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Can High School Assessments Predict Developmental Education Enrollment in New Mexico?

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DISSERTATION

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Dedication

To Jeremy, Tucker, and Miles for endless love and support

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ABSTRACT

Thousands of American's enter postsecondary institutions every year and many are under-prepared for college-level work. Subsequently, students enroll in or are placed in developmental courses in preparation for the rigor of college-level classes. Numerous studies have looked at the impact of developmental course work on student outcomes, but few focus on predictors that could identify students who are likely to need developmental education. The potential for early prediction (and therefore possible intervention) is less understood. This study addresses this gap by examining the connection between high school assessments and subsequent developmental courses enrollment in college. Using longitudinal data from New Mexico this project estimates how well math and reading scale scores from the eleventh grade New Mexico Standards Based Assessment (NMSBA) predict an individual student's remedial course enrollments in English, math or both upon entry to college. This is possible due to a state level system in which a student's high school assessment and college enrollment data are captured.

Therefore, unlike previous studies, this study examined the potential for existing assessment data, with a wide range of students (N = 7,233), to predict which students are likely to enroll in remedial education. Using logistic regression techniques, odds estimates for math and English enrollment based on scale score, gender, and ethnicity predictors are provided. The results indicate that the higher the test scale score, the less likely it is that a student enrolled in remedial college courses. This study revealed gender and ethnic variation in the strength of prediction. Women enroll in remediation significantly more than men given equivalent NMSBA scores. Native Americans and Hispanics enroll significantly more than Whites. This work also adds to the literature examining the efficacy of high school exams, specifically, these results suggest that high school assessments have potential as an important indicator of academic college readiness.

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Chapter One

Literature Review

Introduction

Miles Tucks was an average 19-year-old college freshman. Popular among his peers, adored and mentored by his parents, a B-C student interested in animals and gifted in sports, he navigated his high school years facing the normal challenges of young adulthood. Before the conclusion of his junior year, he conversed with his parents, teachers, and coaches about the importance of preparing for college. Miles assumed college was the next logical step as he enjoyed school and earned his best grades in the sciences and in English. Dreaming of becoming a veterinarian and confident that his high school diploma would guarantee his entrance into collegiate academics; he quickly realized he was not qualified in the eyes of his recruiters.

Miles received a letter from Justin Other University stating that he had been accepted into their freshman class, but he was also concerned to learn that his acceptance carried the stipulation that he complete a "remedial course sequence." Miles was not certain what a "remedial course sequence" was, but it did not sound encouraging. Still, he had been accepted and could proudly tell his parents. Miles came to learn that because his college entrance exam scores were slightly low, he had been deemed under-prepared for success in the first college math class required for a biology degree. This meant that Miles needed college math remediation.

To be clear, Justin Other University does not exist and Miles is not a real person. His story, however, is not unlike that of many American youth. In fact, according to a survey of students enrolled in remedial classes, a majority reported that they believed they were ready for college and four out of five of those surveyed earned a high school GPA of 3.0 or higher (Strong

American Schools, 2008). By most, Miles would be considered an average kid and by many standards, a very fortunate one. He had the advantage of loving, educated parents, caring mentors, average high school test scores, and a high school diploma – still, he found himself under-prepared to begin college with college-level work. Students like Miles need to know more about the requirements for success in college-level classes and yet they appear not to be receiving sufficient quality signals about the adequacy of their current levels of preparation.

Much of this problem is due to inadequate secondary to postsecondary system connections, which results in limited signals about student academic preparation. The historical split in educational levels in the United States is in part responsible for the lack of collaboration and coordination across levels of the larger educational system. The result is inconsistent communication among secondary and postsecondary educators concerning expectations for students in college. This impacts the academic opportunities and success of students who seek to advance their educational lives beyond high school.

Detailing the Problem

Thousands of American's enter postsecondary institutions every year and many are under-prepared for college-level work. Greene & Foster (2003) discovered that not nearly as many students as one would think possess the minimum qualifications for a four-year college. Only one-third do according to their research. There can be an unexpected gap between students' outcomes on assessments and their belief about their own knowledge and abilities. Students can get discouraged by this and for many it results in dropping out of college (Deil-Amen and Rosenbaum, 2002). Lucky for Miles, and millions of others like him, most colleges in the United States accommodate for this by offering remediation programs. These programs are generally intended to raise student skills so they have a better chance of being successful in college-level,

credit-bearing course work. This is particularly true of community colleges, where open door admissions policies are standard (Pulley, 2007; Boylan, 2008).

Community colleges generally have an open door policy when it comes to admissions, but this does not necessarily mean immediate access to college-level courses since, according to many studies, remedial coursework is a reality for over half of students who enter college (e.g. Goldrick-Rab, S. 2010; USDOE, 2008; Winograd, Dasenbrock, & Garcia 2010). For instance, the U.S. Department of Education (USDOE) reports that 40% of college (4 year) students take some remedial education and for community college (2 year) students that percentage is 63% (USDOE, 2008). The National Educational Longitudinal Study (NELS) (1988-2000) exposes similar findings, showing that 60% of new community college students enrolled in at least one remedial class. Moreover, many recent studies confirm that the demand for remedial courses remains steady (Collins, 2009; Bettinger & Long, 2009; Pulley, 2007). This pervasive occurrence of under-prepared students is seen by some as a primary reason why so many college students drop out (Venezia, Kirst & Antonio, 2003). This is particularly true for those from disadvantaged backgrounds. In fact, remediation rates have been significantly linked with key demographics such as income (e.g. Presley & Gong, 2005), ethnicity (Bailey, Jeong, & Cho, 2010), and parental education (e.g. Harrell & Forney, 2003).

High school students are told regularly about the importance of going to college and they appear to be receiving those signals. In 2008, 69% of students in the United States enrolled in a 4-year or 2-year college the semester following graduation, though race/ethnicity gaps persist (USDOE, 2008). In the same year, the variation by ethnicity is notable with 72% of Whites, compared with 56% of Blacks and 64% of Hispanics attending some kind of postsecondary institution immediately after graduating (Hussar, Hussar, Planty, Snyder, Bianco, Fox, Frohlich,

Kemp, & Drake, 2010). Kirst and Venezia (2004) discovered that the proportion of ninth graders that graduate high school in four years and earn their bachelor's degree within six years is less than one-fifth. So although many students would like to go to college, this finding demonstrates the reality of the challenge these students face. As National Center for Education Statistics (NCES) data consistently demonstrate, many non-Whites and students facing economic disadvantage are considerably less likely than affluent White students to graduate from high school and successfully complete college (Hussar et al., 2010).

Adelman has been studying this topic for some time and as early as 1994 his data suggested that around 40% of new college students enroll in community colleges (Adelman, 1994, 1998, 1999, 2004). Among them, 35% were non-Whites. In 4-year schools the number is even less at 25%. As we have seen, for those who do enter college, roughly half face developmental education as part of that experience. While enrollments in remedial coursework do not predict an academic death sentence, there is mounting evidence that developmental education (particularly multiple enrollments) limits the chances of earning a degree and often delays the time to completion (Adelman, 2006).

For example, an NCES (2001) study demonstrated that remedial students performed as well as non-remedial students when they took only one remedial course. This demonstrates that remedial coursework will not altogether prevent academic success. Many students who take multiple remedial courses, however, do not continue on in their second year (Adelman, 2004b; USDOE, 2006). These figures are startling, particularly when 75% of jobs by 2020 will require a degree, advanced degree, or special occupation certificates or apprenticeships (Gordon, 2009; Partnership for 21st Century Skills, 2008). While there is debate on this issue (see Rosenbaum, 2004; Spann, 2000) there appears to be agreement that there is indeed an increase in jobs that

require a more educated work force (e.g. Carnevale, Smith, Jeff Strohl, 2010; Bailey, 2010; Higher Education Coordinating Board, State Board for Community and Technical Colleges and Workforce Training and Education Coordinating Board, 2011).

The Problem of Mixed Messages

There is disconnect between the signals students are receiving about the importance of going to college and the signals they receive about how prepared they are to do so. It is a familiar question: How do we know if middle and high school kids are being adequately prepared for college? The ability to easily predict whether a student is college ready has been desired for many policy organizations with a goal of school reform (e.g. Achieving the Dream, 2010; Center for American Progress, 2009). According to current educational reform trends, a big part of the answer is contained in the standards of literacy and numeracy proficiency set for students (NGA and CCSSO, 2010).

