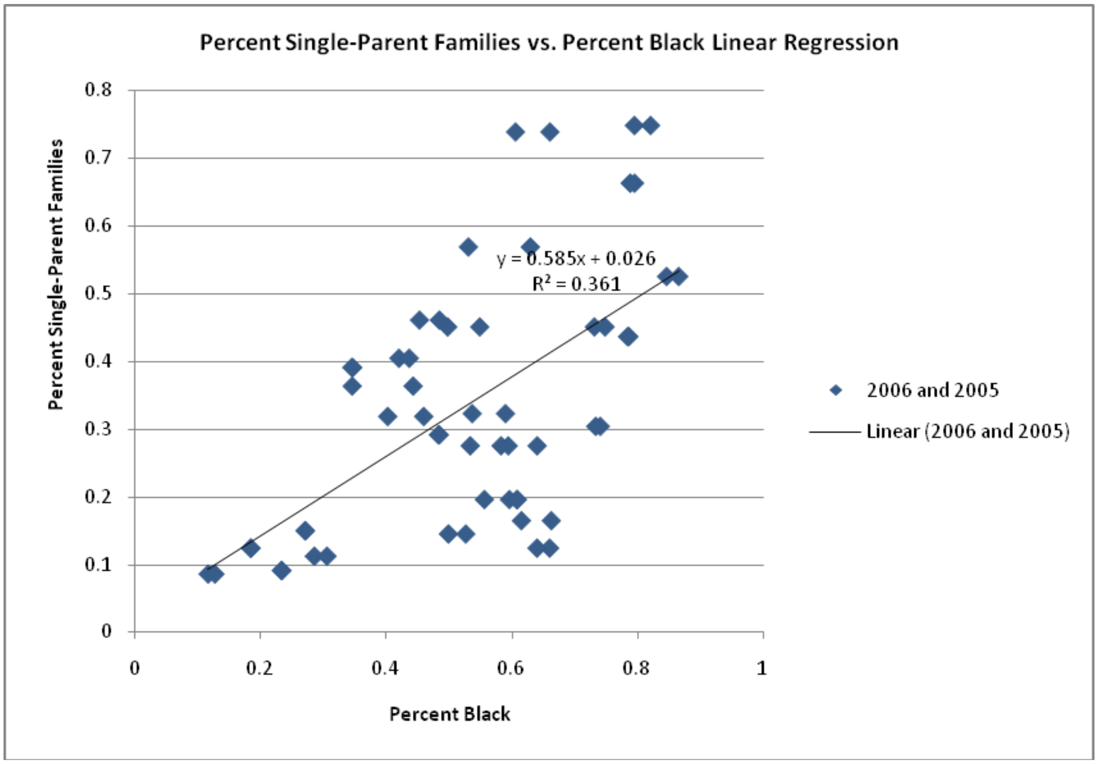


Figure 29

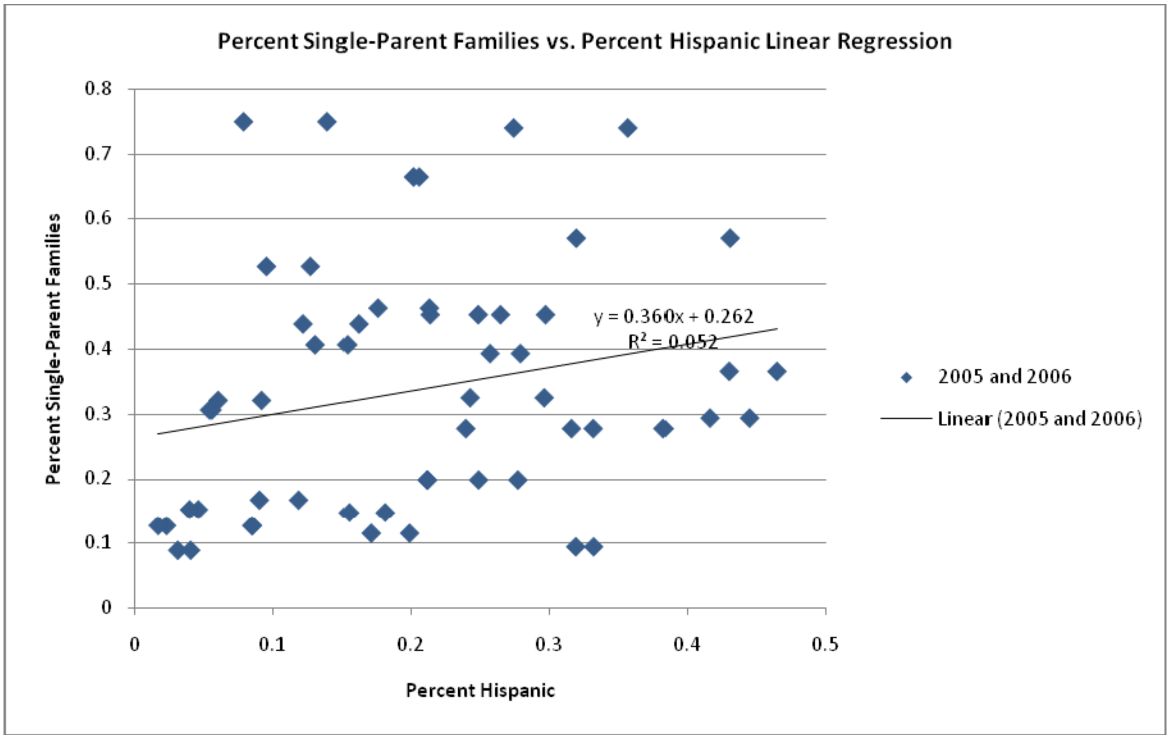


Figure 30

