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Opportunity Gaps and Remediation: Can Academic Intensity in High School Level the Playing Field?

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Opportunity gaps and remediation: can academic intensity in high school

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by

Brian J. Buddenhagen

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Title: Opportunity gaps and remediation: can academic intensity in high school
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Abstract

College remediation—sometimes referred to as developmental education—has come under increasing scrutiny as policymakers have focused on the racial and economic disparities evident in academic outcomes. The courses are designed to remedy the academic deficiencies of incoming freshmen, but descriptive statistics indicate that these students fare poorly in college, and many will not persist to graduation. This phenomenon is especially pronounced in community colleges, which—due to policy decisions and open enrollment philosophies—take on a the largest proportion of students in remedial education. Considering the attention paid to remediation, the following study focuses on predictors and interventions that could potentially help educators identify students who may need remediation well before high school graduation, and apply timely treatments that could reduce the likelihood of those students requiring remedial education in college.

The study considers current research around predictors of college success and persistence—the likelihood that students will persist to four-year degrees—and uses this research to construct a study that seeks to identify variables that can reduce the likelihood that secondary students will need college remediation. The study considers background, skills-based and behavioral variables, but focuses in particular on *academic intensity*—

the general rigor and level attainment achieved by students in their high school careers. To explore the phenomenon, it uses data collected by a large, urban school district in the Rocky Mountain West — data that includes information of standardized test scores, high school course-taking behaviors, and remediation status for those students who attended in-state, public institutions of higher education.

In order to measure the effects of academic intensity, the study makes use of eight-grade standardized test scores as independent variables. These scores are collected early enough that effective interventions can be applied before high school graduation, and they offer a convenient means of assessing the likelihood that students will require remediation. They also offer a means of measuring the effects of those interventions: ideally, the study will demonstrate that the predictability of those scores is significantly weakened as the level of academic intensity is increased.

Researchers vary in their definitions of academic intensity, with most focusing upon the number of Carnegie units completed in each discipline, and on the highest level of achievement within each discipline. Using the most reliable data available, this study focuses on two primary measures: student participation and achievement in Advanced Placement (AP) curriculum, and the calculated difference between a student's weighted and unweighted grade point average, which reflects the breadth of a student's participation in accelerated or AP curriculum. Though AP curriculum, in particular, possesses limitations demonstrated in previous research, these measures offer up the most consistent and trustable data.

Using binary logistic regression, the study reveals three primary findings: race- and class-based remediation gaps cease to measure as significant when skills-based and dispositional student characteristics are factored into the model; after factoring in dispositional measures of academic intensity, only eighth-grade standardized math test scores and the volume of AP tests passed by students persist as significant predictors of college remediation; and the calculated difference between a student's weighted and unweighted GPAs offers the single best predictor of college remediation.

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Chapter 1. Introduction

College remediation─also referred to as developmental education─whatever

criticisms and uncertainty surround its existence, is commonplace: in fall 2000, 76% of

higher educational institutions offered remedial coursework to incoming freshmen, and

28% of those freshmen enrolled in at least one remedial course (Parsad and Lewis, 2003).

Those proportions are especially skewed toward community colleges, which shoulder the

greatest responsibility for serving unprepared students entering higher education. To its

detractors, remediation is a redundant waste of resources that essentially charges

taxpayers twice for the same service: that is, it uses public funds to reeducate students

who did not learn their subject areas sufficiently prior to matriculation from the k-12

system. To supporters, remediation is an essential component of access─it acts as a

social leveler that opens pathways for disadvantaged students to access the educational,

workplace and economic benefits bestowed by higher education. Any attempts to

significantly curtail remedial programs, then, run the risk of shutting out large

proportions of poor, minority, and first-generation students from higher education.

Indeed, after the City University of New York eliminated remediation at its four-year

institutions (pushing it, instead, to two-year community colleges), enrollment numbers

indicated that a significant portion of minority students were enrolling elsewhere, or choosing not to go to college at all (Parker and Richardson, 2005).

However, despite the social utility of remediation, lowering the rates of college remediation is a legitimate policy-making and educational goal. Though students who need additional instruction and assistance will perform and persist with greater success for having taken remedial coursework, research still indicates that they are at a disadvantage compared to their peers who scored with sufficient subject-area skills to enter directly into mainstream classes that move them closer to graduation. Lower rates of college remediation, then, would—ideally—indicate a better-prepared student body with the best chances of college success. The burden of this responsibility will necessarily fall on high schools.

Current research tends to converge on "academic intensity"—a term coined by Clifford Adelman (1999)—as the most effective means of decreasing college remediation rates, and increasing the first-year performance and long-term persistence of students. Though the precise definition and verbiage of academic intensity varies among studies, Adelman's research provides the terminology for this particular study, and lays the groundwork for much of the current theory (Adelman, 1999, 2009). In general, academic intensity refers to curriculum that builds skills like critical thinking and close reading, and effective habits such as organization and time management.

This study, then, seeks to extend the phenomenon further. It asks the basic question: if educators can identify promising or at-risk students as early as the eighth

grade, could they provide timely interventions that would stand a better chance of success over four years? The study will apply similar predictors to middle school students—eighth-graders, specifically—and determine if intervening behavior (e.g., enrollment in academically intense curriculum—) in high school is correlated to changes in remediation rates.

Adelman, in an argument for curricular intensity as a means to better the college prospects of students, wrote:

> ...there's not much your toolbox can do to fix grades or class rank. On the other hand, we can work on the intensity of curriculum (e.g. the amount of math instruction and, more importantly, getting students *beyond* algebra 2), and on increasing the proportion of non-school time that students use to work on that curriculum. (1998, p. 11)

These sentiments best summarize the intentions of this study: to gauge the impact of the variables that can be controlled—in this case, high school curricular choices—and their potential ability to weaken the variables over which students and educators have only marginal control: standardized test scores.

The research question.

The research question is as follows:

"Does high school academic intensity weaken the correlation between eighth grade standardized test scores and enrollment in a remedial college course?"

The study defines the question as follows:

1. *high school academic intensity*—a measure of the level and rigor of the classes for which a student earned credit.

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2. *Weaken the correlation refers* to the ability of 8th grade standardized test scores to predict the need for remediation as an incoming college freshman five years later. Based on previous research, the study assumes a significant correlation, though the study will test and establish this link in its analysis.

3. *Eighth grade test scores* will come from reading, writing, and mathematics performance on a state achievement test.

4. *enrollment in a remedial college course* is determined by the colleges to which students matriculate; generally, in the state in which the study occurs, this determination is made by either ACT scores or placement tests designed to sort students into remedial or mainstream college courses. Though significant diversity exits within the phenomenon of remediation (Merisotis and Phipps, 2000), for the purposes of this study, a remedial course will be defined as any mandatory, first-year, basic-skills class in which study participants were enrolled.

Organization and Terminology.

Remediation is an organized, institutional response to broader academic and social influences. The need for remedial courses are correlated with students' high schools of attendance; their family income and ethnicity; and whether the new students attend a four-year or community college. College remediation is also connected to

students' first-year college performance, and their persistence to degree completion. This study argues that these individual pieces are part of the same phenomenon.

The study considers the following structural aspects of college remediation and its associated phenomena:

1. *Standardized tests, remedial placement exams and advanced placement exams:* each of these categories of exam are significantly different from the other, but all significantly influence the types of courses that students tackle in their first year of college, as test scores are used as efficient—if flawed—tools for sorting students into appropriate course tracks.

2. *Academic intensity, Advanced Placement, high school course performance and school-to-college supports.* If tests indicate a student's skills and knowledge, then these variables give an idea of a student's behavioral and motivational characteristics. The study considers Advanced Placement (AP) separately from academic intensity because AP—much like standardized assessment—has grown to become a popular means within states to create an easy-to-quantify measure of academic intensity and course equity among high schools. They are, though, highly imperfect measures, which this study addresses in its limitations section. The study will consider all as predictors of college performance, persistence, and remediation.

3. *Persistence.* This refers to a student's ability to persevere toward the completion of a four-year degree. Though this study will not explicitly explore and measure persistence in its population sample, it addresses the idea extensively in the literature review. Lessons gleaned from research in persistence offers valuable guidance to this study's design and interpretations.

4. *Ethnicity and family income.* Though the study is most concerned with exploring high-school coursetaking as a means of lowering remediation rates, these two variables remain highly correlated with remediation and college persistence, and must be considered to obtain the fullest picture of the phenomenon.

See *Appendix I* for a graphic rendition of the model described above.

Chapter 2. Background

Defining remediation.

College remediation—or developmental education—causes some degree of consternation in state legislatures for three primary reasons: its cost, the uncertainty of its outcomes, and the very fact that U.S. high-schoolers exit their primary schooling lacking some of the essential skills to succeed in college.

At its most basic, college remediation is a "catch-up" program, in which colleges and universities identify students whose skills and preparation fall short of institutional standards, and enroll those students in courses that remedy their preparatory shortfalls. However, its philosophical implications are far greater: because of resource and educational inequities in students' primary school years, strict admittance standards would tend to disproportionately bar the underprivileged from attending college. Remediation opens higher education to a broader range of students, and allows those students to take part in the economic advantages afforded by four-year degrees. In this view, remediation is a rung on the ladder of upward mobility, and a social class leveler. This phenomenon has historical precedence in the United States: land grant institutions provided remedial courses to a wave first-generation college students in the 19th century,

for example, and universities that accepted the flood of World War II veterans taking advantage of the GI Bill did the same (Merisotis and Phipps, 2000). As Merisotis and Phipps point out, "those halcyon days when all student who enrolled in college were adequately prepared, all courses offered at higher education institutions were 'college level' and students smoothly made the transition from high school and college simply never existed" (2000, p. 69).

Remediation is not standardized, meaning that it is complex, and by no means uniform. Tremendous variation exists according to the amount of remediation offered by individual institutions; by the selection criteria employed to identify and enroll students in remedial coursework; whether remediation is compulsory or optional; how remedial courses are funded; and how credit is awarded within those classes. The challenge to researchers, then, is to describe an institutional function that lacks consistency.

The financial costs of college remediation are shouldered both by the states and the students themselves; indeed, one of the central arguments against providing remediation is that it asks for students and taxpayers to, in effect, pay twice for the same service: the k-12 school system is tasked to prepare students for college, so college remediation pays for a service that the k-12 sector failed to provide. The cost is significant: the state in which this study takes place estimated that, in 2012, remediation cost $58.4 million, of which the state paid $19.1 million and the students themselves $39.3 million (Colorado Dept. of Higher Ed., 2013). The expenses associated with remediation can increase the

cost of a college education for students in remedial education, as institutions often do not award credit toward graduation for remedial courses.