The Common Core State Standards (CCSS) Initiative has been led by states and coordinated by the National Governors Association Center for Best Practices (NGA Center) and the Council of Chief State School Officers (CCSSO). The goal of these standards (collaboratively designed with teachers, school administrators, and other experts) is to ensure that students who attain them will be "college and career ready" (NGA and CCSSO, 2010). Only five states and Puerto Rico have NOT adopted the standards. . Within the CCSS states there is still great uncertainty about the testing that will accompany the new standards. In the absence of fully implemented national standards, all 50 states and the District of Columbia have set standards state by state and most have designed associated assessment systems to test students accordingly. There is debate about the adequacy of state level standards to prepare globally competitive students. Opponents of state by state standards (e.g. NGA Center, CCSSO, the

Obama Administration, 2010) claim most state standards are too low and too different from one another, while proponents (e.g. Ravich, 2010) maintain that no two states look alike, therefore a national standard, voluntary or mandatory, would result in even worse outcomes than the present system. From yet another perspective, progressive education reformers like Sir Ken Robinson (2009) and Sam Chaltain (2010) share the sentiment that the nation's laser focus on assessment systems does not adequately address the question of education reform in the first place.

Regardless of the particular viewpoint, No Child Left Behind mandated that states move away from high school testing systems where the performance of students is compared to that of other students, to testing systems that are standards-based. That is, the yard stick for student learning is a standard and not another student's performance. What is not clear is whether these standards are in line with colleges' and universities' expectation of what students should know and be able to do to successfully study at the college-level.

The question then becomes: Can state standards-based assessment outcomes effectively predict students' preparedness for study at the postsecondary level? Furthermore, for states that have assessments aligned to rigorous standards (i.e. meet college entrance expectations), can high school assessment scores be used as an appropriate signal of a student's readiness to study at the postsecondary level? The answer may lie in the adequacy of the connections between our educational subsystems, specifically the levels of communication and coordination that exist between them.

If all of the educational levels in the United States are viewed as a large single system of education, then pre-K programs, elementary school, middle school, high school and postsecondary, and vocational institutions are the subsystems. It could be argued that our larger educational system allows too many students to fall through the cracks. Disjointed K-12 and

higher education reforms may not be sufficient, principally in light of the fact that many challenges in education are found at the juncture between systems. A central challenge, for example, is how to decrease developmental education rates, particularly for students who move straight from high school to college (Collins, 2009).

To deal with the rates of developmental education enrollments, we must better understand which academic factors from a student's background are likely to predict whether a particular student will or will not need developmental education (Achieve, 2011). More and better signals will support student movement from one system of education to another. Miles's transition could have been smoothed by reliable signals from his high school about his level of preparation. This, of course, assumes that high schools receive adequate signals from postsecondary institutions about what is expected of students in college.

If it can be demonstrated that existing tests can accurately provide an early indication of students' levels of preparation, it would benefit students and educators greatly. The sources for signals can be found many places and high school test scores may be one of them. This insight would provide another, if not many, additional links in the education knowledge supply chain by informing issues such as curricular content, course requirements to graduate, placement testing, and college/work-ready assessments. As the need to understand outcomes increases so too will the communication between stakeholders of these subsystem, which would hopefully result in a more streamlined and useful relationship between them. Analyzing problems at the juncture between education subsystems requires innovative consideration of existing testing data.

This study used data from New Mexico to explore the potential of using high school assessment scores to predict students' remediation enrollment in college. The topic is considered through the useful lens of systems theory and signaling theory. Systems theory provides a

framework for considering the structure of public education in America, including common education and postsecondary education systems. Applying signaling theory to this issue raises the possibility that everyone within these systems receives signals about what is important to teach and learn from state standards, assessments, and admission requirements. Together these ideas provide context for research situated at the juncture between secondary and postsecondary education.

Theoretical Support

This study uses systems thinking and signaling theory to consider the problem under investigation and primarily to explore potential problem-solving strategies that might address it. General systems theory (Bertalanffy, 1950; Boulding, 1956) considers all types of systems, whatever their particular area of application, with an objective to clarify the nature of a whole range of systems. According to Jenlink (2004), a system is defined as "rationally arranged and mutually supporting components organized such that they are definable within and according to their environment and specific purpose" (p. 201). These ideas have generally shifted from description (how are systems structured?) to contingency (what conditions lead to what forms?) to process (how do systems change from one form to another?). Questions about our education system today are generally questions of process (what type of learner and what kind of curriculum are within and between the parts of the whole system) because we know public education is a large and complicated system with many co-dependent and moving parts.

This research borrows specifically from soft systems thinking (SST) as described by Checkland (1981), which assumes that people are active in the development and interpretation of the systems they are in. From the constructivist perspective, SST views a student (practitioner, parent or policy maker) as active in designing their individual meaning of school. The problem

of adequate preparation for college then is that readiness is defined by a multitude of individual interpretations rather than through clear and consistent signals or indicators of adequate preparation. The latter could help facilitate positive individual experience within the system.

The organizational relationships in public education, described by Weick (1976) as a "loosely coupled system" (p. 8), have, until recently, been a useful narrative. Current local and national policies beg us to reexamine whether this system of education can continue to function in the best interest of the key stakeholders. Practitioners and state and federal policymakers are reconsidering public education and the organizational structure. The trend in P-20 (common acronym for a seamless system from pre-school through college and the workforce) legislation and national standards are clear evidence. This re-thinking appears to connect the subsystems/levels of public education much more directly.

In New Mexico, for example, a number of efforts are underway which seek to streamline the connection between the secondary and postsecondary public education systems. High school redesign, secondary exit to postsecondary entrance alignment, participation in the College and Career Readiness Policy Institute, Achieving the Dream networks, and a progressive dual credit initiative are among the projects well underway or completed. Given this level of state and local attention to remediation, it appears educators are dedicated to ensuring that students who graduate high school (or earn a GED) are prepared for success in college. Less is being done to evaluate how well these reforms and improvements are working at increasing student preparation for college.

This study also draws upon a modified version of signaling theory (Kirst & Venezia, 2004). Through the secondary to postsecondary transition lens, signaling theory suggests that educations key stakeholders (e.g. parents, students, teachers) are receiving consistent quality

signals from state standards and associated assessments (among other sources, such as postsecondary admission requirements), about what needs to be taught and learned in high school. The clarity and reliability of signals is critical to adapting communication practices and policies that are consistent with what comes next for the greatest number of students (e.g. the next educational subsystem). Signaling theory was similarly used in a recent study that explored the system connection between higher education and work (Raffe, 2008).

This study considers signaling and systems thinking in partial support of this assessment of the connection between state secondary tests and postsecondary remediation prediction. These theories provide a valuable theoretical perspective for this examination and they inform analysis efforts that will focus on the use of clear and consistent signals in improving system functioning. Based on the results obtained from this work, the discussion will benefit from systems thinking to describe problem-solving methods for facilitating positive change in the public education system. The essential principle of this framework is that creating unambiguous connections between educational sub-systems demands that in turn more consistent and reliable signals are sent between those systems, resulting in superior student outcomes.

This work is important as the nation considers why and how hundreds of thousands of recent high school graduates come to developmental education in our society. What do students, families, educators, and researchers need to know in order to guide course taking and instruction decisions? If either Miles or his community of support knew more about the potential meaning inherent in his high school test scores, perhaps he would have been advised to take an additional year of math in 12^{th} grade. Perhaps he would have enrolled in a dual credit course or been encouraged to research and prepare for the college courses central to his field of interest. Underlining these discussions is the important truth that all students should have access to

available information that can alert them as to how prepared they are for college-level course work.

Defining College Remedial Education

What defines college remediation? Who needs it and how much is generally required? It is obvious that the need to remediate in college was a problem for Miles, but how big is the problem nationally and what attention and debate currently surrounds the issue? Is there information available that, if considered more fully, could have helped Miles avoid remedial math? Could high school test scores be an available indicator/signal of college readiness? Does ethnicity matter when considering how strongly that indicator/signal predicts remediation?

Postsecondary remediation usually refers to courses, programs, or services designed to help under-prepared students to successfully study at the college-level. The precise label for remediation has long been debated. Historically popular terms for remediation have included: compensatory education, academic support programs, learning assistance, and preparatory studies. More contemporary terms include: basic skills, college preparation, and developmental education. Developmental education and remediation are now the most common terms, though for some there is a distinction between the two. Boylan (1999) has pointed out that remediation involves "bringing up the skills of under-prepared students to the levels required of their institution within specific domains" (p. 5), while developmental education is a broader term which refers to the general "goal of talent development" for all students.

Many however, argue that the word "developmental" became popular as a way to avoid using "remedial education" because it is a more stigmatizing label (Attwell, Lavin, Domina, & Levey, 2006; Maxwell, 1979). In this paper, the language of remediation and developmental education are used interchangeably to refer to classes intended to build skills so that students can

be successful in college-level course work. College-level courses are those which are credit-bearing (earn students credits towards a degree), unlike remedial course which do not result in credits toward a degree.

Despite the term used, most colleges offer specialized classes for those students without sufficient reading, math, or life skills. In fact, developmental education has deep historical roots. Wyatt (1992) explored this in detail. Her work reminds us of the long history of managing skills deficiencies in colleges. Over a century ago, Harvard, Princeton, Yale, and Colombia had to establish developmental education courses because over half of their students fell short of meeting the basic requirements for entrance (Wyatt, 1992). Since then, the G. I. Bill and decades of open admissions policies have shepherded millions of under-prepared students into college. Today, this trend persists.