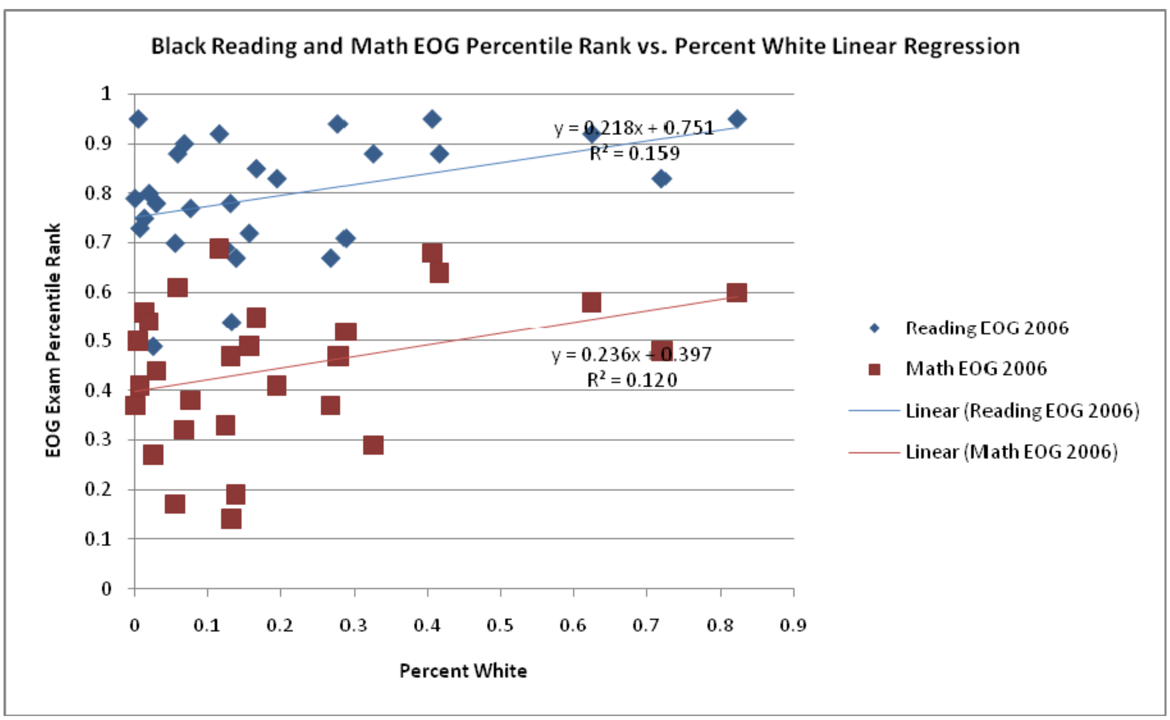


Figure 31

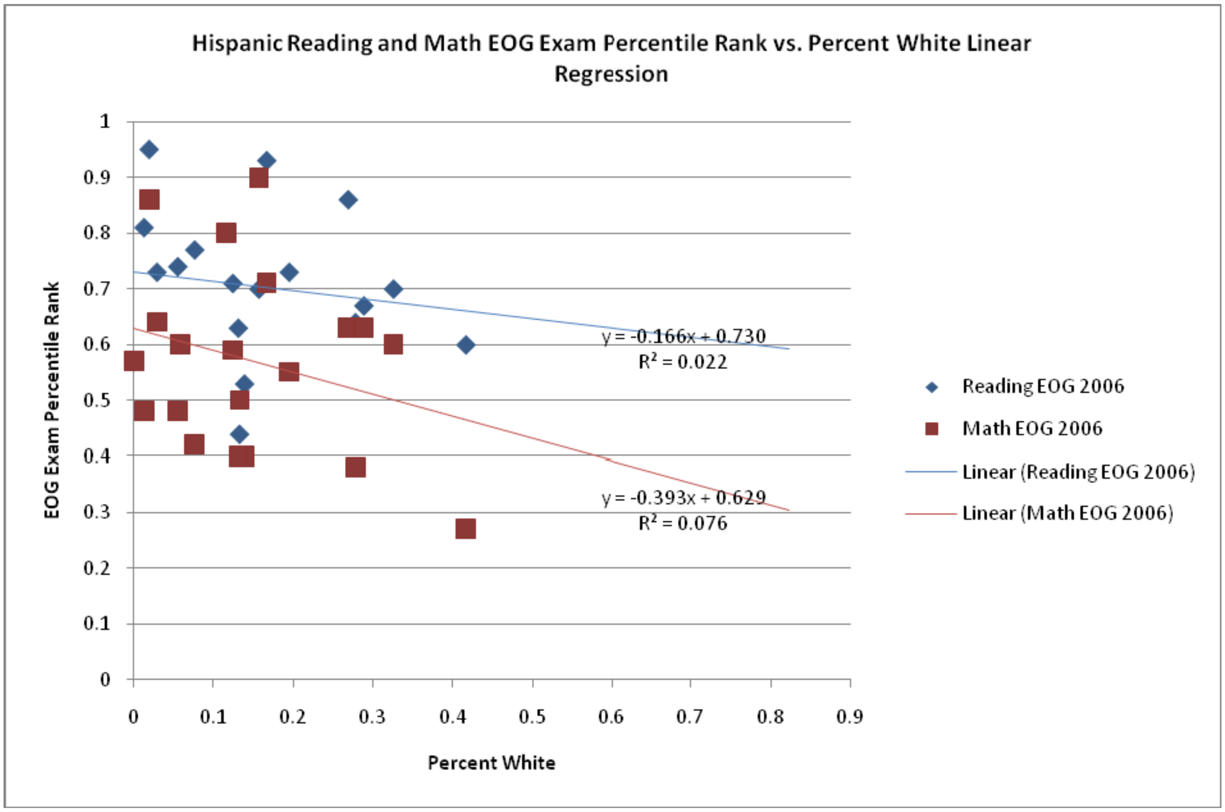


Figure 32