However, despite policy-makers' focus on cost-benefit analyses, it should also be noted that the student populations who take remedial coursework are a diverse set: though studies tend to focus on poor, minority, first-generation college-goers, all walks of life engage in remediation. Even college preparatory work in high school—the focus of this study—is no antidote to college remediation: students who are "college ready" by curricular standards may still end up in a remedial course (Hoyt and Sorensen, 2001; Merisotis and Phipps, 2000).

Community colleges have taken on the largest share of the burden of educating underprepared college students. Consequently, the "remediation problem" is an especially salient issue in community colleges. However, the extent of remediation for students varies greatly: though the least-prepared students in community colleges may find themselves in sequences of remedial courses that may delay entry into mainstream college classrooms for a year or more, most students spend less than a year taking remedial courses, and oftentimes students are enrolled in just a single remedial course (Merisotis and Phipps, 2001).

Remediation and College Persistence

Before this study tackles the literature around remediation, it must first examine the the idea of *persistence*—a student's commitment to completing the full four years of college and earning a college degree. Though this study is primarily focused on

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predicting a student's need for remediation soon enough to offer timely interventions, research surrounding persistence helps draw a more comprehensive picture of what goes on among students who are identified for remediation.   The phenomena are linked, and the factors that help one predict a student's likelihood of graduating from college will also help one design a relevant study surrounding pre-collegiate preparation in high schools.

Remediation is, at its core, a focused, technical process that deals with big-picture issues linked to socioeconomics, race, ethnicity, school environments and family history. The research on persistence helps one understand the social and emotional processes that accompany adjustments to college, and helps explain—above and beyond academic competency—why one student successfully moves out of remediation and on to a four-year-degree, while the next student does not.

Examining available descriptive statistics, one notices the disparities that surround these groups: the National Center for Education Statistics' National Educational Longitudinal Study of 1988 (NELS : 1988/2000) shows that, after entering an institution, Blacks and Hispanics are less likely to persist to a degree—whether two-year or four-year—than Whites and Asians (Adelman, 2004, p. 29; Aud, et al, p. 108; Ross, et al, 2012, p. 186), and that low-family-income students are less likely to persist than higher-family-income students (Adelman, 2004, p. 31). First-to-second-year retention is also connected to credit completion: the fewer credits completed by a student—especially 10 or less—the less likely a student is to re-enroll for a second year (Adelman, 2004, p. 42).

Minority students enroll in higher education at rates roughly proportional to their distribution in the general U.S. population, yet graduate at a far lesser rate than their White peers (Kinser & Thomas, 2004, pp. 25-26). This discrepancy between enrollment and graduation can be explained through both preparatory and emotional factors—elements that, though described separately here, are intertwined in reality.

Preparational factors are those related to the academic preparation of students; Kinser and Thomas note that the National Assessment of Educational Progress (NAEP) demonstrates significant academic skill gaps between White and minority students graduating high school, and that White high-schoolers earn significantly higher average GPAs than their non-white peers. This discrepancy can be partly explained by the types of schools that American high-schoolers tend to attend: students of color are more likely to graduate from poor high schools with fewer resources and inadequate college-preparatory programs (Kinser and Thomas, p. 27). Variation in high school experiences may help account for the uneven experiences of students in their first year of college.

Though the level of high school preparation will tend to predict academic performance within classrooms, the preservation—or loss—of confidence and self-esteem describes the emotional factors that help explain why students don't finish college. Kinser and Thomas point out that high-achieving, hardworking minority students may enter college with unrealistic expectations due to the low quality of academic preparation offered by their high schools, their potential status as first-generation college-goers, and the contrast between supportive high schools and the colder

"sink-or-swim" approach of many higher education institutions. Additionally, encounters with majority white culture, the diminishing of their own cultures, and pressures to conform to majority standards tend to erect "psychological barriers" for minority students (2004, p. 31).

Part of the emotional equation can be described through the idea of *validation*: essentially positive interactions with instructors and peers that build the self-esteem of students, and increase the likelihood that those students will perceive their educational experiences in a positive light. Jaloma and Rendón (2004) argue that minority students are more likely to have memories of invalidating experiences from their pre-collegiate educations, and that "these types of students are likely drop out early in their college careers is they continue to have invalidating experiences" (p. 42). Students who have experienced invalidation prior to college, they note, can be particularly harmed by these interactions, as their prior experiences make them less likely to trust or reach out to instructors—a particularly harmful behavior in higher education, where students are expected to be independent and advocate for themselves.

The reasons for dropping out of school are complex, and research generally agrees that the reasons for leaving school vary according to race (Fischer, 2007). Some patterns, though, tend to hold consistent across groups: all students tend to benefit academically from professor and advisor interactions, and social and peer connections (Fischer, 2007; Kuh, at al, 2008; Nora, Cabrera, Hagedorn and Pascarella, 1996). However, efforts to engage students in the college community have a greater positive effect on minority

students and those who enter with academic skill deficiencies, to the point that they substantially lesson the effects of pre-collegiate experiences and academics (Kuh, et al, 2008, p. 555). Though academic ability, on the surface, would appear to explain much of the variance among student groups regarding persistence, Cabrera, et al (1999) reported that academic ability, among African-Americans, exerted an indirect influence on persistence at best, and that persistence was better-explained by social and attitudinal variables, with parental support exerting an especially strong effect. These studies indicate that graduation gap may start with preparatory factors, but it is widened by the varied, unique social and emotional factors dealt with by poor, minority, and first-generation college students.

Students who enter college with notable skill deficits likely enter with a unique set of attitudinal and behavioral characteristics that—while connected to their academic abilities—are not measured or explained by traditional evaluations of college preparation. Grimes and David (1999), for example, found significant attitudinal differences between underprepared (remedial) and college-ready students; they reported, for example, that underprepared students self-rated themselves as having lower intellectual self-confidence; reading speed and comprehension; writing and mathematics skills; public speaking; and as having a lesser understanding of others (p. 80). Underprepared students also tended to demonstrate an external locus of control (that is, they feel that they have little control over their immediate environment) and higher levels of anxiety—particularly testing anxiety (Grimes, 1997). Gerdes and Mallinckrodt, though they did not focus on

remediation, compared college drop-outs who struggled academically, versus those whose academic standing was good; they reported that the students in poor academic standing had not anticipated having clear academic goals, and felt tense and nervous (1994).

These results indicate that students are aware of skill deficiencies, and that this awareness exerts a negative influence on their self-worth and self-confidence. Negative changes in academic self-esteem between freshmen students' fall and spring semesters have also been correlated to decreased social adjustment, academic adjustment, and personal emotional adjustment, and with increased levels of self-reported depression (Friedlander, Reid, Shupak and Cribbie, 2007, p. 266). Robbins, et al (2004), in an examination of the correlations between pyscho-social and study-skill factors and retention, found that academic skills were weakly correlated with first-year college GPA, but were strong predictors of college persistence. Finally, regression analyses have demonstrated that students who have positive self-perceptions of their academic abilities tend to successfully adjust to college at higher rates (Boulter, 2002).

Much of the research that surrounds persistence gaps tends to assume that minority, poor, and first-generation college students persist at lower rates because they experience subtle discrimination at their college, or do not have access to the hidden social standards understood by their peers, both of which tend to isolate students and potentially lead to decisions to disenroll. Terenzini, et al (2001) supports this view in the United States, as affluent students tend to rely on several sources of information, are more knowledgeable

about college costs, are more likely to broaden the search to include a wider geographical range, tend to consider higher-quality institutions, and have parents who planned and saved for college expenses (p. 8).

Archer and Yamashita (2010) posited that working-class students in England, despite optimistic assessments by their teachers, were likely to avoid higher education if they felt that their skills were deficient, that college presented greater risks than reward, or that they would be reprimanded or humiliated for not conforming to the standards of higher education classrooms.

Though no studies directly investigate the confluence of race, SES and remediation, existing studies explore phenomena that likely overlap the remediation/persistence link. Poor students are also more likely to hold down jobs while in college, study less, are less involved, and report lower GPAs (Walpole, 2003, p. 63). Stage (1989), sought to link "motivational orientation" (social integration into college) and college persistence: she found that a student's initial commitment to an institution was significantly related to a student's social integration into that college, and that student's later persistence in college.

It should be noted that the descriptive statistics regarding persistence closely track those regarding remediation: both remediation and persistence rates show marked gaps between Whites and minorities, and poor and middle-class families. This overlap indicates that remediation is likely a smaller part of a much larger, more complex whole. This study will later explore the strength of correlations between degree persistence and remediation—they are clearly linked variables—but the nature of the association is

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significantly more complex than it initially appears. Considering the descriptives above, though, studies of retention and persistence, clearly, must account for factors of race and socioeconomics to get a full grasp on the phenomena.

The emotional aspects of persistence are important to the study, primarily, as an unreported variable that should be understood to fully comprehend the dynamics behind remediation. As noted before, remediation is a technical solution to skill gaps, but student experiences are tied to emotional variables that impact the study. The psychometric measurement of skill-gaps are inadequate in isolation, and successful studies around remediation will likely need to consider students' awareness of their skills-gaps, how that awareness impacts student attitudes and self-worth, and how those feelings influence retention. Consequently, the careful consideration of the emotional experiences of students inspired the inclusions of a "school-to-college" variable in the study—a consideration of whether students participated in the Advancement Via Individual Determination (AVID) program, which explicitly provides added academic and emotional support to first-generation college-goers in the school district that is the focus of this study. While academic intensity is focused on skill-building, such programs offer guidance, mentorship and support—facets that acknowledge the emotional lives of students. The body of research also seems to imply that academic intensity may serve a function of "toughening up" students emotionally, so that they are more likely to circumvent remediation—or persist beyond remediation and complete their degrees.

Profiles of remediation

Looking at the big picture of remediation in the United States, three major

observations become quickly apparent: two-year community colleges take on

significantly more students who need remediation than four-year institutions; open

enrollment institutions take on more such students than selective ones; minority and poor

students take up a disproportionately large percentage of those who take remedial courses

in college; and students require mathematics remediation at a higher rate than they do

reading or writing.

Community colleges offer more remedial courses, as they are more likely to enroll

more students in remedial classes. This is due to three factors: the two-year college is, in

part, a gateway to four-year colleges, and offers additional teaching and skill-building

before students enter a university; second, most community colleges are non-selective,

open-enrollment institutions that will not deny students access due to low high school

GPA or weak academic skills; finally, states frequently subsidize remedial courses at

community colleges, while many four-year institutions require students to pay full tuition

for these courses (or, as in the case of CUNY and the University of California system,

states have completely removed remediation from four-year colleges, and assigned the

task entirely to the community college system). Whatever the causes, the results are the

same: community colleges are the principal providers of remedial education.