Defining College Readiness

It is important to connect discussions and definitions of developmental education in the greater context of "college readiness." The larger national college readiness discussion informs the conversation about college remediation and, in many cases, college remediation is used to help define readiness (Achieve, 2011; Gates Foundation, 2009). For example, in a discussion about how "state action has lagged in creating accountability systems that value college and career readiness" (p.8), a report from Achieve (2011) states that,

> Consistent with the work currently under way with the Race to the Top assessment consortia, end of high school assessments should also signal readiness for college-level work. Including the right kind of incentives for states to have robust college- and career-ready indicators in their accountability systems, such as those that value and reward the number of students who earn a

> college- and career-ready diploma, score college ready on high school assessments, and enter two- and four-year colleges without the need for remediation, is key. (Achieve, 2011 p. 8)

It is important to recognize that a full and realistic definition of college readiness also includes non-academic factors such as general social preparedness (e.g. rules, expectations, relationships and personal difficulties of separation from family systems) (Conley, 2007; Fike & Fike, 2008). These factors make a difference in the broadest definition of college readiness. While the purpose of this work is focused on academic preparation as it relates to readiness, acknowledgement of cooperating factors is important. In fact it underscores the importance of defining more and better metrics to inform students about how prepared they are academically for success in college credit-bearing course work.

There are no doubt a number of components that, taken together, define the scope of a fully operational definition of college readiness. Popular in the literature for example, is the term "habits of mind," which refers to a student's ability to employ analytical thinking, problem solving and inquisitiveness (Brown & Conley, 2007, p. 154). Assessing the need for remediation coursework measures just some of what is needed to succeed in college. Certainly it is important to communicate a broad understanding of the knowledge, skills and abilities students need for success in college. Conley (2005) pointed out that assessments used for remedial placement are narrow and do nothing to address essential social issues. Even if a student passes a placement test, they may still lack the "college knowledge" (p. 1) Conley argues are essential. Some indicators of "college knowledge" include the type of classes taken in high school and associated grades received scores on SAT or ACT, writing ability, metacognitive strategies, and soft skills such as study habits and time management (Conley, 2005).

Also increasingly among the examples of what defines students' college readiness is their need for remediation. One popular definition of "college ready" includes remediation as central to the definition.

> College readiness can be defined operationally as the level of preparation a student needs to enroll and succeed—without remediation—in a credit-bearing general education course at a postsecondary institution that offers a baccalaureate degree or transfer to a baccalaureate program. Succeed is defined as completing entry-level courses with a level of understanding and proficiency that makes it possible for the student to be eligible to take the next course in the sequence or the next level course in the subject area (Conley, 2007, p. 3).

It is critical to recognize that the variations on the definition of college readiness are many and that the focus of this investigation is on early prediction of college remediation via one indicator of that complex term – high school math and English assessments. Indicators of the need for remediation are potentially very powerful as they go beyond measuring whether a student simply attends college after high school. As a group of researchers recently noted, "In a world of open-admissions, defining college readiness by whether a student can walk through the door of a college does not raise the bar for high schools since by that definition graduating from high school makes students college-ready" (Roderick, Nagaoka, & Coca, 2009, p. 191). Students deserve better information in high school about how likely they may be to go on to college ready to study college-level material. Those like Miles, for whom college is an explicit goal, can use this information to make measured decisions about the focus of their senior year. For those who have not fully considered college or dismiss the idea for one reason or another, great encouragement and inspiration may be found in knowing that they are on track.

By collaborating with colleges and universities around the country, College Board and ACT have established college readiness benchmarks. The ACT benchmark for example, indicates the minimum score needed on an ACT subject-area test to signify potential success in the corresponding first-year credit-bearing college course**.** What these benchmarks do not provide is an indicator of whether students are on track for credit-bearing college courses in the first place.

College readiness discussions are further complicated by the confusion surrounding exactly what constitutes a "college-level" course. From institution to institution, there are differences on this, to the degree that in a given state there is typically a wide range of accepted cut-scores, below which students require remediation. This should not, however, thwart efforts to continue to align secondary exit with postsecondary entrance so that the path to postsecondary education is better defined by clear expectations and early indicators of how on track students are for a seamless transition to college.

We know, for example, that student success in college math is related to how well a student understands precollege math (Bahr, 2008). Success in individual subjects and general college success, however, is not the same thing. The recent attention paid to college readiness by secondary and postsecondary educators and policy-makers calls for deeper investigation of the indicators that could be considered valuable at predicting college readiness, particularly from the perspective of academic readiness.

Think for a moment about the first half of the Conley (2007) definition of college readiness. "College readiness can be defined operationally as the level of preparation a student needs to enroll and succeed—without remediation—in a credit-bearing general education course at a postsecondary institution that offers a baccalaureate degree or transfer to a baccalaureate

program…(Conley, 2007, p. 3).” An obvious question to most educators is how to assess readiness.

> Today, the most common policy prescription for helping high schools promote college readiness are to align high school curricula and graduation requirements with college readiness standards, move larger numbers of students into more rigorous coursework, and increase the rigor of state exit examinations to meet college entrance requirements. Evaluating how well these policy remedies work requires indicators and data that link high school and postsecondary performance. (Roderick, Nagaoka, & Coca, 2009, p. 186)

It is, therefore, critical to collect and utilize information about the numbers of students who enroll and succeed – without remediation - to inform more appropriate institution policy, resource distribution, reform efforts and most importantly in order to guide how we improve individual student opportunities to succeed according to the second half of the Conely (2007) definition. “…Succeed is defined as completing entry-level courses with a level of understanding and proficiency that makes it possible for the student to be eligible to take the next course in the sequence or the next level course in the subject area (Conley, 2007, p. 3).”

While complex issues remain unresolved, there is widespread agreement that being college ready, if only from an academic perspective, means that a student can enroll immediately from high school into college-level credit-bearing courses. In fact, in 2006, the Commission on the Future of Higher Education pointed to high school reform as essential to postsecondary access and success. In the same year, a national focus on streamlining primary and secondary standards with postsecondary requirements began (Action Plan for Higher Education, 2006). There are similar messages today from the federal government. Evidence of this can be found in

the extraordinary amount of resources targeted at “adopting rigorous standards, recruiting and retaining highly effective teachers, turning around low performing schools and building data system to better track student achievement and teacher effectiveness” between and among the full PreK-20 pipeline (Bulkley & Burch, 2011, p. 238).

Individual states are also working to smooth the change for students between secondary and postsecondary systems. Texas, for example, has defined a noteworthy process for defining college readiness using vertical teams (working with others above and below a given grade level) of high school and college educators to create standards and measures of college readiness (Texas Higher Education Coordinating Board, 2005; Achieving the Dream, 2008). The standards describe to key stakeholders (students, parents, educators) what one must know in order to succeed in credit-bearing courses in colleges in Texas. In 2006, the New England Board of Higher Education published a report detailing the policies, procedures, and goals of a consortium of New England states in improving college readiness (Thomas, 2006). In the report, a “significant gap in readiness for underrepresented minority students” was reported along with the introduction of a new and rigorous “college-preparatory curriculum for all students.” (Thomas, 2006).

In New Mexico, great effort has gone into the creation of state standards; however, measures of college readiness have not been formally articulated. A growing number of students are graduating from public high schools in New Mexico and enrolling in college, but the percentage of those who are considered "college ready" under the Conley definition described above remains relatively low (Winograd, Dasenbrock, & Garcia 2010). In New Mexico, consistently more than 50% of high school graduates who enroll in college just after graduation take a least one developmental education course (Winograd, Dasenbrock, & Garcia, 2010).

When student course-taking patterns were reviewed over a six- year period, it was discovered that nearly 70% of students eventually take a developmental education course (NMHED, 2009). Many students discover along the way that they have a remediation need, while others who may be aware of their remediation needs delay the necessary work. For these reasons the actual percent of students who experience remedial coursework as part of their college career is greater than 50%. Why is it reasonable to expect high schools to prepare students for college? The response to this question likely depends on one's philosophical position regarding the purpose of academic preparation in our country. What is not often disputed, however, is the increasing importance of having a college degree, particularly given that the United States continues to move from an economy based on goods to one based on services (Urquhart, 1994).

Additionally, college remediation rates remain high as the number of people attending college continues to grow. If students believe that their high school diploma is an indicator of their preparation for college then it is increasingly important that the signals high schools send to students, educators, and policy makers about what is important to know be in line with the expectations. While this is addressed further in the discussion of high school assessments below, the view of education as a single system spanning preschool through college and one's career is increasing in popularity (Duncan, 2009). In New Mexico there is even a Director of P-20 Policy and Programs at the state level. As a result, testing systems have become an area of focus when considering how to align organizational units that have been historically separate. It is reasonable then, that an exploration of the relationship between standardized high school assessments and the likelihood of college remediation may shed light on this discussion.