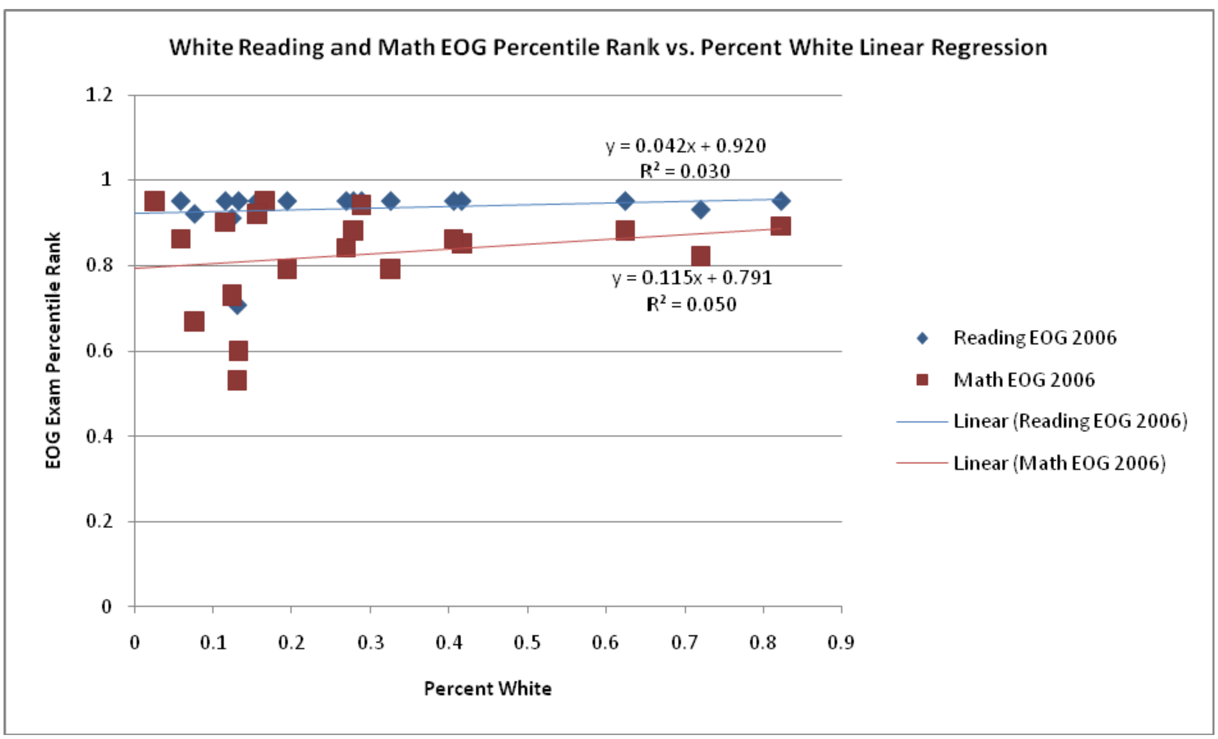


Figure 33

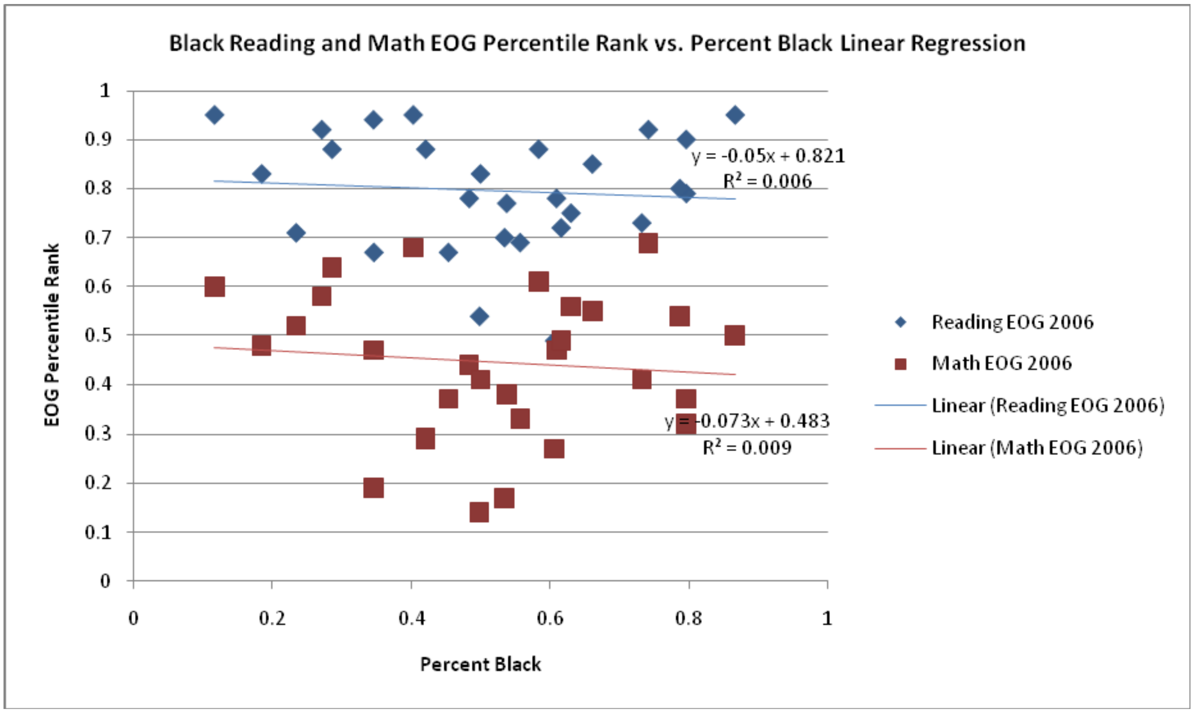


Figure 34

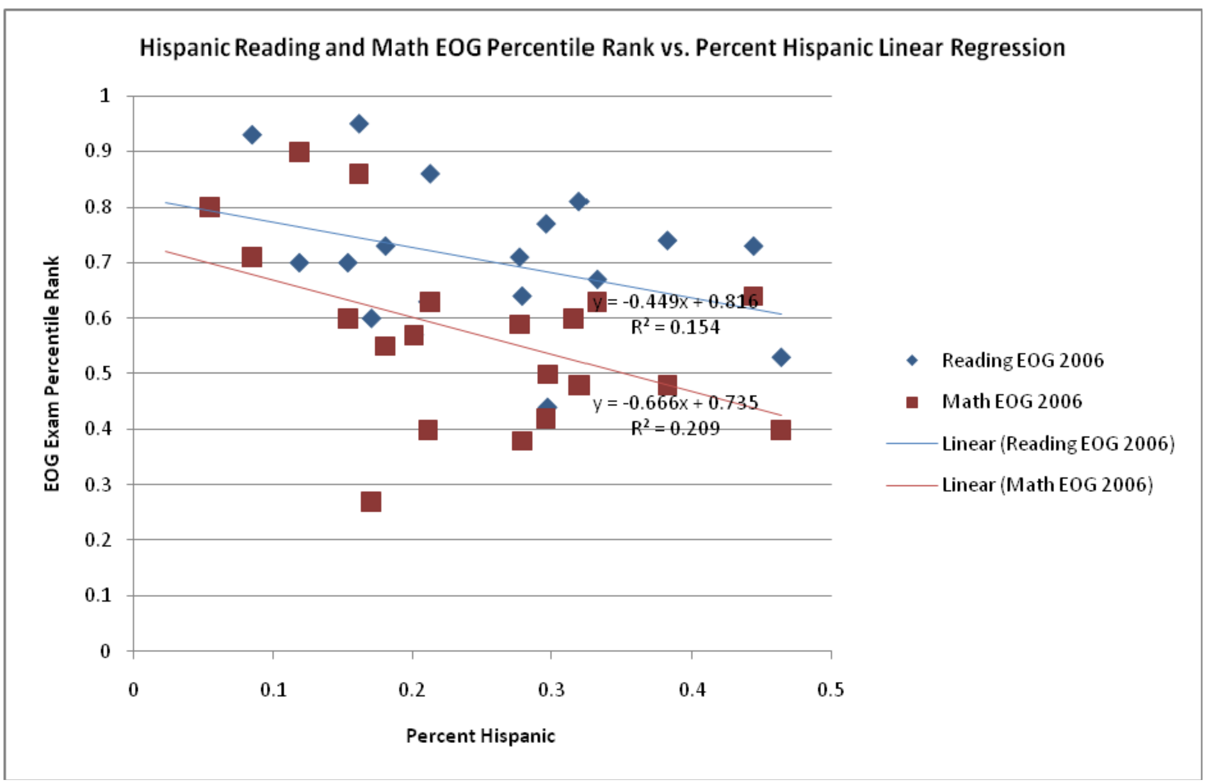