Adelman's analysis of the data collected from the The High School and Beyond

Longitudinal Study of 1980 Sophomores (HS&B/So:80-92) shows that 25.3 % of

students at four-year institutions took one or more remedial classes, compared 61.1% of

community college students (2004). This pattern holds in the state that is the subject of this study: in it's most recent legislative report, the state department of education reported that 66% of students enrolled at the state's public two-year institutions required remediation, compared to 24.4% of students in the state's four-year institutions (Colorado Dept. of Higher Ed., 2013). It should be noted that Adelman also parsed the data for students who needed remediation in multiple subjects, not just a single area of weakness: at four-year institutions, 6.6% of students took two or more remedial classes beyond remedial math; at community colleges, 21% of students took two or more (2004, p. 90). Descriptive statistics support the notion that community colleges are taking on the largest proportion of students in need of remediation, and are taking an especially large proportion of the students most in need of this help.

Research and longitudinal data collection also illustrate significant remediation gaps in the context of race and ethnicity (Ross, et al, 2012, p. 186; Bahr, 2010). In the 2007-2008 school year, for example, on a self-reporting questionnaire, 19.9% of White students reported that they had taken a remedial course. Compare this to the 30.2% of Whites who reported remediation, 29% of Hispanics, 22.5% of Asians/Pacific Islanders, and 27.5% of those who identified themselves as being of two or more races (National Center for Education Statistics, 2013). On the same questionnaire, slightly more women (24.7%) reported taking remedial courses than men (21.6%). The exact percentages vary according to the methods of data collection, and how researchers define remediation, but this pattern remains consistent across all reports and studies. For example, the US

Department of Education's *The Condition of Education: 2011* reported that whites

enrolled in remedial courses at lower rates than other groups─with 31% of white

students reporting that they'd taken such coursework, 45% of blacks and 41% of

Hispanics (Aud, et al, 2011). Adelman's analysis of the HS&B/So:80-92 data set shows

the following breakdown of remediation rates by ethnicity: 34.6% of Whites; 61.7% of

Blacks; 63.2% of Hispanics; and 38% of Asians (2004, p. 93).

Family income gaps are also pronounced. Attewell, et al, using data from the

National Education Longitudinal Survey of 1988 (NELS: 88), reported that, though

students from the lowest family income quartile were more likely to take remedial

courses, students from all family income levels participated in remediation at significant

rates. The authors reported that 52% of those in the lowest quintile took remedial

coursework, compared to 24% of those in the highest quintile (2006, p. 899). Bettinger

and Long (2006, p. 19) reported that 82% of students from families of incomes of

$100,00 or above required no remediation, while 50% of those whose parents made

$18,000 or less required no remediation. Adelman, again using the HS&B/So:80-92 data,

reported that 24.8% of students from the highest-family income quintile took one or more

remedial classes, while 63.2% from the lowest-SES quintile did so (2004, p. 92).

Studies of SES, college enrollment and persistence tend also to examine the types

of institutions to which students matriculate, which helps draw a more comprehensive

picture of first-year college students and remediation. This study has already established

that community colleges take on significant proportions of students who require

remediation, but the least selective of four-year institutions also take on significant

numbers. Several studies consider the type (public, private, two-year, and four-year) and

selectivity (open admissions versus highly selective) of colleges and universities, and

examine how students from different family income quintiles aggregate into the different

types. In the 2007-2008 school year, students self-reported on questionnaires

remediation rates of 12.8% at the most selective four-year institutions, and 25.6% at open

enrollment colleges (Sparks and Malkus, 2013, p. 3). Again, note that these numbers are

likely skewed by the nature of self-reporting. The remediation/selectivity split mirrors a

family income/selectivity split: Carnevale and Rose (2003), using the NELS: 1988 data,

found that, among the most selective four-year institutions, three percent of students were

drawn from the lowest quartile of family income, while 74% were drawn from the

highest-income quartile. As they examined the income profile in increasingly less

selective schools, they found this gap to gradually close: among the least selective four-

year schools, 16% of the student population was drawn from the bottom quartile of

family income, while 35% were drawn from the top quartile (p. 106).

Mathematics remediation constitutes the largest proportion of freshman remedial

coursework—a pattern that bears across institutional type, ethnicity and family income.

The National Center for Education Statistics' 2000 Postsecondary Quick Information

System (PEQIS) survey indicates that 22% of incoming freshmen needed a remedial

math course; 14% needed writing remediation, and 11% needed reading. In the same

report, public four-year institutions demonstrated a consistent pattern, with math

remediation taking a larger share than writing and reading (Parsad and Lewis, 2003, p. 8). The NELS:88 data shows that mathematics remediation accounted for 28% of remediation in 2000, writing accounted for 18%, and reading 9 percent (Attewell, Lavin, Domina and Levey, 2006, p. 897). In the state that is the subject of this study, the state department of higher education reported that, in 2012, 51% of students enrolled in math remediation, 31% is English, and 18% in reading (Colorado Dept. of Higher Ed., 2013, p. 13). Bettinger and Long found a similar math/English gap in Ohio community colleges (2005).

Considering the above, one can argue the following:

First, remediation is, as stated earlier, commonplace. Students of all walks of life and academic abilities take the courses, likely because even the highest-skilled student will still possess weaknesses in some areas. The higher rates of math remediation point to this phenomenon: it is probable that many highly articulate and literate students need some additional math preparation.

Second, despite its ubiquity, remedial courses tend to congregate with greater frequency at higher educational institutions that serve higher proportions of minority students and poor students. As noted above, these students are more likely to enroll in open-access "gateway" institutions—the community colleges and public four-year institutions that educate student populations that are academically, ethnically and socioeconomically diverse.

Finally, it's suggested that those students taking remedial courses in those gateway institutions are the ones of greatest concern; students accepted to selective four-year schools have in effect, already completed the hardest step—acceptance to a selective institution. These students can participate in remedial coursework and still find success. Students taking remedial coursework in which large numbers of their peers are doing the same, though, may find remediation to be emotionally deflating. Without the pride of acceptance to a selective school, they may have few confirmations of their skill or worth —they are unlikely to receive the validation described earlier by Jaloma and Rendón.

The influences of remediation on student persistence to a four-year college degree.

A quick survey of descriptive statistics and research indicates that students enrolled in college remediation are significantly worse off than their unremediated peers: compared to their classmates, students who take remedial courses are more likely to drop out of college and less likely to complete their four-year degrees (Adelman, 2009; Bailey, 2009; Bettinger and Long, 2005; Kreysa, 2006; Hoyt, 1999). Remediation has also been associated in students' first year with a lower GPA (Adelman, 2005; Hoyt and Sorensen, 2001), higher numbers of course withdrawals and transfers, and fewer credits earned toward degree completion (Adelman, 2005).

Students who enrolled in remedial reading were significantly less likely to persist to a degree than those who enrolled in remediation for math or other subjects—Adelman reported that 70% of the class of 1992 who took remedial reading did not earn a two-or-four-year degree (2005, p. 152). At a Utah community college, students who were

remediated in multiple subjects persisted at lower rates than those who were remediated

for just one subject (Hoyt, 1999; Hoyt and Sorensen, 2001). Adelman has also reported

statistics that showed college completion rates steadily declining according to the total

number of remedial courses in which a student was enrolled: using NCES data on the

high school graduating class of 1982, he found that 54% of students who required no

remediation earned a four-year degree; 45% of students who took one remedial course

earned a degree; and only 18% of students who required three or more remedial class

earned their undergraduate degrees (1998, p. 11).

However, these researchers have concluded that these statistics are deceptive, and

failed to control for other variables that could influence the persistence rates of students

enrolled in remediation. Bettinger and Long argue that researchers should not simply

compare unremediated students against those who are remediated, as each group

possesses characteristics unique to itself, which may account for the differences in

college success and persistence—not remediation. According to the authors,

> Although a simple comparison suggests that remedial placement has a
> negative impact on students, it masks the fact that students are not
> randomly placed in remediation. Better-prepared students are less likely to
> be placed in remediation and they also do better in college. (2005, p. 23)

In effect, they argue that descriptive statistics and simplistic research

methodology may only be comparing family income, ethnicity and other background

variables, rather than the true effects of remediation. For example, it would be

inappropriate to compare the effects of remediation between a group of high-income

students who participated in remediation at low rates against a poor student population

that participated in remediation at higher rates. Rather, researchers should control for characteristics before comparison, to ensure that they are comparing the proverbial apple against the proverbial apple.

More sophisticated analyses by these researchers tells a much different story: as other variables are controlled in analysis, the marked persistence gap between remediated and unremediated students begins to shrink. Adelman (2005, 2006), Bettinger and Long (2005), Kreysa (2006) and Attewell, Lavin, Domina and Levey (2006) demonstrate, through different variations on regression analysis, that—after controlling for background variables—no statistically significant difference regarding student retention and graduation exists between remediated and unremediated students, and that it in some cases it may confer an advantage. The methodology of all of the researchers involves controlling for variables in such a way as to compare remedial students against students who demonstrated similar background and skill variables, but due to variation in institutional enrollment practices, were not placed in remedial coursework.

For example, Adelman, though he indicates that remediations "stalls" student momentum (p. 47), declined to add remediation to his regression analysis of student persistence and degree completion in a 2006 study because, in previous research, he had been unable to demonstrate significant correlations between remediation and degree completion. He notes that "sufficient numbers of students who took remedial classes successfully moved through them so that remediation did not make a strategic difference in degree completion" (p. xxiii). Kreysa came to the same conclusion, noting that "the

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remedial education program is successful in assisting students to "catch-up" academically with their peers" (2006, p. 262).

Bettinger and Long's research argues that no meaningful differences exist between the groups in reading, while students who participated in math remediation in Ohio community colleges were 15% more likely than their unremediated peers to transfer to a four-year institutions, and completed an average of 10% more credit hours while enrolled in their community colleges (2005, p. 24). In a 2009 study, Bettinger and Long paid particular attention to marginal students—students "on the borderline" of remediation who would be enrolled in such courses in one institution, but not another. In their research, they discovered that marginal students in English remediation were 15.2% less likely to drop out than similar students who did not take such a class, while students in math remediation were 13.9% less likely to drop out of college than comparable marginal students who did not enroll in remedial coursework (p. 755).

Attewell, Lavin, Domina and Levey (2006) illustrated the need to control for intervening variables by comparing an initial bivariate regression analysis (remediated vs. unremediated) against logistic regression and propensity matching. Though the bivariate analysis showed significant correlations between remediation and the persistence variables noted above, the more sophisticated analyses reduced the remediation/attrition correlation to insignificance, and demonstrated a positive effect on first-year credit completion (p. 904). They went on to note:

> We interpret this as meaning that taking one or more remedial courses in a
> two-year college does not, in itself, lower a student's chances of

> graduation. Causal factors that do reduce one's chances of graduating include low family SES, poor high school preparation, and being Black, but not college remediation per se. (p. 905)

These same types of results—in which students of similar background who qualified and completed remediation fared the same or better than their peers who qualified for, but bypassed, remediation—is repeated in more studies (Adelman, 2006; Hoyt, 1999a).   Ultimately, research indicates that remedial students enter college significantly handicapped compared to their more capable peers, but are likely better off enrolling in and completing remedial coursework than not.