Remediation: Who needs it, How Much and How Often?

A study using data from the National Education Longitudinal Study (NELS) (Attewell, Lavin, Domina, & Levey, 2006) found 58% of students in their longitudinal sample took at least one remedial course, 44% took between one and three, and 14% took more than three remedial courses. Other samples suggest similar regularity. For example, according to data on over a quarter of a million community college students around the country, 59% enrolled in at least one remedial course (Achieving the Dream, 2008). In New Mexico, there has been a seven year trend where half of public high school graduates take remedial courses in math and/or reading the first semester they go to college (Winograd, Dasenbrock, & Garcia 2010).

Students from every race and ethnicity, from rural, urban, and suburban neighborhoods, and those who are rich and poor are found in developmental education programs (NMHED, 2009). Disproportionally, however, they are minority students, students low on the socioeconomic ladder, and English is a second language learners. According to the National Center for Education Statistics (2004), 61.7% of Blacks and 63.2% of Hispanics who enrolled in postsecondary education participated in at least one remedial course, compared to 35.6% of Whites. An early NCES study (1995) revealed that colleges with high minority enrollment offered the greatest number of remedial courses. Attention to the type of remedial classes taken also reveals specific racial and ethnic group differences. The NCES data reported that Hispanic and Asian students enrolled in remedial reading and writing courses more than Black or White students. Conversely, Black and White students enrolled in remedial math more than Hispanics and Asians.

Particular data on Native American students' developmental education course taking patterns is sparse. Some have pointed to the fact that when samples are gathered for study, the

number of Native Americans students included is often low in comparison to other sub groups (Bahr, 2008; Ignash, 1997; Larimore & McClellen, 2005). Previous analysis of the data set used for the present study revealed that Native American students who scored proficient or above on the NMSBA enrolled in more remedial courses than other students who scored similarly (Winograd, Dasenbrock, & Garcia 2010). Many questions exist concerning why test scores might be more predictive for certain ethnicities. This finding prompts the need to more deeply investigate the role of ethnicity in developmental course enrollment patterns. These statistics show the importance of considering ethnicity and other demographic factors when creating policies around remedial education. With a large population of Native Americans, state level data from New Mexico presents a unique opportunity to add to the body of knowledge about Native American students' developmental education course taking patterns and related policy considerations.

Developmental Education Placement Polices

Even if a student moves directly from high school to college, this does not guarantee he or she will begin with college-level course work. There are many assessments currently used to determine remedial education needs and postsecondary course placements. While a plethora of college placement tests exists, Accuplacer and Compass are used extensively by community colleges and four-year colleges and universities. In many colleges however, enrollment in remediation is not mandatory, even if test scores are below the designated cut point. Many colleges will recommend a remedial course or course sequence, but analysis of a large data sample highlights a gap between a student's referral and their enrollment in the recommended course or sequence (Achieving the Dream, 2008). The data revealed that for those referred to

math remediation, 21% had not enrolled in any remedial math course three years out from their first enrollment. For reading, the number increased to 33%.

So, do students who enroll in remedial education complete those courses and enroll in and successfully complete credit-bearing courses? Do they graduate at a similar rate to peers who do not take remedial courses? According to NELS data, the answers depend on the type of course. Writing and reading remediation courses had a pass rate of 68% and 71% respectively while only 30% passed all of the remedial math classes they enrolled in (Attewell, Lavin, Domina, & Levey, 2006). The Achieving the Dream sample reveals similar trend with a 13% difference in those who complete reading sequences (44%) verse math sequences (31%) within three years. These data suggest that math deficiencies are more difficult to overcome, although work by Adelman (2004a) indicates that students with reading deficiencies are those least likely to graduate from college. This makes intuitive sense, since we know reading is typically required within other disciplines.

It is important to note that this discussion so far presumes that students enrolled in college course work –whether developmental or credit-bearing – should, in fact, complete a college degree. Of course, in reality there are multiple characteristics of dropouts, and they are not all due to academic failure. For many students, dropping out is voluntary withdrawal or temporary or transfer. Tinto (1975, 1997) reminds us that a failure to recognize these distinctions can have a significant impact on higher education policy. At its core, college is an educational experience and that must include consideration of educational/academic practice and vital social domains. There is no doubt that a longitudinal process of academic, background, and social interactions leads people to a variety of persistence and drop out behavior (Tinto, 1997). To suggest that all students who go to college should in fact finish is unrealistic; this is important to

acknowledge. Working, however, to establish indicators that can inform students in time to make academic adjustments may assist many on the journey to degree completion.

Degree completion for remedial students is a complex process as outcomes seem to depend on factors included in or excluded from analysis. Developmental education programs do not appear to increase one's likelihood of success when looking directly at the proportion of remedial verses non-remedial students who go on to earn a degree. The NELS sample provides evidence to this end. Less than a fourth of those who enrolled in remedial education earn a credential over an eight year period with an additional 14% transferring without the same (NELS, 2000). On the other hand, almost 40% of students who did not enroll in any remedial courses earned a degree in the same time period. Adelman's analysis exposes a similar trend in graduation rates with 39% of those who took remediation graduating verses 69% who took no remediation (Adelman, 1999, 2004a).

On the other hand, if developmental programs were not available, it is likely that outcomes for students with deficiencies would be even worse. Indeed, when researchers control for demographic characteristics and academic skills upon entry they tend to find that students in community colleges who take remediation do as well as students who have never enrolled in such courses (Adelman, 1998; Attewell, Lavin, Domina, & Levey, 2006). Additionally, Bettinger & Long (2009) and Jepsen (2006) have found generally positive college persistence and attainment outcomes for those who have received remedial instruction. Their results indicate that these students are more likely to continue in college when compared to students with similar test scores and personal characteristics who did not take such courses.

The continuing debate about the efficacy of developmental education programs underscores the importance and relevance of the topic for continued study. Furthermore, few

would argue that college retention and success are greater for students who move directly into college-level work and are prepared to do so. Therefore, this study seeks to explore how additional use of existing information from the high school system may be able to minimize the number of students who require remediation by predicting the potential need in time to "remediate" before college.

High School Assessments

Traditionally, a core purpose of secondary education was to sort and select students. Those who rose to the top were meant to go on to a higher education institution and the rest prepared to transition straight to work. Traditional education in the United States helped fill demand for a large workforce. The 1980's saw two publications that contained unfavorable outcomes about secondary students in the United States, *A Nation at Risk* (National Commission on Excellence in Education, 1983) and the International Assessment of Educational Progress (1988). These international comparisons shepherded in a new era of high school exit exams, which by the mid-1980s to the early 1990s had become common. Unfavorable international comparisons remain today (Program for International Student Assessment, 2009) and are again acting to spotlight the adequacy (or perceived inadequacy) of our education systems. The buzzword in education then became and today remains, "accountability" (Lartigue, 1999).

Systems that are designed for "accountability" obligate those within them to meet set standards. As Burger (1998) notes, "the concept of educating all students will be rejected by systems whose core purpose is sorting and selecting" (p. 4). Content standards then are created to describe what students should know and be able to do. Standards based assessments then, are "an outcome-based philosophy of education in which high standards of learning are set, the curriculum is aligned with those standards, and students are tested to ensure they meet the

standards" (Venezia, Kirst & Antonio, 2003). As such, most states use standards based assessments to verify whether students are proficient in reading, mathematics, and science (Venezia et al, 2003). Not much, however, is documented on how and if states are using existing high school assessment system or college entrance examination performances to benchmark college readiness. This is likely due to data collection and system limitations, coupled with a slow evolution to two-way data flows (Venezia et al, 2003). States have limited information which links secondary and postsecondary student level data; "Evaluations of this type require individual student level data that link high school and postsecondary performance so that indicators of college readiness can be defined and followed in order that educators have timely intervention measures to track student progress toward college readiness" (Venezia, Kirst & Antonio, 2003, p. 4).

College readiness indicators can likely be identified within the information we already collect from students. In lieu of expensive and complicated new systems, how can educators and policy makers leverage what they have to better understand questions about remediation? All entering college students in Texas, for example, must meet a minimum cut-score on required reading, writing, and math tests (set by Texas Higher Education Coordinating Board, 2005). Those who pass or are exempt can continue on to earn college-level credit while those who score below the minimum passing standards must receive academic advising and remedial instruction (Texas Higher Education Coordinating Board, 2005).