Figure 35

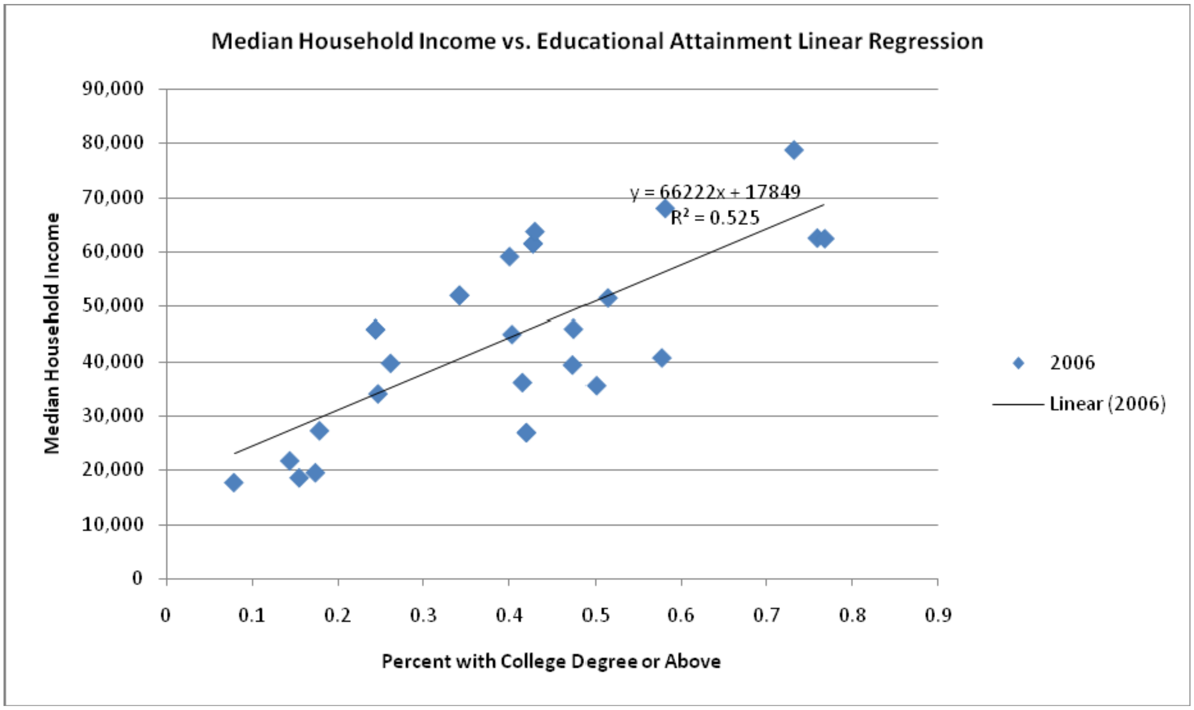

Median Household Income vs. Educational Attainment Linear Regression
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Median Household Income
y = 66222x + 17849
R² = 0.525
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
Percent with College Degree or Above
2006
Linear (2006)