When we measure and judge remedial education, all higher education institutions realistically need to do is prove no significant difference between the two groups—the philosophical underpinning of remediation, after all, is to allow skill-deficient students to catch up with their peers, not pass them up. In the context of this particular study, these researchers provide guidance regarding the interpretation of results, and the need to tease out phenomena that are masked by straightforward descriptive statistics: both ethnicity and family income, which tend to exert an overpowering influence on student data, should be controlled for in statistical analyses (or examined in isolation, when needed).

Institutional methods for evaluation of remediation needs

Though significant variations exist for institutions' methods to identify students for remediation, states and colleges increasingly rely on standardized assessments as an efficient means of identifying students for remediation, even if these assessments contain significant flaws in their predictive validity. The use of assessments in community college

must be paid particular attention, as community colleges take on the majority of students who require such support, and it is here that the pressure for efficient, standardized measures are greatest.

According to the National Center for Education Statistics, in 2000, the majority of higher educational institutions gave placement tests to all entering students (57% to 61% of all colleges). Four-year colleges were more likely to rely on multiple predictive measures outside of placement exams, including GPA and ACT/SAT scores, while two-year colleges were more likely to rely exclusively on such exams (Parsad and Lewis, 2003, pg. 21). This indicates that four-year colleges and universities tend to take a slightly more complex picture of their students than community colleges. This likely is a selectivity effect: community colleges typically enroll any high school graduate, and hence will tend to be aggressive in their identification of students who need skills remediation.

Two college placement exams dominate the higher education market: ACCUPLACER, by College Board (62% of the market); and Compass, by ACT, Inc. (36% of the market). The tests are short, taking an average of 30 minutes, and assessments are made with a relatively small number of questions (Scott-Clayton, 2012). The tests are "usually calibrated to select students who have severe deficiencies, typically those who lack the skills required at the eighth grade" (Levin & Calcagno, 2008, pg. 183).

The state in which this study occurs uses four placement methods in it's higher education institutions: students can test out remediation if they meet state-established thresh holds on the ACT or SAT exams; if they pass the ACCUPLACER exam (passing scores vary from 80% to 95%); if they complete a college-level math and writing course; or they have taken the necessary remedial coursework (Lefly, Lovell & O'Brien, 2011). This state-wide consistency and need for efficiency will confer a similar advantage to this study's analyses, though the heavy reliance on standardized assessments to assign college remediation will likely exaggerate the correlations between state assessments and college remediation.

Predicting remediation

Regarding the predictive abilities of placement exams like the ACCUPLACER and Compass tests, researchers have demonstrated that college remediation placement exams are better at predicting who will do well in college-level coursework than those who will fail; also, correlations involving math placement exams are stronger than those involving reading or writing (Scott-Clayton, 2012). Above and beyond placement tests, this study is particularly interested in predicting remediation before a student's senior year.

Senior year tests have been significantly correlated with a student's need for remediation: in 1992, students who scored in the highest quintiles on a senior test were placed in remedial courses at the lowest rates: 8.9% of students who scored in the highest quintile required remedial coursework, compared to 65% in the lowest one (Adelman, 2004, p. 93). However, a student's 12th-grade year is far too late to apply

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effective interventions that could influence his or her first-year college placement. It is relevant, then, to examine earlier predictors—starting with a student's junior year, and then moving backward to middle school.

Standardized tests correlate with remediation and first-year performance, partly because standardized assessments like the ACT and SAT are used as a means of "testing out" of remediation. The state in which the study conducted, for example, allows students who score a 17 or above on ACT subject tests to circumvent the ACCUPLACER exam and bypass remediation entirely at state institutions—within those subjects. However, the ACT and SAT are not designed as placement exams—they are broader in scope, and are designed to capture a student's capabilities, rather than skills deficiencies.

Multiple studies have attempted to correlate standardized test scores with first-year college performance and college persistence. Though these studies generally do not address remediation explicitly, they deal with related phenomena, and their findings offer relevant context to the present study. Higher levels of college course completion are related to higher ACT subject scores (especially in math), which are, in turn, correlated with lower rates of remediation (Hoyt & Sorensen, 2002). These findings are congruent with the remedial placement exam studies.

While College Board research has demonstrated that the SATII adds significant predictive power regarding performance and persistence (Camara and Echternacht, 2000), when coupled with high school GPA, a substantial body of research indicates that the SATII does not significantly improve institutions' abilities to predict first-year college

performance when used in conjunction with GPA (Geiser and Santelices, 2007; Keller,

Crouse and Trusheim, 1994). Though standardized exams are valid predictors of first-

year college GPA and retention, high school GPA, ethnicity and other "dispositional"

characteristics (a student's cognitive, behavioral, and affective traits) tend to be stronger

predictors of first-year college performance (Armstrong, 2000; Daniels, et al, 2012;

Scott-Clayton, 2012). Despite a popular opinion that secondary schools are not

successfully signaling college readiness through course grades, "dispositional variables

may be of greater predictive power than final [exam] grade because they reflect the more

enduring student characteristics that portend likelihood for success" (Armstrong, p. 691,

2000).

Academic intensity.

This brings the study back to the concept of academic intensity: Adelman (1998,

2006) laid out the particular importance of high school coursework over GPA, class rank,

and test scores in predicting a student's persistence in college: "the intensity and quality

of one's secondary school curriculum was the strongest influence not merely on college

entrance, but more importantly, on bachelor's degree completion for students who

attended a four-year college at any time" (2006, p. 5).

In a simple survey of descriptive statistics from the NELS: 1988 data, Adelman

(1998) found that students in the top 20% of curricular intensity were remediated at a rate

of 27.5%; students in the second quintile, on the other hand, were remediated at a rate of

48.4% (p. 11). Hoyt and Sorensen (2002) examined the correlations among the academic

intensity of high school curriculum, ACT scores, and remedial college placement. They found that higher levels of completion of coursework (e.g., calculus as opposed to geometry) correlated with higher ACT scores and lower rates of remedial placement. They also discovered, though, that students who scored well on the ACT were often still placed in remedial classes due to low scores on the Compass test. Hoyt (1999b) stressed the importance of examining both remediated and non-remediated students in research, because "by examining the retention of only underprepared students, researchers may not be able to detect the relationship between remedial education and retention" (p. 64).

Abrams and Jernigan (1984) followed a sample of at-risk college students and measured how often they took advantage of student support services, and how well that frequency correlated to student persistence. They noted that they were unable to correlate the high school GPAs of students with how often they sought tutoring; they deduced that many of these higher-GPA students, "had not taken many 'tough' academic courses" (p. 265). This suggest, again, that the rigor of the courses, more than the GPA that students earned in their courses, are more reliable indicators of a student's college preparation. Pike and Saupe (2002) confirmed the importance of the three predictors of college persistence in their own study of first-year college grades, discovering that "test scores, high school performance, and courses taken during high school were significantly related to first-year grade point averages," and explained about one third of the variance in students' first-year grades (p. 200). Horn and Kojaku (2001) found that 78% of students who completed academically intense high school coursework were still enrolled at their

first choice of college three years after high school graduation; only 55% of those who had not were still enrolled (p. 17).

In summary: though college standardized exams carry predictive power, more sophisticated statistical analyses have demonstrated that their predictive validity is comparatively weak when one considers the curricular intensity of a student's high school experience, a student's performance in those courses, and Armstrong's dispositional characteristics, which include "self-efficacy, past experiences, or performance in school, involvement in school activities, high school GPA, high school preparation, and perceived importance of attending school to the student" (2000, p. 685).

College placement and success, in this view, reflects the background and personality traits of the individual students first, and their academic competencies second. The research indicates that, if one were to track two students with equivalent cognitive skills—but who are separated by their motivational characteristics—one would expect the student who engaged in more challenging coursework in high school (and who has demonstrated greater commitment, motivation, and discipline), to be less likely to enroll in remediation, and to adapt more easily and more successfully to college. According to the literature, even if a student *does* take significant remedial coursework, solid dispositional characteristics will allow that student to persevere through remediation and on to a four-year degree.

Defining academic intensity.

A rich set of data and studies consistently reinforces the predictive powers of academically intense high school curriculum in regards to remediation and overall college performance, and in comparison to other measures like standardized tests and grade point average. A definition of academic intensity, academic rigor, or college-preparatory curriculum varies, though Adelman and other researchers have settled on some key features that apply to this study.

NELS: 88 quantifies the intensity of high school curriculum according to a number of measures. These include: the number of Carnegie units completed of English, math, foreign languages, history and social sciences, and computer science; the highest level of math completed; the number of AP courses taken; and the number of remedial math or English courses taken. Daggett (2005) presents a model of academic intensity that demands "rigor and relevance," with the highest level of intensity being those that demand that students apply evaluative thinking in real-world settings ─ a level of intensity that he labels "adaptation." Academic intensity, in part, focuses on the *level* of completion, over minimum subject-area credit requirements.

The New Basics Curriculum offers a stands-based definition of core requirements sufficient for college preparation; it includes four years of English, three years of math, three years of natural science, three years of social studies, a half-year of computer science, and strong recommendations for two years of foreign language and a year of fine arts coursework. Martinez and Klopott (2005) indicate that traditional high-school tracking─where students are separated by ability─ensures that students low-tracked out

of minimum core requirements like the New Basic Curriculum are severely handicapped when they enter college classrooms. Musher, et al (2005), in study of academic intensity and test performance, used a school that employed the Knowledge is Power (KIP) curriculum as a standard-setter for academic intensity. The researchers noted that part of the program's intensity comes from "an uninterrupted, unified curriculum interwoven and reinforced by the activities and behaviors of all stakeholders, including parents, teachers, and community leaders" (p. 354), as well as extended school days and years. The researchers determined that the KIP school's curriculum had significant impact on the study participants' test scores through the eighth grade—results that would be even more intriguing if followed through to students' college graduations.

Ultimately, Adelman and others argue against a credit-completion model of intensity and argue instead for a highest-level-of-attainment model. Adelman draws a particular distinction between the *volume* of courses (e.g., the total number of Carnegie units of any particular subject) and the *level* of courses (e.g., calculus versus pre-algebra). In the first model—which is typically based on completion of minimum credit requirements, measured by Carnegie units—students can conceivably complete four years of math, for example, but successfully avoided any truly rigorous, college-preparatory coursework over the course of those four years. The highest level of attainment model, though, pays attention to the academic rigor of a student's highest level of completion within each discipline.

For example, regarding math completion, Adelman indicated that Algebra II is a lynchpin course, meaning that students who persist beyond Algebra II in high school complete college at dramatically higher rates. In his study of the NELS: 88 data, he found that a step beyond Algebra II doubled a student's chances of completing college (1998). Furthermore, he found that, for the class of 1982, "reaching calculus in high school increased the odds of earning a bachelor's degree by a very impressive 8.18 to 1" (2006, p. 62); ten years later, he found that ration to be 7.52 to 1 (2006). Fong, Huang and Goel (2008) tested the link between math achievement and math remediation in Nevada, and discovered that "the chances of remediation drop steeply with an increase in the level of the grade 12 mathematics courses, even after controlling for grade 12 mathematics GPA, type of college attended, gender, and race/ethnicity" (p. 24).