In New Mexico, high school students take the New Mexico Standards Based Assessment (NMSBA) as a requirement of graduation (New Mexico Courses of Instruction and School Programs 23-13-1.1, 2006-2011). This exam, however, does not routinely inform college course placement decisions in New Mexico colleges and universities. Each college in New Mexico

places students according to individual college placement policies (New Mexico Higher Education Department, General Education Core Competencies Assessment, 2012). This research may provide evidence in favor of using the NMSBA to inform college placement decisions. There is a need to better understand the alignment between state high school assessments and college-readiness standards in order to more effectively manage the relationship between high school education/graduation and college readiness.

To summarize, this study proposes to examine the ability of the current NMSBA system, particularly eleventh grade math and reading scores, to predict a student's remedial course work upon entry to college. A particular focus will be on developing evidence for the potential value of the NMSBA in predicting remediation upon entry to college and by extension the value of NMSBA as a college readiness assessment. This will include a detailed exploration of variations in predictive strength by ethnicity. Details of the project objectives and the research hypothesis including design and analysis considerations follow. This review describes why it is difficult for educators, policy makers, and high school students to focus adequately on college readiness if they do not have a valid set of indicators from which to build better programs, define appropriate policies, and benchmark accountability.

Exploring the utility of the NMSBA beyond its original purposes may reveal conclusions which impact how "college readiness" is assessed and addressed. This study brings further attention to alignment between high school exit requirements and college entrance requirements. It may result in an evaluation of current practices and policies which support high school college preparatory work and college developmental education programs. This analysis may also inform next steps in the broader college and career readiness policy discussion well underway in New Mexico and other states.

Chapter Two

Method

The data set, participants, design and procedures of this study are described in this chapter. Generally, the methodology for these analyses was designed to explore the strength of the eleventh grade NMSBA to predict a student's remedial course enrollment in college. The chapter concludes with a presentation of the methodological approach employed to analyze and interpret data from individual student's high school and college records.

Objectives

The purpose of this research is to advance understanding of the relationships between New Mexican secondary student scaled scores on the eleventh grade NMSBA and subsequent developmental education enrollment, specifically in mathematics and English remediation at public colleges and universities in New Mexico. The general research question asks: Do high school achievement test scores predict whether students enroll in developmental math and/or English? More specifically:

1. Do student scaled scores in math (while controlling for gender) predict student enrollment in remedial course work in math upon entry to college?
2. Do student scaled scores in reading (while controlling for gender) predict student enrollment in remedial course work in English upon entry to college?
3. Do math and reading scaled scores from the eleventh grade NMSBA (while controlling for gender) predict student enrollment in remedial course work in math, English or both upon entry to college?
4. Is there an interaction between NMSBA and ethnicity on remedial enrollment rates while controlling for main effects?

Sample

Participants are 7,233 public high school graduates in New Mexico who enrolled in college the Fall semester immediately following graduation. They represent 184 public, charter, Native American, and alternative high schools as well as 14 public colleges and universities and 13 branch campuses across the state of New Mexico. Forty-four percent (*N* = 3,176) of participants are male while 56% (*N* = 4,057) are female. Sixty-four percent (*N* = 4,607) of students were 18 years old upon entry to college while 36% (N = 2,626) were 19 years old. Participants are 2% (*N* = 114) Asian, 2% (*N* = 181) Black, 49% (*N* = 3,567) Hispanic, 8% (*N* = 594) Native American, 38% (*N* = 2,760) White and .2% (*N* = 17) other. As illustrated in Table 1, these demographics generally match closely with the New Mexico primary and secondary student population, college freshman population and the populace of New Mexico as a whole.

A notable difference can be found in the percent of females represented in the study sample. There are 7% more females in the sample than in the secondary student population and 5% more females in the sample than in both the college freshman population and the populace of New Mexico as a whole. Reversely of course this means the percent of males in the sample is lower than in the other demographics reported. Another notable difference is in the Hispanic populations. The sample containing 49% Hispanic students is 11% greater than postsecondary students, 4% greater than the population as a whole and 6% less than the Hispanic population of secondary students. The sample includes New Mexico high school graduates who attend New Mexico public colleges and universities. Not included in the analysis are students who attend college out of state, who attend a private college in state, who join the military or do not attend college directly after high school graduation. Data do not include students who attend Native American postsecondary institutions (Navajo Technical College, Diné College, Institute of

American Indian Arts, or Southwestern Indian Polytechnic Institute). Additionally, the sample does not include the variety of students who come to college years after graduating from high school or earning a General Education Diploma. Moreover, students who delay taking necessary developmental course work until later in their college careers are not represented. The sample does however represent a statewide cohort of students who went on to college the semester following high school graduation. They include students who entered two- and four-year, public colleges in pursuit of vocational credentials, and associate's and bachelor's degrees.

Table 1

Population Demographic Comparisons

	Study Participants 2008*	Secondary Students 07-08**	Postsecondary Students Fall 08***	State of New Mexico 2008****
Female	56%	49%	51%	51%
Male	44%	51%	49%	49%
African-American	2%	3%	3%	3%
Hispanic	49%	55%	38%	45%
Asian/Pacific Islander	2%	1%	2%	1%
Native American	8%	11%	8%	10%
No Response	.2%	N/A	7%	N/A
Foreign	N/A	N/A	2%	N/A

*Note: Percentages may not add up to 100% due to rounding error. *Source: New Mexico Office of Education Accountability.**Source: STARS 120th day submission to New Mexico Public Education Department.***Source: DEAR Fall semester third Friday submission to New Mexico Higher Education Department.***Source: U.S. Census Bureau, Quick Facts New Mexico*

Data Sources

New Mexico Standards Based Assessment (NMSBA)

In 2006, over 11,000 high school juniors (public, charter and alternative) completed the NMSBA. Students with NMSBA English and mathematics scores comprised the original data-analysis sample collected by the New Mexico Public Education Department (NMPED). Test scores were reported by districts to the state education department where they were stored in the Student and Teacher Reporting System (STARS). The NMSBA is a criterion-referenced test which measures performance in Mathematics and Reading. The assessment was designed to measure student progress toward the New Mexico Content Standards and ultimately to determine how well students achieve them (Harcourt Assessment Inc., 2007).

Students receive Item-Response Theory scaled scores for math and reading. There are four performance levels defined for the NMSBA. These are 1) Beginning Steps, 2) Nearing Proficiency, 3) Proficient, and 4) Advanced. For the purposes of No Child Left Behind, a passing grade on any NMSBA subject test is a performance level classification of Proficient or Advanced. Table 2 provides English and Math score ranges for the four proficiency levels of the NMSBA at the 11^{th} grade for the year the data was gathered.

Table 2

Scaled Score Ranges for NMSBA

Content Area	Beginning Steps	Nearing Proficient	Proficient	Advanced
Math	0-560	561-593	594-634	635-999
Reading	0-577	578-621	622-671	672-999

The Cronbach's Alpha reliability coefficient (Math $\alpha = 0.92$, Reading $\alpha = 0.92$) was the reported test statistic to demonstrate the reliability of the NMSBA scores (Harcourt, 2007). Evidence of the validity of the NMSBA assessment comes primarily from test content and

relation to other variables. In terms of test content, multiple internal and external reviews were conducted to ensure that test items were aligned to the New Mexico Content Standards (Harcourt, 2007). Evidence of internal structure is found in the item score/test score correlation coefficient (Reading $r = 0.97$; Math $r = 0.92$) (Harcourt, 2007). These are acceptable correlation levels to suggest that the items are working together to measure the same construct. Additionally, the relationship among other variables shows correlation levels between math and reading ($r = 0.68$) that were expected given the level of reading required to complete math items (Harcourt, 2007).

New Mexico College Enrollment Data

Enrollment data for New Mexico's eight 4-year colleges and universities and seventeen two-year colleges is reported by the institutions to the New Mexico Higher Education Department (NMHED) annually. The state of New Mexico requires NMHED to conduct an annual data verification process (Section 21-1-26.3 NMSA, 1978). This coupled with school's independent data verification procedures, which are required by NMHED policy, increase the accuracy of this data source. In the 2007-2008 school year, 18,588 students graduated from public, charter and alternative high schools in New Mexico. Of them, 9,855 students enrolled in college at a public college or university in New Mexico in Fall 2008. This means that over half (53%) of the graduating class went on to a public college or university in New Mexico. Fall semester enrollment data for all students was collected from each public postsecondary institution by NMHED. These data were processed and stored in the Data Editing and Reporting System (DEAR).

Variables

There are four independent variables (predictors) in this study: NMSBA English scaled scores; NMSBA math scaled scores, gender, and ethnicity (used for data matching and drawn from both data sets). The ethnic groups were: 1) Hispanic, 2) White, 3) Native American, 4) Black, and 5) Asian.

The outcome measures include: enrollment in developmental English, enrollment in developmental math, and enrollment in both developmental English and math. Fall enrollment in New Mexico institutions of higher education indicates the courses a student has officially enrolled in for a given Fall semester. Enrollment data, however, do not communicate anything about course retention or completion. The U.S. Department of Education's National Center for Education Statistics created standardized taxonomy for areas of study called the Classification of Instructional Programs (CIP) (National Center for Education Statistics, 2007). Enrollment data are coded by CIPs which helps with the accuracy of tracking and reporting. There are CIP codes for remedial math and remedial English so it was possible to establish when a student enrolled in just math, just English, or both math and English. Table 3 provides a list of all the relevant variables in the study data set.