Figure 36

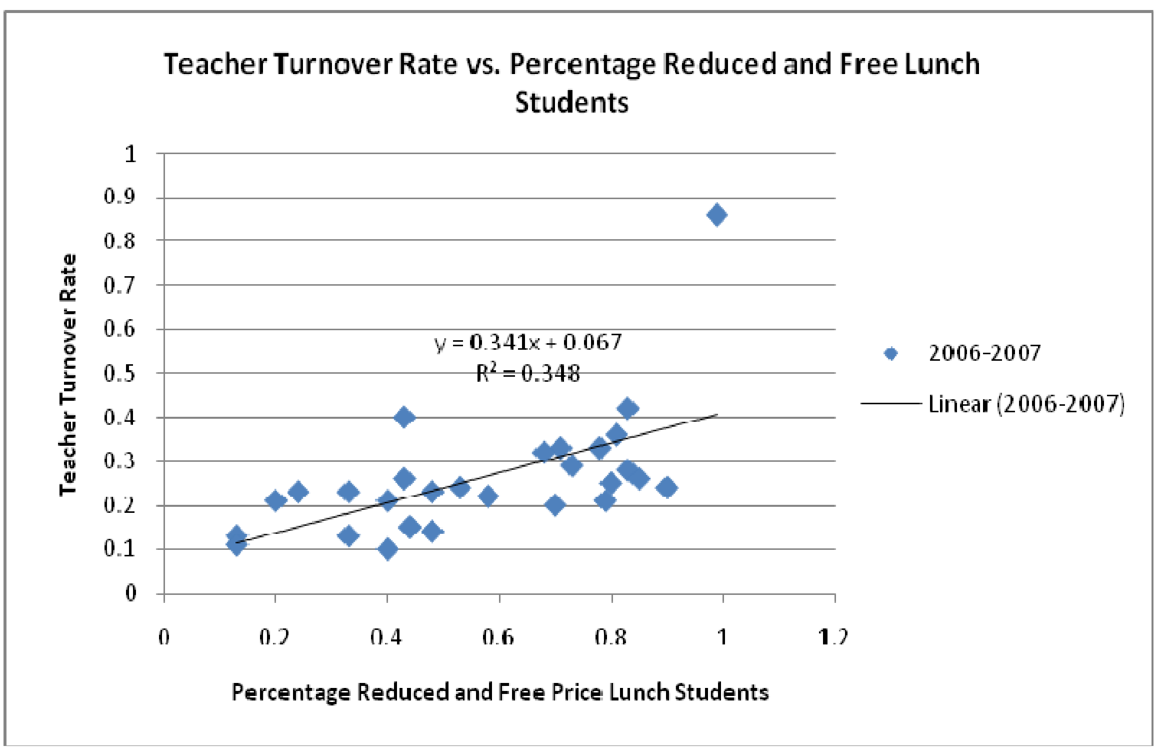
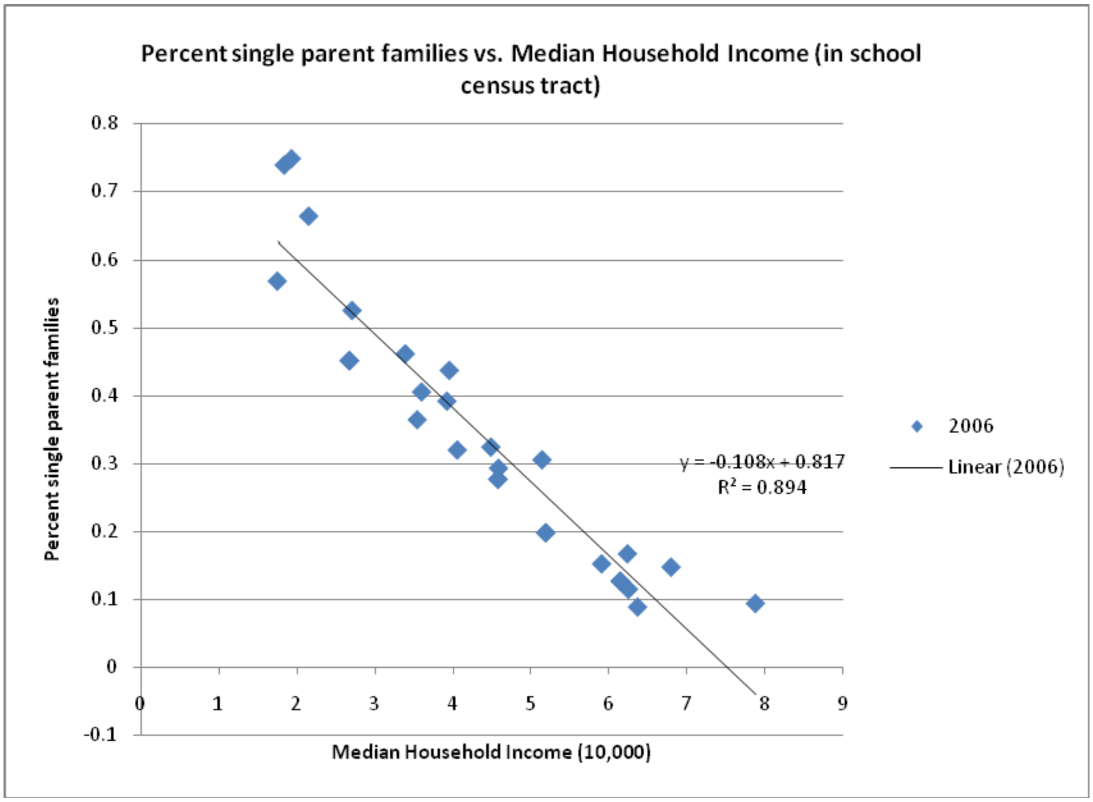

Teacher Turnover Rate vs. Percentage Reduced and Free Lunch Students
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Teacher Turnover Rate
y = 0.341x + 0.067
R² = 0.348
0
0.2
0.4
0.6
0.8
1
1.2
Percentage Reduced and Free Price Lunch Students
2006-2007
Linear (2006-2007)

Figure 37


Percent single parent families vs. Median Household Income (in school census tract)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0
1
2
3
4
5
6
7
8
9
Percent single parent families
Median Household Income (10,000)
y = -0.108x + 0.817
R² = 0.894
2006
Linear (2006)

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