This study will use AP courses and calculus as its most significant measure of "leveled" academic intensity, and assumes that these courses are designed and taught with significantly higher levels of intellectual and academic intensity than comparable courses. Additionally, the study will utilize general intensity variable calculated by finding the difference between students' weighted and unweighted GPAs. Though imperfect, these measures offer the greatest degree of consistency and reliability within the district's dataset.

Predicting remediation earlier than high school

A small body of research has investigated earlier predictors of remediation. According to a March 2011 Colorado Department of Education study, "data analyses

revealed a high degree of congruence between state assessment results from earlier grades and the need for remediation in the first year of college" (Lefly, Lovell and O'Brien, pg. 3). The authors found strong correlations as far back as the 6th grade, though they were unclear on their methodology and the strength of their correlations.

This particular study seeks to apply the three components of academic resources —test scores, achievement, and especially course-taking—and test their applicability to middle school students. It will explore, in particular, potential relationships between middle school standardized test scores and high school coursework: low middle school test scores might generally derail students from academic success, but the study hopes to find that intervening academic intensity might weaken the tests' abilities to predict college remediation.

Hoyt and Sorensen (1999), while studying the ability of high school math to predict the chances of remedial math in college, sought to explain variation in remediation rates among the high schools studied. They ultimately determined that, "the differences in remedial placement of graduates was explained primarily by eighth grade math test scores, and to a lesser extent by gender," and pointed out that "differences in remedial placement attributed to attendance at a particular high school became insignificant" (p. 41).

These are the only studies linking middle school test data to college remediation thus far, and it proves to be highly useful toward the construction of the current study; if Hoyt and Sorensen's data hold true, and the middle school test scores of the study

population are correlated to college remediation, then the study can utilize those test

scores to explore student behaviors that weaken the predictability of those scores.

Chapter 3. Methodology

This study analyzed data from a cohort of the 2011 graduates of a large, urban

public school in the Rocky Mountain region. Using binomial logistic regression, the

study tested the null hypothesis—that academically intense high school coursework has

no measurable influence on the likelihood that students identified as candidates for

college remediation in the eighth grade will, in fact, require remediation as college

freshmen.

Population, sampling and data collected.

The study sample consists of 3,360 students who entered community colleges and

universities within the state, and for whom academic histories, standardized tests scores,

demographic information and remediation status was recorded. Within this population,

the district recorded the remediation status of 1,255 students, who were graduates who

attended public institutions within the state, and for whom remediation status was

recorded. Of those students, 34.7% took at least one Advanced Placement test, while

16.4% passed at least one AP test.

Further descriptive statistics of the study population are summarized in table 3.1

below:

Table 3.1: Descriptive statistics of study sample

Category	%
Remediation:	
Remediated one subject	16%
Remediated two subjects	14.3%
Remediate three or more subjects	21%
Socioeconomic Status (SES_:	
Free lunch elig.	47.9%
Reduced lunch elig.	64.0%
Did not qualify	45.7%
Race/Ethnicity:	
Hispanic or Latino	49.7%
Black or African American	20.3%
Asian	34.0%
White	22.7%
American Indian or Alaskan Native	0.6%
Native Hawaiian or Pacific Islander	0.4%
Two or more races	3%

A further exploration of the sample confirms the remediation gaps according socioeconomic status and race and ethnicity, summarized in table 3.2 below. Note that "remediation percentage" of each is reported as a proportion only *within* the race/ethnicity category, and not as a proportion of the entire study sample:

Table 3.2: Descriptive statistics of sample: remediation, SES, race and ethnicity

Race/Ethnicity, by family income	remediated *n*	remed. %	unremed. *n*	unremed. %
Hispanic or Latino	**310**	**48%**	**220**	**36%**
free lunch	199	64%	116	53%
reduced lunch	27	9%	22	10%
Ineligible	84	27%	82	37%
Black or African American	**200**	**31%**	**89**	**15%**
free lunch	112	56%	26	29%
reduced lunch	14	7%	8	9%
Ineligible	74	37%	55	62%
Asian	**37**	**6%**	**30**	**5%**
free lunch	19	51%	20	66%
reduced lunch	3	8%	3	10%
Ineligible	8	22%	14	47%
White	**80**	**12%**	**240**	**39%**
free lunch	24	3%	20	8%
reduced lunch	4	5%	5	2%
Ineligible	52	65%	215	90%
American Indian or Alaskan Native	**5**	**<1%**	**0**	**0%**
free lunch	3	60%	0	0%
reduced lunch	0	0%	0	0%
Ineligible	2	40%	0	0%
Native Hawaiian or Pacific Islander	**4**	**<1%**	**2**	**<1%**
free lunch	2	50%	1	50%
reduced lunch	1	25%	1	50%
Ineligible	1	25%	0	0%
Two or more races	**22**	**3%**	**18**	**3%**
free lunch	10	45%	5	28%
reduced lunch	2	9%	0	0%

Ineligible	10	45%	13	72%
Total	**606**	**48%**	**649**	**52%**

The sample data reflects the patterns established in prior research: 80 out of 320 (25%) of whites received remediation, for example, compared to 59% of Hispanics or Latinos, and 69% of Blacks or African-Americans. Whites in the sample also tend to skew to the higher end of family income: 65% of White students who received remedial education were ineligible for free or reduced lunch; only 27% of remediated Hispanic or Latino students came from the socioeconomic category, and only 37% of Blacks or African Americans.

These descriptives, though, fail to describe the full complexity of high schools within the district, and the availability and participation within college-preparatory curriculum within each school. As of the time of the study, students attended one of 40 high schools. Those 40 schools are diverse: they include traditional comprehensive schools, magnets, charters and online programs; the largest top 2,000 students, while the smallest teach less than 100 high-schoolers. Many are are urban institutions serving high-poverty neighborhoods, while others are more suburban in their profiles. A consideration of this diversity is necessary to fully interpret the study's data—especially when one evaluates the academic intensity and preparation of the district as a whole.

To get a handle on the diversity, one can examine three different high school programs: *School A*, a mid-sized, selective arts magnet; *School B*, a large, college-preparatory comprehensive school; and *School C*, a smaller high school that serves

students who are mostly poor and minority. The two schools are profiled according to their size, their proportions of minority students, test performance, graduation rates, and numbers of AP tests taken; all data was compiled from the state department of education's 2012-2013 district data, and is summarized in table 3.3 below:

Table 3.3: Comparison of three sample schools

	School A	School B	School C
enrollment	1,060	2,384	831
% minority	35%	55%	96%
mean ACT score	23	20	14
graduation rate	96.95%	89.6%	64.75%
AP tests taken	407	1,646	208

These three schools offer only a limited glimpse of the variation among schools, but offer insight into the district-level data. For one, the profiles partly reflect the dynamics described in remediation and persistence research: schools with higher proportions of White students register higher mean ACT scores, graduation rates, and numbers of AP tests taken—all anecdotal evidence of of college preparation. When one looks closer at AP test-taking of each school, the between-school variation becomes even more clear: In School A, students completed AP tests on 13 distinct subjects; in School B, students finished *28* different subject-tests; in School C, students completed tests that covered only seven subjects (Denver Public Schools).

These three schools also demonstrate why most research has found AP participation to be a weak predictor of college performance and persistence. Though all three schools registered significant numbers of students taking tests, their true proportions vary substantially: in School A, approximately four AP tests were taken for every 10 students; in School B, 7 tests were taken for every 10 students; and in School C, 2.5 tests were taken for every 10 students. Though these illustrative examples provide a tiny sample, it is likely that the variation in school-to-school test-taking conventions—and student demographics—will weaken the ability of AP participation to predict college remediation.

It appears that Whites are not remediated at lower rates simply by virtue of their ethnicity or family income, but because White students appear to be more likely to attend schools that offer better college-preparatory curriculum. Though research indicates that all students are likely to benefit from an academically intense high school curriculum, it seems that White students are more likely to attend schools that offer such a curriculum. Also, one must consider the school-to-school variation when interpreting the forthcoming *GPA gap* variable. Students who score near a value of 1—which indicates that nearly all courses completed were at either an AP or honors level—most likely graduated from a school with a profile like School B's. The advanced course offerings in School C are likely far more limited, and students who attended that school were unlikely to have had the opportunity to engage in the levels of curricular intensity offered at the other two schools. Ultimately, attempts to explain discrepancies in remediation rates through race

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and family income are overly simplistic, as they fail to consider the variation in school-choice decisions among different groups.

Rationale for a revised measure of academic intensity.

It should be noted that the Adelman's (2006) measure of academic intensity included Carnegie unit measures of cores subjects (English, math, history, social studies, foreign language, laboratory science and computer science), the highest level of math completed, whether the student completed at least one AP course, and the lack of high school remediation in either English or mathematics (Adelman, 2006, pp. 12-13). However, Adelman's definition needs to be modified for the purposes of the study. In particular:

1. The district that is the subject of this study has revised graduation requirement to include four Carnegie units of English and mathematics, and three units of science and social studies. Because these requirements exceed those in Adelman's measurement, all graduates in this study will have achieved these benchmarks, rendering the variables insignificant.

2. The course data available contains too much variability in reporting to be considered reliable. Though the district defines course titles, individual schools have the leeway to decide how to assign individual courses to the district's list of titles; consequently, the actual content of a course may vary significantly from school-to-school, whatever the district's definition.

3. The district has committed to increasing Advanced Placement participation and test-taking across a broader variety of students. Though the study will still consider AP coursework, the greater participation within the district means that the study must distinguish between course participation (the aforementioned dispositional variable) and test performance (the "skill" variable).

Consequently, Adelman's model is inappropriate for the district that is the focus of this study. The study relies instead on the most dependable variables to assess academic intensity, school-to-college supports, and remediation rates.

Description of variables.

The variables used are as follows, grouped by dependent, academic, dispositional, and background variables:

   a. *dependent variables: Remedial Math; Remedial Reading; Remedial Writing; Total Remediation.*

These variables reflect a student's remediation status upon entering college; the subject-specific variables indicate the types and volume of remedial courses taken, while the *total remediation* variable will be calculated by a simple sum of three subject-specific variables, then recorded into a dichotomous variable in which 0=no remediation, 1=remediation.

   b. *academic variables: 8th-grade math; 8th-grade reading; 8th-grade writing; AP tests passed; weighted GPA; unweighted GPA.*

The *8th-grade math, reading* and *writing* variables represent student performance on 8th-grade state exams, and will be initially correlated with remediation status to determine the variables' suitability as predictor variables. The *AP tests passed* variable was separated from *AP tests taken variable* (described below) because "tests passed" measures academic ability, rather than the motivation and orientation to engage in AP coursework or to take AP exams.