Table 3

Variables Included in the Study Data Set

Demographic Variables (NMPED & NMHED)	NMSBA Variables (NMPED)	College Enrollment Variables (NMHED)
First & Last Name	High School Name	Institution 1 (*N*=14)
Gender	Math - Scaled Score	Campus 4 (*N*=1)
Ethnicity	Math - Achievement Level (4 proficiency levels)	Remediation Math Enrollment (0-4 enrollments)
Date of Birth	Reading – Scaled Score	Remediation English Enrollment (0-4 enrollments)
Age (upon enrollment)	Reading - Achievement Level (4 proficiency levels)	

Procedures

Data Manipulation

Since 2006, NMPED and the NMHED have submitted data files to the New Mexico Office of Education Accountability (OEA) for analysis related to the annual Ready for College report. The appropriate information from the public education and postsecondary system was collected so that students and their associated data could be successfully identified and linked between the two. More specifically, the aim was to capture all public school juniors from the STARS database and search for that same group in the DEAR database. Original data were collected separately by NMPED and NMHED, and then combined for OEA as a cross agency data set.

Public education and higher education in New Mexico use different student identification systems. This limits the ability to match students between data sets using a single key identification, such as a social security or student identification number. Student matches were

therefore determined using five key demographic variables shared between data sets. These include: first and last name, date of birth, gender, ethnicity, and graduating high school.

Data were deliberately excluded for students who had no NMSBA data or who were missing any data elements necessary to match students across educational systems. Any students missing these variables were removed. Only seventeen students had "no response" in the data and these were removed. Accounting for these necessary data manipulations, this work resulted in a cross agency data set with individual student-level data successfully matched on all five points yielding 7,233 students.

After student data were matched and a single data set was created, all personally identifiable information associated with individual participants was removed. Informed consent was not required, since this study proposed a secondary analysis on an existing data set used by the state for program and policy decision-making. A request to use this data set was made to OEA and permission was received prior to beginning this project. Prior to commencing the study, approval was received from the University of New Mexico Internal Review Board. Upon completion of the study all data will be returned to OEA.

Analysis Plan

Logistic Regression Models

Four-predictor logistic models were used to test the research questions concerning the relationships between the probability that a student enrolled in remedial instruction in college and his or her high school NMSBA math scores, NMSBA reading scores, gender, and ethnicity. The logistic regression analysis was used to assess the predictive capability of NMSBA math and reading scaled scores with regard to a subject's decision to take remedial classes while also assessing the impact of gender and ethnicity. The same logistic regression analysis strategy was

repeated three times: 1) math remediation; 2) English remediation; 3) any remediation. The step-by-step detail for that strategy was as follows.

Each model was constructed to explore the predictive relationship between the dichotomous categorical outcome variable, remediation, and the predictor variables of NMSBA scores, gender, ethnicity, and NMSBA/ethnicity interactions respectively. Each model was constructed in four steps resulting in the following block structure: block zero which was the intercept only block; block one which added the NMSBA and gender predictors; block two which added the ethnicity predictors (using White as the reference group); and block three which added the NMSBA/ethnicity interaction predictors. A probability of $\alpha = .01$ was applied to each predictor variable in the regressions to defend against making Type I errors. The models were designed so that the significance of the overall model, each block, and the individual predictors could be determined. The -2 Log Likelihood statistics and the Hosmer-Lemeshow test were reviewed to assess for significant improvement in the overall model. Classification tables were also reviewed as a supplemental assessment of model fit. The significance of each block within the models as well as the individual predictor variables were assessed using the Wald statistic.

The specific research questions underpinning this study were explored by constructing a model for predicting the observed data using the logistic regression strategy described above. Table 4 displays the variables included in each model so there is a frame of reference for the logistic regression results displayed in the results chapter.

Table 4

Variables in each Logistic Regression Model used to Predict Remediation

Type of Remediation Predicted	Math Remediation Model	English Remediation Model	Any Remediation Model
Block 0	Intercept Only	Intercept Only	Intercept Only
Block 1	Math SBA	Reading SBA	Math SBA
	Gender	Gender	Reading SBA
			Gender
Block 2	Math SBA	Reading SBA	Math SBA
	Gender	Gender	Reading SBA
	Ethnicity	Ethnicity	Gender
			Ethnicity
Block 3	Math SBA	Reading SBA	Math SBA
	Gender	Gender	Reading SBA
	Ethnicity	Ethnicity	Gender
	Math*Ethnicity	Reading*Ethnicity	Ethnicity
			Math*Ethnicity
			Reading*Ethnicity

The following explains how each research question maps to the models depicted in Table 4.

Research Question 1 – *Do student scale scores in math (while controlling for gender) predict student enrollment in developmental course work in math upon entry to college?* Within Table 4 this research question is depicted in block one of the Math Remediation Model.

A logistic regression model (referred to as the "math remediation" model) was created to assess whether math scaled scores predict student enrollment in math developmental courses. The model uses math NMSBA scores as predictors and enrollment in math developmental course as the outcome variable. The model was first constructed in two blocks, block zero is the intercept only and block one adds math NMSBA scores and gender.

Research Question 2 - *Do student scaled scores in reading (while controlling for gender) predict student enrollment in English developmental course work upon entry to college?* Within Table 4 this research question is depicted in block one of the English Remediation Model.

A logistic regression model (referred to as the "English remediation" model) was created to assess whether reading scaled scores predict student enrollment in English developmental courses. The model uses reading NMSBA scores as predictors and enrollment in English developmental course as the outcome variable. The model was first constructed in two blocks, block zero is the intercept only and block one adds reading NMSBA scores and gender.

Research Question 3 - *Do reading and math scaled scores from the eleventh grade NMSBA (while controlling for gender) predict student enrollment in developmental course work in English, math or both upon entry to college?* Within Table 4 this research question is depicted in block one of the Any Remediation Model.

A logistic regression model (referred to as the "any remediation" model) was created to assess whether reading scaled scores and math scaled scores predict student enrollment in any developmental courses. The model uses the NMSBA scores (math and reading) as predictors and enrollment in any developmental course as the outcome variable. The model was first constructed in two blocks, block zero is the intercept only and block one adds NMSBA scores and gender.

Research Question 4 – *Is there an interaction between NMSBA and specific ethnicity categories on developmental enrollment rates while controlling for main effects?* Within Table 4 this research question is depicted in block three of all the models.

Two additional blocks were added to the model described above to explore specific ethnicity categories. Block two adds Native American, Hispanic, Black, and Asian ethnic groups (White was used as the reference), and in block three an interaction term was created for ethnicity by scaled score and it was entered into the model as a predictor variable.

Chapter Three

Results

Introduction

The purpose of this research study is to obtain an understanding about the relationships among New Mexico secondary student scale scores on the eleventh grade NMSBA and subsequent developmental education enrollment, specifically mathematics and English remediation at public colleges and universities in New Mexico. The general research question asks: do high school achievement test scores predict whether students are likely to enroll in developmental math and English? More specifically, do English and math scale scores from the eleventh grade NMSBA predict an individual student's enrollment in developmental course work in English, math or both upon entry to college? The final sample consists of 7,233 students representing 184 high schools in 89 towns and cities across New Mexico. Students in this sample attended 24 postsecondary institutions after high school graduation. The chapter is comprised of summary statistics and logistic regression results for all four research questions.

Summary Statistics

The following summary statistics are included to describe sample outcomes with particular attention to ethnic and gender variations in NMSBA performance and postsecondary remedial enrollment. The scores and proficiency category breakouts for NMSBA English and math are reported for the sample as well as postsecondary remedial enrollments. Frequencies and percentages were calculated for categorical variables. The sample size, mean, standard deviation, and range have been calculated for continuous variables.

The NMSBA math scale scores in this sample (N = 7,233) ranged from 490-732 (M = 591.8; SD = 28.9) out of a possible range of 0 - 999. Similarly, the NMSBA reading scale scores

ranged from 392 – 740 (M = 628.1; SD = 31.7) out of a possible 0 - 999. There are four categories used by the New Mexico State Department of Education to describe the proficiency of students based on their test outcomes. Table 5 presents all of the proficiency categories for math and reading by gender and by ethnicity. Many more students (male and female) are proficient (i.e. Proficient or Advanced Proficient in Table 5) in reading than math. Conversely far more students (male and female) are at the Beginning Steps category on math than reading and this is particularly true for Blacks, Hispanics, and Native Americans. Note that within this sample, 4,109 (57%) students scored below proficient in math while 3,124 (43%) scored proficient or above in math. In reading 2,751 (38%) of students scored below proficient, while 4,480 (62%) scored proficient or above.