Though the two GPA variables are initially categorized as academic, they will be used to calculate a new dispositional variable—*GPA gap*—by computing the gap between a student's weighted and unweighted GPAs, which would indicate curricular intensity above-and-beyond basic graduation requirements, and should provide valuable additional information regarding a student's academic track in high school. *Unweighted GPA* is measured on a 0-4 point scale, and does not award additional credit for accelerated or Advanced Placement coursework. *Weighted GPA* is measured on a 0-5 point scale, and awards additional credit for those classes.

    c. dispositional variables: AVID; AP tests taken; Calculus; GPA gap.

The *AVID* variable refers to Advancement Via Individual Determination, a school-to-college program to support and mentor college-bound students through their four years of high school. Many of the schools in the district that is the focus of this study use the program, and its programming includes encouragement to enroll in higher-level, college-preparatory courses. The *AP tests taken* variable was not identified as an academic variable, as the motivation to take an AP course or test is a dispositional characteristic,

while the actual performance within the course or on the subject test is a measure of academic ability. The study uses AP tests taken over course enrollment due to the quality of the data: course enrollment data within the district lacks consistency and uniformity, and does not offer the reliability of testing records. The use of the *calculus* variable follows the same line of reasoning, and the study will consider the completion of a calculus as a motivational characteristic more than an academic one. *GPA gap*, as described above, was computed as the difference between students' weighted and unweighted GPAs. The variable reflects two measures: a student's academic performance in high school, and the number of accelerated or Advanced Placement classes for which a student earned credit. High schools award an extra grade point in these classes—An "A" would earn five points, instead of four—so the larger the gap between the two GPA variables, the greater the volume of such courses taken by the student, and the better that student's performance; it should be noted that, though AP coursework factors into this variable, the variable measures a broader array of advanced coursework, of which AP is one part. *GPA gap* will function as the principle generalized measure of academic intensity.

d. *Background Variables: Family Income (FRL); Race & Ethnicity.*

Family Income will be approximated from records of student free and reduced lunch status. *Race & Ethnicity* data will be gathered from student self-reporting of federal race and ethnicity. Both will be used to compare groups within analyses, and to control for background variables.

These categories may demonstrate significant variation, and the potential effects of academic intensity may be greater within some groups than in others. The study will analyze both remediated and unremediated student data, as a study that ignored unremediated students would fail to capture the phenomenon accurately.

Analytical methodology.

The study utilizes binomial logistic regression to examine the data, and it will seek to express the individual effects that each variable contributes to a student's predicted need for remediation. In particular, analysis will seek to establish the effect if dispositional variables—*AVID* status, *AP tests taken*, *GPA gap*, and *calculus*—on the odds of students being placed in remedial classes as college freshmen. To reject the null hypothesis, the study hopes to show that the inclusion of those variables significantly reduces the ability of 8th-grade test scores to predict the odds of students to be place in remediation.

Before conducting a final analysis, the study will utilize multiple imputations—specifically a Markov Chain Monte Carlo simulation—to deal with the missing cases in the data set. The process is detailed below.

Limitations.

The study as proposed is limited on four fronts: the characteristics of the data sample itself; the imperfections of the variables used; the study's reliance on Advanced Placement; and the reliance of colleges and universities on standardized tests to evaluate incoming students for remediation needs.

a. Missing data:

Regarding the data, it demonstrates the highly-transient nature of urban schooling populations; the wide income gaps that exist between the richest and poorest of urban families; and the dispersal of high school graduates across a variety of community colleges, four-year colleges and universities. High rates of mobility within the sample means that the data sample will account for only a portion of the middle-school students who were available for sampling five years prior—significant numbers have been lost through movement or dropping out. Even without mobility to account for, the sample is likely also affected truancy and poor record-keeping by individual schools. This effect is especially pronounced within high-poverty populations, meaning that poor students in the district will be substantially underrepresented in the data set, which would create potential bias within the study results. Students on the higher end of the income scale, too, will impact the availability of data: some families likely elected to educate their children in private settings prior to high school, meaning standardized test data may be missing for a portion of upper-income students. Likewise, these students may be more likely to attend private or out-of-state institutions, and the study may, consequently, be missing remediation data from these individuals.

Also missing from the data set are variables matched to type of institutions—two-year versus four-year—and the high schools from which students graduated. The inability to differentiate between community colleges and four-year institutions is a particularly vexing limitation, as research has already indicated that community colleges

take on most remediation in higher education, and that student experiences with

remediation likely differ between the two types of institutions. Though the study can still

explore its hypothesis, the absence of this variable robs it of information that could add

complexity to its interpretation of results.

Compounding the problem of missing data are the differing reasons for that data to

missing: test scores and GPA, for example, are missing at random, but remediation data,

in particular, is not—those values are missing because those students did not matriculate

to in-state public colleges and universities. Of concern is whether the data is Missing

Completely at Random (MCAR) (that is, the missing data follows no pattern, and missing

values are unrelated to other variables within the data set), or Missing at Random (MAR),

in which the "missingness" of values can be correlated with variables within the data set.

The second option is highly likely within the remediation data set, as background

characteristics such as socioeconomics, race, ethnicity and language background tend to

impact the accuracy of data—the mobility of poorer families, for example, means that

their children will often slip through the fingers of data collectors, whether from

standardized tests or self-reported questionnaires.

Of particular concern is data that is Missing Not at Random (MNAR): in this case,

data is likely missing through intentional omissions, and those data points may not be

directly correlated with any existing values within the data set. For example, if all

higher-income families opted out of standardized tests for their 8th-grade students, such

missing values could not be ignored, and the study's methodology would need to be altered.

The study assumes that the missing data is not MCAR; to determine if any of the data is MNAR, though, the study compared the numbers of valid values between the highest-and-lowest SES categories within the sample. The rationale is that, if numbers of valid values between the two groups do not differ substantially, then those missing values will be missing due to random effects within the groups, rather than due to deliberate omissions. Note that the variables considered reflect the original data set provided by the district, before any values were transformed or recoded.   The results are summarized below, in table 3.4:

Table 3.4: Comparison of missing percentages, free lunch versus ineligible for free/ reduced lunch.

Variable	FRL	% Missing	MCAR/MAR
8th grade math	free	23.9	MAR
	ineligible	31.8	MAR
8th grade reading	free	23.8	MAR
	ineligible	31.5	MAR
8th grade writing	free	23.8	MAR
	ineligible	31.5	MAR
APTestsTaken	free	63.7	MAR
	ineligible	51.5	MAR
APTestsPassed	free	63.7	MAR
	ineligible	51.5	MAR
weightedGPA	free	1.6	MAR

	ineligible	0.7	MAR
unweightedGPA	free	1.6	MAR
	ineligible	0.7	MAR
remediation, math	free	65.4	MAR
	ineligible	60.3	MAR
remediation, writing	free	65.4	MAR
	ineligible	60.3	MAR
remediation, reading	free	65.4	MAR
	ineligible	60.3	MAR
AVID	free	0.0	N/A
	ineligible	0.0	N/A
Calculus	free	0.0	N/A
	ineligible	0.0	N/A

Though missing values can likely be correlated to family income, in this case, the data falls within the realm of MAR: missing values are related to another variable (*FRL*), but missing values within those categories (high-versus-low-family income) are clearly missing in a random manner. Though the percentages of missing values differ between the highest and lowest socioeconomic groups, the proportions of values missing are reasonably close to one another within the variables, and the data shows no clear pattern of missingness: lower-income students do not consistently miss more values across all categories, for example.

One concern regarding this study was the possibility that larger numbers of wealthier students would matriculate to out-of-state or private colleges and universities,

while lower-income students would be missing significant numbers of standardized test scores. Though higher-family-income students are missing remediation data in a slightly higher proportion to students coming from the lowest category of income—60.3% compared to 65.4%—higher-income students are also missing standardized test scores at a higher rate —31.5% compared to 23.8%. Ultimately, though the data is clearly not MCAR, the values are sufficiently random to conduct more sophisticated statistical analyses.

The study, then, will utilize multiple imputation, a procedure in which missing values are predicted using existing values, which are then used to create an imputed data set for analysis. The study will use the Statistical Package for the Social Sciences (SPSS) to run a Markov Chain Monte Carlo (MCMC) simulation to handle the missing values. MCMC predicts missing values from observed values in the data set, and uses a Markov Chain—a series of iterations based only on the current, observed values—to construct a series of imputations: multiple versions of the original data set that include estimated missing values. After the process is complete, data analysis will pool the multiple imputations into a single representation of the data. The advantage to this method over alternatives, such as casewise deletion, lies with its preservation of data: deletion runs the risk of removing cases in a non-random manner, which would significantly impact the validity of analytical results.

     b. *fuzzy boundaries:*

The second major limitation lies with the variables: though the study seeks to address background, academic and situational variables separately, in reality the boundaries are porous, and it will be impossible to compute a truly "pure" variable.

The *GPA gap* variable, for example, will tend to measure both the academic and dispositional characteristics of students: though a student's (or family's) decision to enroll accelerated or Advanced Placement courses is a dispositional behavior, that student's performance in said classes will, primarily, be a measure of academic ability. This study weighs *GPA gap* toward the side of disposition because even students who earned a D in an academically intense course received a GPA bonus, but complexities like these must be addressed during the discussion of results.

e. Advanced Placement:

The reliance on Advanced Placement also presents a notable limitation, as a significant amount of research indicates that AP is a weak predictor of college performance, and is susceptible to correlations with the background characteristics of students.

Colleges and universities heavily weight AP coursework in their admissions decisions for students, even though the classes and associated coursework were originally designed for college course placement (Geiser and Santelices, 2004). In general, the highest correlations between AP and college performance indicators (class performance, persistence, or both) are between the total number of AP tests passed and college

performance (Geiser and Santelices, 2004; Doughtery, Millor and Jian, 2006), with the numbers of AP courses taken offering weak predictive abilities, at best.

For example, Doughtery, Mellor an Jian (2006) found that 64% of the students who passed an AP exam in high school graduated from college within five years; 42% of those who took a course but did not pass an exam graduated within five years, while 17% of those who did neither graduated in the same time frame. Black and Hispanic students were harmed significantly more than their white peers when they did not take AP coursework (ten percent of African Americans, and eight percent of Hispanics, graduated within five years if they took no AP coursework; 17% of White students passed).

Geiser and Santelices (2004), found that AP test scores were highly correlated to college performance, and that subject-specific exams like AP and SAT II were better-correlated to college performance than broader measurements like ACT and SAT I. However, they would go on to conclude that "the number of AP and other honors-level courses taken in high school bears little or no relationship to students' later performance in college" (p. 19). College performance in this case included students' performance in their first two years of college coursework (the study population was restricted to a publicly-funded four-year college), as well as their persistence toward graduation. Klopfenstein and Thomas (2009), taking into account student characteristics such as ethnicity, family income, high school characteristics and non-AP course-taking histories, argued that, though student participation in such courses predict college GPA and retention well, that the predictive powers of these courses are not due to the benefits

granted by these programs, but that "AP-taking is likely the result of signaling: high ability, motivated students take more AP classes to differentiate themselves from other students in the college application process" (p. 887). In effect, the authors feel that these AP students would have fared just as well in college had they chosen to take non-AP courses. Additionally, the authors advocated that schools push for more credit requirement in the math and sciences over the expansion of AP favored by many contemporary policy-makers.

The Advanced Placement variables in this study, then, offer both reliability and convenience, but their predictability will be limited: although it has been shown to predict first-year college performance and long-term persistence, those studies also show that AP course completion is a weak predictor at best, and it has been linked in no way to reducing rates of remediation. The between-school comparisons offered earlier in this paper helped illustrate the school-to-school inconsistency that may help explain the AP limitations. The expansion of AP availability in the study district has relieved some of the school-to-school inequities regarding AP access, which may in turn improve college access to a broader spectrum of students. However, as more students take AP, the signaling characteristics of AP courses may be shown to be weakened, and it may not prove to be an effective measure of academic intensity.

The study will address AP limitations in its discussion of results, but will also attempt to add descriptive power to the study by considering the number of AP tests taken

versus AP tests passed. In this way, the study can separate, to some degree, the

disposition of a student to take AP from that student's academic ability in AP.

 d. standardized tests:

 Finally, the state's reliance on standardized tests—the ACT and ACCUPLACER

—to determine college remediation status will tend to heighten the correlations among

8th-grade tests, AP tests passed, and remediation.

 All limitations are significant, and all need to be addressed in the preparation,

analysis and interpretation of the sample data.

Chapter 4. Findings

The study's analysis asks to what degree and significance each variable (and class of variable) contributes to one of two outcomes: remediation or no remediation. After filling in missing values via multiple imputation, the researcher conducted a series of binomial logistic regressions: first using only background variables, then including skill-based variables, and finally including dispositional variables in the full analysis. The three-step process is intended to demonstrate the effects of each class of variable as they are added to the model.

The first step—the binomial logistic regression of background variables—seeks to confirm the high correlations between race/ethnicity/family income and first-year college remediation. The results are summarized in Table 4.1 below; a positive value indicates that a variable contributes toward remediation, whereas a negative value indicates that a variable reduces the likelihood of remediation:

Table 4.1: Binary Logistic Regression: remediation and background variables.[1]

Variable	B	S.E.	Sig.	Exp(B)
Family Income				
Free Lunch	0.915	0.106	0.00*	2.497
El.				

Red. Lunch El.	0.353	0.175	0.044*	1.423
Race & Ethnicity				
American Indian or Alaskan Native	1.092	0.769	0.16	2.980
Asian	-0.601	0.312	0.05	0.548
Black or African American	0.785	0.246	002**	2.191
Hispanic or Latino	0.617	0.242	011*	1.854
Two or more races	-0.985	0.244	000**	0.373
Native Hawaiian or Pacific Islander	0.204	0.786	0.8	1.226

1 odds-ratios are expressed in relation to either the highest category of SES, or in relation to White students.
* Significant at the 0.05 level.
** Significant at the 0.01 level.

The regression output demonstrates that most categories of family income, race and ethnicity are correlated with college remediation status, with only American Indian or Alaskan Natives, Asians and Native Hawaiian or Pacific Islanders failing to meet the threshold of significance. The odds of low-income students taking at least one remedial course are higher than their wealthier peers (students in the lowest category of family income were nearly 149% more likely to take remediation than students in the highest category), and the odds of remediation for minority students are significantly greater than their White counterparts. Black and African American students, for example are over

twice as likely than Whites to take at least one remedial class (119%), while Hispanic or Latino students are 85% more likely. The results conform with current research and reflect simple descriptive analyses of student populations who are undertaking remediation.

The next step of analysis explores the isolated effects of academic and skills variables on remediation. The results are summarized below in table 4.2:

Table 4.2: Binary logistic regression, remediation and skills variables

Variable	B	S.E.	Sig.	Exp(B)
8th-grade math	-0.019	0.002	0.00**	0.981
8th-grade reading	-0.011	0.003	0.01**	0.989
8th-grade writing	-0.006	0.003	0.039*	0.994
AP tests passed	-0.410	0.082	0.00**	0.664

*   Significant at the 0.05 level
** Significant at the 0.01 level

The first test of the model adheres to the body of research: an increase in the standardized scale scores of math, reading and writing were significantly correlated to a decrease in college remediation. Math scale scores exert a greater influence on remediation than reading and writing, a finding consistent with previous research: a one-point increase in 8th-grade standardized math scores, for example, decreases the odds of college remediation by 1.9%, whereas a one-point increase in reading scores is associated

with a 1.1% decrease in odds, and a one-point increase in writing scores lowers the odds

by just 0.6%.

Advanced Placement tests exert significant influence: each AP test successfully

passed by a student lowered remediation odds by 33.6%. This makes sense given the

context: AP tests are completed closer to high school graduation, and so offer a snapshot

of skills immediately before graduation. Advanced Placement tests may also be sensitive

to family income effects, as wealthier families may seek to differentiate themselves by

taking multiple exams.

Next, the study explored, in isolation, dispositional factors—*AVID*, *AP tests taken*,

calculus and *GPA gap*—to explore the effect of these variables on college remediation.

The results are summarized in table 4.3 below:

Table 4.3: Binary logistic regression, remediation and dispositional variables.

Variable	B	S.E.	Sig.	Exp(B)
APTestsTaken	-0.303	0.049	0.00**	0.739
AVID	0.513	0.182	0.07	1.670
GPA gap	-6.111	0.410	0.00**	0.002
Calculus	0.331	0.116	0.05*	0.718

* Significant at the 0.05 level
**Significant at the 0.01 level.

Three of the four dispositional variables demonstrate strong, significant effects of

the odds of remediation, with *AVID* failing to meet the threshold of significance. *GPA*

gap—the generalized measure of academic intensity—exerts the strongest effect: a one-

point difference between a student's weighted and unweighted GPA lowered that student's odds of remediation by 99.8%. This result is sensible: a one-point difference indicates that *nearly all* of a student's coursework is accelerated or Advanced Placement, and that the student has a strong disposition toward a college-preparatory level of academics.

Each AP test taken by a student lowered the odds of remediation by 26.1%, and the completion of calculus lowered a student's odds by 28.2%. Though the *AP tests taken* variable is unique to this study, the results, again, conform to expectations generated by current research: both the level of course completed and the disposition to take advanced courses—independent of whether the AP exam of passed or failed—exerts a significant effect on remediation odds.

In the final analysis, the study considers the dispositional, skill, and background-based variables concurrently, to examine the the full impact of each on college remediation. The results are summarized in table 4.4:

Table 4.4: Binary logistic regression, full model.

Variable	B	S.E.	Sig.	Exp(B)
APTestsTaken	-0.039	0.067	0.562	0.962
AVID	0.120	0.201	0.555	1.127
GPA Gap	-3.570	0.484	.000**	0.028
Calculus	-0.017	0.140	0.904	0.983
8th-grade math	-0.016	0.002	.000**	0.984
8th-grade reading	-0.009	0.003	0.007	0.991
8th-grade writing	-0.002	0.003	0.007	0.991
AP Tests Passed	-0.281	0.103	.013*	0.755

Family Income				
Free Lunch El.	-0.012	0.159	0.942	0.989
Red. Lunch El.	-0.170	0.239	0.478	0.844
Race & Ethnicity				
American Indian or Alaskan Native	1.127	1.487	0.454	3.086
Asian	-0.099	0.472	0.833	0.905
Black or African American	-0.075	8	0.821	0.928
Hispanic or Latino	0.070	0.331	0.833	1.073
Two or more races	-0.321	0.334	0.337	0.726
Native Hawaiian or Pacific Islander	0.383	1.040	0.713	1.467

* Significant at the .05 level   ** Significant at the .01 level

The final regression demonstrates the following:

Using the new model, only three variables meet the threshold of significance: *GPAgap*, *8th-grade math*, and *AP tests passed*. Under the full model, a full point of difference in academic intensity reduces the odds for remediation by 97.2%; a one-point rise in 8th-grade test scores accounts for a 1.6% drop in odds; and each AP test passed reduces the odds by 24.5%. Two of the three variables that were targeted by the model—eighth-grade reading and writing standardized test scores—no longer exert a significant effect on the odds of students requiring college remediation. Though AP tests were not key to the original hypothesis, their significance reflects both the importance of skills and

timeliness—AP tests are taken in close proximity to high school graduation, and so offer a final indication of student competencies just before matriculation to college.

Consequently, one can conclude that academic intensity is a more reliable predictor of remediation than 8th-grade test scores, *with the exception of 8th-grade math scores*. The results are congruent with current research: in particular, not only does academic intensity exert a significant influence on the odds of a student requiring remediation, but none of the background variables remain significant, indicating that variables such as race and family income are weak predictors compared to the core dispositional and skill-based variables in the study. The significance of math scores as predictors also fits with current models, as this study has already made the point that math scores, as a whole, are more reliable predictors of college performance than reading or writing scores.

Regarding the hypothesis, the results are mixed: we reject the null hypothesis—that academic intensity will not weaken the predictive powers of standardized test scores—in regards to reading and writing scores. However, we must accept the null hypothesis in regards to math scores.

As a final consideration of the hypothesis, the study completed a binary logistic regression that compared the predictability of eighth-grade tests scores with and without the *GPA gap* variable included. The results are shown in table 4.5 below:

Table 4.5: binary logistic regression, comparison with *GPAgap* present and removed, only 8th-grade test scores summarized.

	odds with *GPA gap*	odds without *GPA gap*

Var.	B	S.E.	Sig.	Exp(B)	B	S.E.	Sig.	Exp(B)
8th-grade math	-0.017	0.002	.000**	0.983	-0.020	0.002	.000**	0.980
8th-grade reading	-0.010	0.003	.004*	0.990	-0.012	0.003	.000**	0.988
8th-grade writing	-0.003	0.003	0.386	0.997	-0.008	0.003	.008**	0.992

* Significant at the .05 level
**Significant at the .01 level.

Though test scores, on the surface, are effective predictors of college remediation—even as early as the eighth grade—the simple addition of academically intense high school coursework lessens the predictability of eighth-grade test scores across all content areas, and renders eighth-grade writing scores insignificant.