Table 5

Number & Percentage of Students within NMSBA Proficiency Categories in Math & Reading by Gender & Ethnicity

	Gender		Ethnicity				
	Female	Male	Asian	Black	Hispanic	Native American	White
			Math				
Advanced Proficient	237 (6%)	356 (11%)	25 (22%)	13 (7%)	143 (4%)	16 (3%)	395 (14%)
Proficient	1332 (33%)	1199 (38%)	50 (44%)	46 (32%)	984 (28%	151 (26%)	1298 (47%)
Nearing Proficiency	2000 (49%)	1276 (40%)	36 (32%)	81 (45%)	1906 (54%)	324 (55%)	919 (33%)
Beginning Steps	488 (12%)	345 (11%)	3 (3%)	41 (23%)	534 (15%)	103 (17%)	148 (5%)
			Reading				
Advanced Proficient	373 (9%)	217 (7%)	14 (12%)	16 (9%)	168 (5%)	17 (3%)	372 (13%)
Proficient	2186 (54%)	1704 (54%)	67 (50%)	83 (46%)	1708 (48%)	278 (52%)	1748 (19%)
Nearing Proficiency	1299 (32%)	1036 (33%)	27 (24%)	74 (41%)	1413 (40%)	240 (44%)	573 (19%)
Beginning Step	197 (5%)	219 (7%)	6 (5%)	8 (4%)	276 (8%)	5 (1%)	67 (2%)

Note. Gender is percent within gender by proficiency category (e.g. 49% of females are Nearing Proficiency in math). Ethnicity is percent within ethnic category by proficiency category (e.g. 52% of Native Americans are Proficient in reading).

In Fall 2008, 3,533 (49%) students from this sample enrolled in developmental education leaving 3,700 (51%) people who did not. There were 2,190 (30%) students enrolled in at least one remedial reading course, with females representing 1,295 (59%) of those enrollments and males representing 895 (41%) of those enrollments. Similarly, there were 2,820 (39%) students enrolled in at least one remedial math course, with females representing 1,774 (63%) of those enrollments and males representing 1,046 (37%) of those enrollments. More females enrolled in reading and math remediation than males, but the gender gap is much wider for math than

reading with females representing 63% of all the math remediation enrollments. Those enrolled in remedial coursework were often enrolled in more than one course. Of those who enrolled in remediation, 42% (1,477 people) enrolled in both reading and math remediation. Table 6 shows how many students enrolled in multiple courses.

One dependent (outcome) variable in the logistic regression analyses was "any remediation" so it is important to point out that for over 1,200 students this meant multiple remedial enrollments. As Table 6 shows, this is particularly true of Hispanics and Native Americans students for whom 29% and 39% respectively, enrolled in more than one remedial course in the Fall semester of their freshman year.

Table 6

Number of Simultaneous Remedial Enrollments by Ethnicity

Ethnicity	0	1	2	3	4	Total Students
Asian	80 (70%)	26 (23%)	5 (4%)	3 (3%)	0 (0%)	114
Black	77 (43%)	66 (37%)	25 (14%)	13 (7%)	0 (0%)	181
Hispanic	1531 (43%)	1018 (29%)	667 (19%)	310 (9%)	40 (1%)	3567
Native American	190 (32 %)	172 (29%)	142 (24%)	83 (14%)	7 (1%)	594
White	1812 (66%)	590 (21%)	256 (9%)	88 (3%)	14 (.5%)	2760
Total Students	3700 (51%)	1873 (26 %)	1100 (15%)	49 (.7%)	61 (.8%)	7233

Note. 17 cases missing ethnicity are not reported here.
Percent is of total enrollment within reported ethnic groups (e.g. 24% of Native Americans had two remedial enrollments).

Table 7 shows the percent of students by gender and ethnicity who scored below proficient in Reading and Math on the NMSBA alongside the percent of students who subsequently enrolled in developmental English and math their first semester of college. Hispanics enrolled in the greatest numbers with 1,311 reading enrollments. This represents 60%

of reading remediation enrollments and 37% of the entire Hispanic sample in the study. Native Americans had 308 enrollments representing 14% of the reading remediation enrollments and 52% of the entire Native American population in the study. Black enrollment was 64 which represent 3% of the reading remediation enrollments and 35% of the entire Black population in the study. White enrollments were 482 which represent 22% of the reading remediation enrollments and 17% of the entire White population in the study. Asian enrollments were 18, less than 1% of the enrollments and 13% of the Asian population. Hispanics enrolled in the greatest numbers with 1,643 enrollments in math remediation. This represents 58% of the total math enrollments and 46% of the entire Hispanic population in the study. Native Americans had 297 enrollments representing 11% of the math enrollments and 50% of the entire Native American population. Seventy-six Blacks enrolled which represents 3% of enrollments and 42% of the Black population in the study. Whites had 771 enrollments, 27% of the math enrollments and 28% of the White population in the study. Asians had 24 enrollments, which is less than 1% of the math remediation enrollments and 21% of the Asian population.

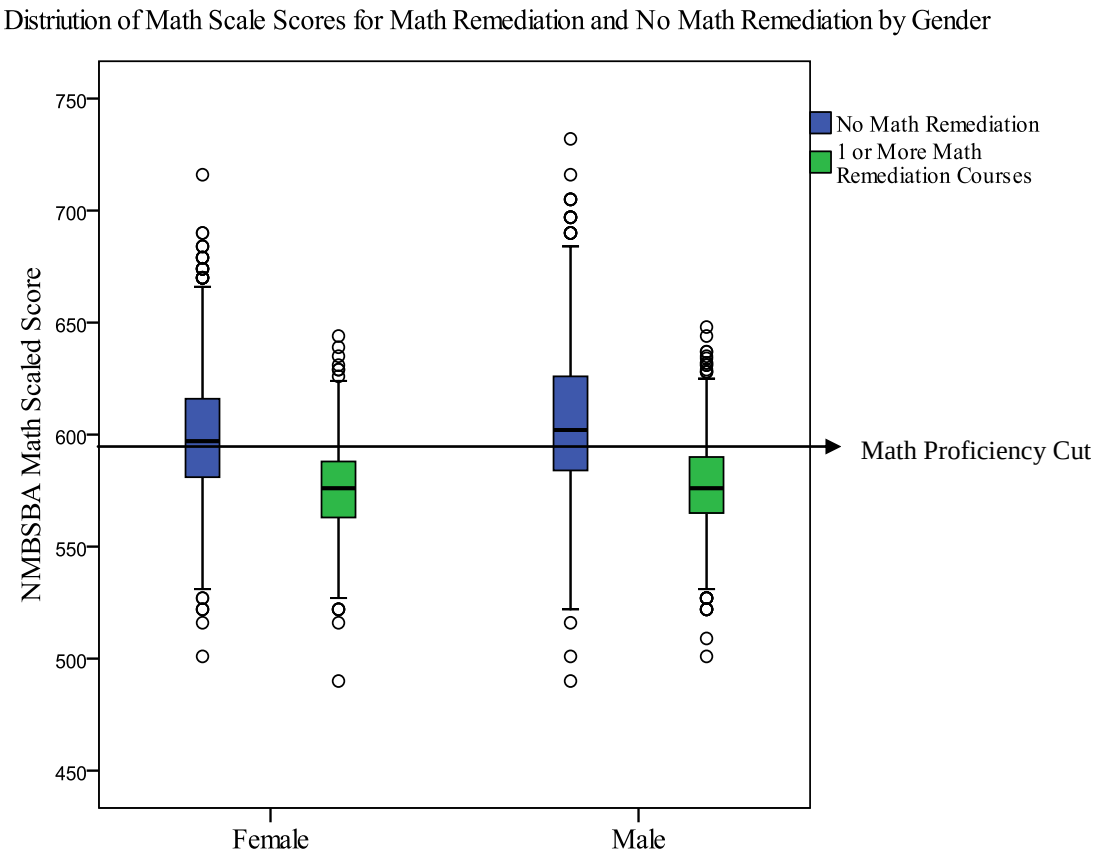
Table 7

Proficiencies in Math & Reading: A Comparison of NMSBA Scores and Subsequent Remedial Enrollment

Gender/Ethnicity	Below Proficient NMSBA Reading	Enrolled in Remedial English	Below Proficient NMSBA Math	Enrolled in Remedial Math
Female	37%	32%	61%	44%
Male	40%	28%	51%	33%
Asian	29%	16%	34%	21%
Black	45%	35%	67%	42%
Hispanic	47%	37%	68%	46%
Native American	50%	52%	72%	50%
White	25%	17%	39%	28%

Table 7 points to a disconnect between the percent of students scoring below proficient in reading and math and the percent of students who later enrolled in remedial English or math. This demonstrates that there is not a one-to-one correspondence between proficiency category and remediation. Figures 1 – 4 explore this further through a series of box and whisker plots. A horizontal arrow runs across each to indicate the designated cut score used by the state department of education and local schools for designating subject proficiency. To explore how the math and reading trends look by gender figures 1 and 2 are presented.