Ultimately, though academic intensity cannot entirely make up for skill deficiencies that may be indicated by low eighth-grade test scores, such classes offer a reliable means of increasing a motivated student's odds of bypassing remediation and jumping straight into the meat of their collegiate academics. Curricular intensity is the most significant activity that a student can take to lessen the odds of needing college remediation, and that intensity can be leveraged to lessen the racial and economic gaps that exist between groups. Math, however, remains a stubborn variable: it seems that, most likely, students who score low math scores in the 8th grade will continue to struggle with the discipline, regardless of high school enrollment.

Chapter 5. Discussion

This study re-affirms the importance of rigorous high school coursework in the preparation of students for college success. Though this appears common-sensical on the surface, the implications are significant.

In particular, the study illustrates the need to create equity in curricular offerings in high schools. Researchers like Adelman have already highlighted the inequities that exist among individual high schools, and a simple anecdotal comparison among three schools has illustrated his argument. This study only re-iterates the need to provide high-quality, college-preparatory offerings to all students, regardless of the location or makeup of the school. Likewise, the study argues against overly-aggressive systems of tracking that reserve advanced and upper-level courses only for the "best and the brightest"—such practices only heighten the "signaling" purpose of such classes, and reserve the benefits of such courses for those whose paths to college completion are all but certain. Those who need and will benefit from the classes most—bright and motivated students who are likely to be the first generation of their families to attend college, but do not come in with the skills and acculturation of their peers—will miss out on significant collegiate preparation, and may face a rockier path in their first months of higher education.

Perhaps one of the most useful outcomes of the study came from the use of the *GPA gap* variable, which appears to be a viable means of measuring a facsimile of the rigor and purpose of high school curriculum. In a field in which the obstacles arise from inconsistent data collection and the variation in the selection criteria for students, the use of weighted and unweighted GPAs offers a means to overcome those limitations. As noted in the study, traditional methods of measuring the intensity of high school students' academic experiences are hamstrung by the effects of policy initiatives, flexible record-keeping, and variations in how courses are taught among schools. In this study, the district's focus on Advanced Placement as a de facto measure of curricular intensity likely increased access to a broader range of students, but weakened correlations between AP and remediation odds; the adoption of tougher Carnegie unit requirements for graduation likely had the same effect. *GPA gap* remains a consistent measure that has been little-altered by these policy changes.

Though the study reinforces the importance of academically intense high school curriculum as the best means of bypassing remediation, it is still hamstrung by one significant weakness: its primary focus. As stated earlier, lowering college remediation rates is legitimate in its aim, but any move to reduce (or eliminate) such programs would be reckless and harmful to students looking to add their families to the ranks of the college-educated. Though this study focused on college remediation over college persistence, it simply focused on one link of a very long chain that leads to college graduation. College preparation, persistence and completion, rather than remediation,

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should be the major policy-thrust of educators and legislators, and remediation should only be explored as a component in a much larger process. From a policy perspective, lawmakers should focus on two areas: finding a means of reliably evaluating individual high schools' abilities to prepare their students for college; and maintaining access to higher education for poor, minority and first-generation students.

Policymakers across the United States are currently addressing the first focus, as they seek to add measures of postsecondary readiness to school profiles and evaluations. In the state in which this study occurred, the defacto measures of readiness will include Advanced Placement participation, college matriculation rates, and remediation rates. However, these measures will have little impact should policy makers apply them without understanding their underlying complexities. As already shown, simple AP participation has no significant impact on the odds that students will not require remediation. Compulsory enrollment in Advanced Placement would raise a school's college readiness profile, but may not significantly impact students' persistence to college degrees, and schools could be potentially penalized for enrolling students in AP en masse, yet failing to show significant, sustained progress toward lowering remediation rates.

Though imperfect, a measure similar to the *GPA gap* variable provides a truer measure of an individuals school's college preparatory programs. If a school were to score a mean *GPA gap* of 0.7, for example, one could interpret that the average student participates in academically intense curriculum in 70 percent of his or her coursework.

The benefit of such a measure is that it takes into consideration both the volume of advanced course offerings, and how often students take advantage of those offerings.

A measure similar to *GPA gap* would also give an indication of the richness of an individual school's curriculum. Though Advanced Placement curriculum qualifies as academically intense, its scope is also narrow and primarily academic. The full array of advanced coursework, though, includes offerings such as honors art and music; culturally responsive courses like honors African-American history and Hispanic-American literature and composition; and career-oriented courses such as engineering and constitutional law. The significance of the *GPA gap* variable in predicting remediation implies that participation in all of these courses—not just core-subject-specific courses— encourages the student dispositional traits that increase the chances of college persistence. A broader definition like *GPA gap* also allows for greater school-level differentiation; instructors will likely exert greater influence over the curriculum taught in non-AP honors coursework, and will be able to adapt content and instruction more effectively.

As current research shows that students' high school experiences are the best predictors of college persistence, policy-makers' attention toward higher education should not be focused on eliminating remediation, but instead be concerned with issues of equity and access. Though remediation is broadly unpopular—taxpayers don't want to pay for it, students look to avoid it, and few want to teach it—The CUNY experience

already illustrates the pitfalls associated with a broad-based elimination of remediation for four-year colleges.

Parker and Richardson (2005) demonstrated that CUNY, which already has a rich history of serving a diverse study body, may have discouraged some minority students from enrolling. CUNY's decision to end remedial education at it's four-year colleges was partly tied to the state of New York's Regent exams—high school exit exams that CUNY felt should be adequate measures of collegiate preparation. Parker and Richardson, in their examination the 2003 cohort of incoming freshmen, found that Hunter and Lehman Colleges became more selective, and were tasked with competing for private and out-of-city colleges for minority students with high test scores. Additionally, despite the end of remediation, both schools experimented with intensive summer workshops and remedial courses taught within the four-year colleges by community college instructors. In essence, in the absence of remediation programs, both schools created alternate programs that filled the gap—and that were remedial in everything but name.

More importantly, in the years after the end of remediation in their baccalaureate programs, the proportion of White enrollment outpaced that of minority students, with the researchers reporting that many minority students—due to the stigma they associated with attending community colleges—enrolled elsewhere, or chose not to enroll in college at all. Minority students failed to meet the minimum Regents or SAT scores required to bypass remediation at higher rates than Whites, meaning that CUNY will need to be vigilant in maintaining diversity on its campus. Finally, Parker and Richardson argued

that the elimination of remediation at CUNY did not mean that its students did not require remedial coursework: "the need for some form of remediation," they wrote, "does not disappear when admission policies change" (p. 20).

Though the declines in minority enrollment were not extreme, the CUNY experience demonstrates the complex social and economic issues tied to remediation in higher education: policy-makers who wish to reduce, eliminate or reform remediation must confront the challenges to equity and access that arise, and find new means of maintaining campus diversity in a system that reinforces the White, higher-income advantages. It should be noted that Lehman and Hunter Colleges adapted to CUNY's policy changes in their own individual means, with one college—Lehman—finding more success with with programming. The CUNY experience also demonstrates the complexities that surround institutional reliance on psychometric testing to sort incoming students. The inability of AVID to significantly impact remediation odds in this study falls under the same umbrella: many AVID students have the motivation and coursework needed to prepare them for college, but test scores remain stubborn barriers. All of these students are first-generation college-goers, and their acculturation process—in which they learn standards of language, in particular—extends well into their college careers. The inability of AVID participation to significantly impact a student's chances of remediation are less a reflection of their preparation, and more a reflection of their status as first-generation college-goers. To apply rigid admittance and remediation standards would inevitably shut out a significant number of bright, motivated, well-prepared students.

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The study also points to the importance of appropriate coursework, whether in high school or college: if students need better college preparation, then they should be enrolling in advanced courses wherever they can. If students enter college without sufficient skills, then they need the option of remediation. Remember that curricular intensity doesn't simply allow students to "skip over" remediation: for those students who *do* find themselves in remediation, it likely betters their chances of succeeding in remedial courses and persisting to graduation.

Remediation, as unpopular as it can sometimes be with policymakers, is not inherently shameful: many bright, competent students find themselves needing extra instruction in math or writing, for example. The failure of this study to demonstrate that intensity weakens the predictability of standardized math scores demonstrates this phenomenon: it is highly likely that many bright, motivated, literate and fluent students still find themselves in a remedial math course, for the simple reason that we can't be experts at everything. Those students need a semester of math remediation, and would likely fair significantly worse if they were cast directly into mainstream college math courses without the additional semester of instruction.

Most heartening is the controllable nature of academic intensity. As demonstrated in the study, uncontrollable variables such as socioeconomic status, race and ethnicity cease to significantly predict remediation when the full model is applied. Interestingly, the model does not imply that curricular intensity will raise students' test scores between the eighth grade and high school graduation. Rather, it implies that curricular intensity

simply trumps those difficult-to-influence factors like test scores. Students who score

well on those tests in the eighth grade will likely have an easier path before them as they

head toward college matriculation, but curricular intensity may offer a means of making

the playing field slightly more level. Test scores, rather than being a certainty, can

instead be circumvented through dispositional interventions that can be controlled and

applied before a student's senior year.

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APPENDIX I: Logic Model

SITUATION	INPUTS	ACTIVITIES	OUTPUTS	OUTCOMES		
				Knowledge	**Actions**	**Conditions**
Material "opportunity" gaps in the educational experiences of students.	8th-grade CSAP growth scores.	Completion of at least one year of AP coursework.	Greater awareness of the culture of college classrooms, and the expectations of higher education.	High school graduates will enter college with a more complete understanding of the cultural elements of college.	Persistence to earn an undergraduate degree.	A narrower remediation gap between white students and African American and Hispanic students.
Uneven expectations for high school students in high-poverty schools as compared to their wealthier peers.	"School effects," that is, the influence of individual middle schools on the likelihood that students will take academically intense high school coursework.	Completion of at least two years of foreign language.	College-prep level math, reading and writing skills.	Adequate skills in reading, writing and math to "test out" of remedial coursework.	Full participation in the academic and extracurricular life of college.	A narrower gap in the material conditions of students in k12 education.
Higher rates of remediation among poor students and students of color when compared to their middle-class or white peers.	The individual characteristics of the students themselves — e.g., wealth, race, and.....	Completion of Calculus.	Higher ACT/SAT scores.		Poor students will enroll in four-year colleges more, and two-year colleges less.	
Lower rates of college persistence among poor students and students of color.		Completion of high school with no failed coursework.	Higher ACCUPLACER scores.		Reduced compulsory enrollment in remedial college courses.	A lessened sense of "deficiency" among students, and a greater sense of academic confidence.
		Completion of one AP-level English course.	Student self-confience.			
		Completion of physics or chemistry.				
		Completion of a college-readiness programs – e.g., A.V.I.D. and future options.				

ASSUMPTIONS
College remediation rates should be decreased.
Indicators of the need for college remediation will show up prior to high school.
College remediation rates can be impacted by focused, long-view high school interventions.

EXTERNAL FACTORS
Schools in high-poverty neighborhoods are at a material disadvantage when compared to their wealthier peers.
School effects – i.e., the influence of individual school climates on the academic choices on children.