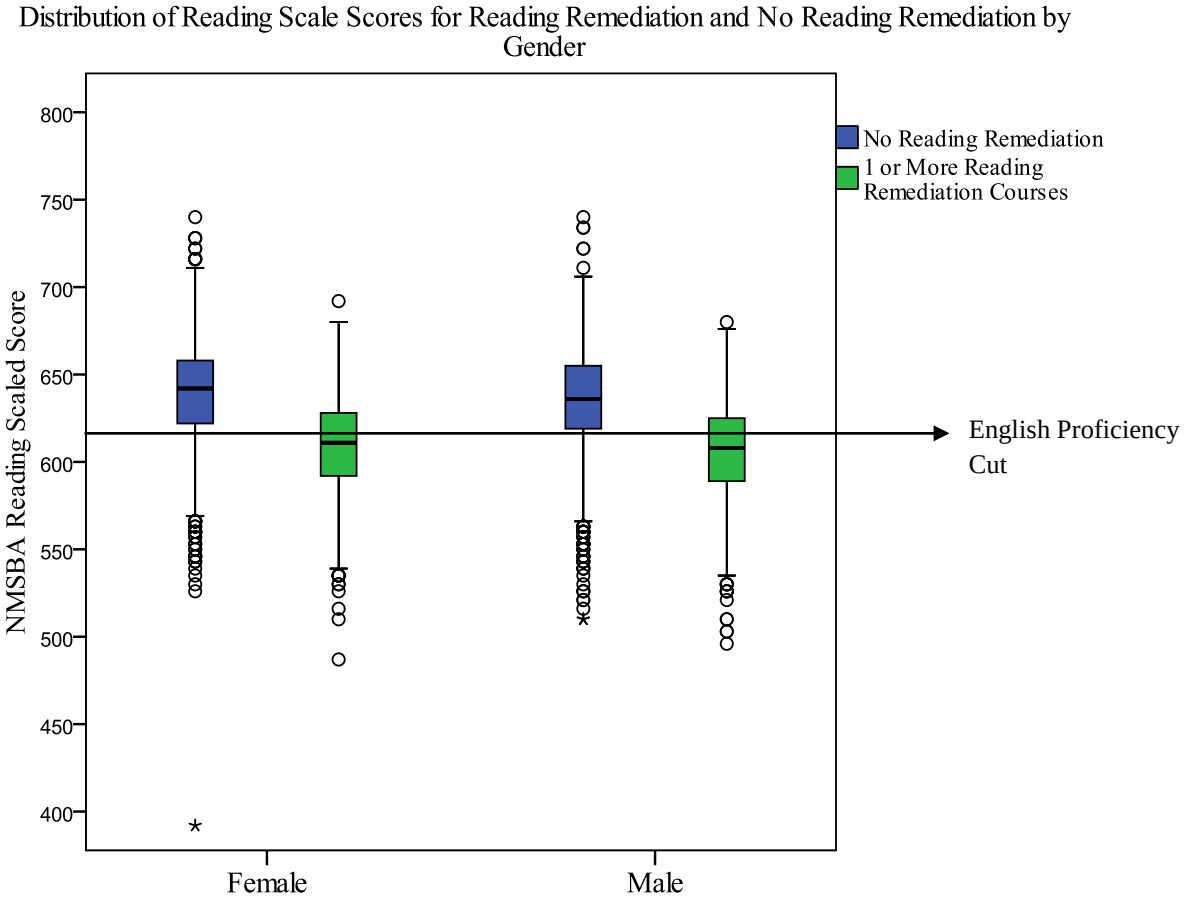
Figure 1.



The bulk of remedial enrollments for women and men fall below the math proficiency cut line. For many students, scoring proficient in math on the NMSBA leads to no remediation enrollment but this appears truer for men (64%) more than for women (56%). There

is a clear area of crossover below the proficiency cut, particularly for women. Nearly half of the women who take no math remediation scored below proficient in math on the NMSBA. At the same time, scoring below 580 in math on the NMSBA appears, by this figure, to predict equally well for women and men the likelihood of enrolling in one or more math remedial courses. The means depicted in Figure 1 were submitted to a two-factor ANOVA in order to determine if any of the visible differences were also statistically significant. (See Appendix D for details.) Those analyses revealed a significant interaction for gender and math, which means students' math scores who took remedial coursework, differed from those of the same gender who did not take remedial coursework. The math scores of students who took remedial coursework also differed by the student's gender and the math scores of students who did not take remedial coursework differed by student's gender.

Figure 2.

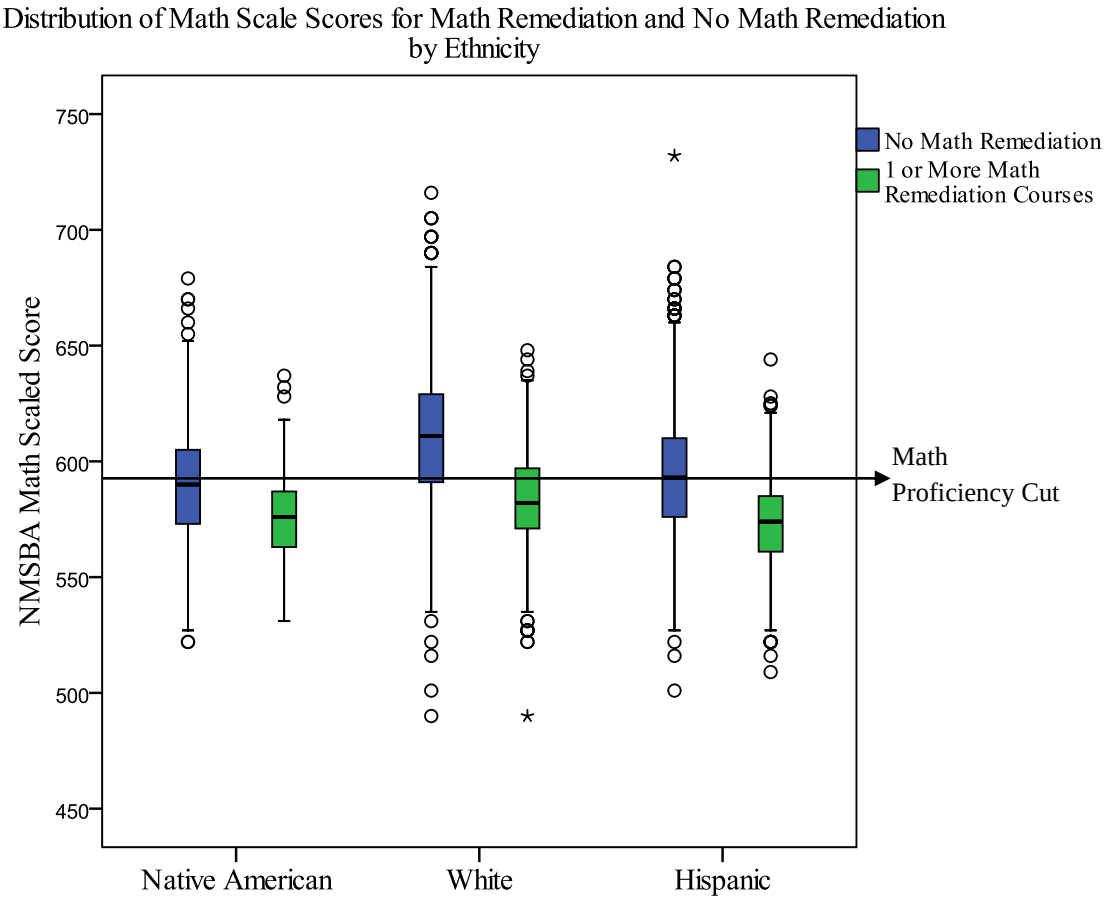


The trend described for math is less clear for reading; however, a score above the proficiency cut line for English does appear to be a good predictor that a student will not enroll in reading remediation. There are a fair number of women (33%) and men (30%) who score above the proficiency cut line and still enroll in reading remediation. Additionally, there are obvious outliers in these data for women and men who score below the proficiency cut line, particularly for those who do not enroll in reading remediation. The means depicted in Figure 2 were submitted to a two-factor ANOVA in order to determine if any of the visible differences were also statistically significant. (See Appendix D for details.) Those analyses revealed that there was a significant main effect of gender with females outscoring males, and English

remediation with those who had no remedial courses outscoring those who did. There was no statistically significant interaction of the two variables.

To explore how the math and reading trends look by ethnicity figures 3 and 4 are presented. Whites, Hispanics, and Native Americans represent the majority of the sample and are central to the analysis in this study. As such these are the three ethnicities included in the following figures.

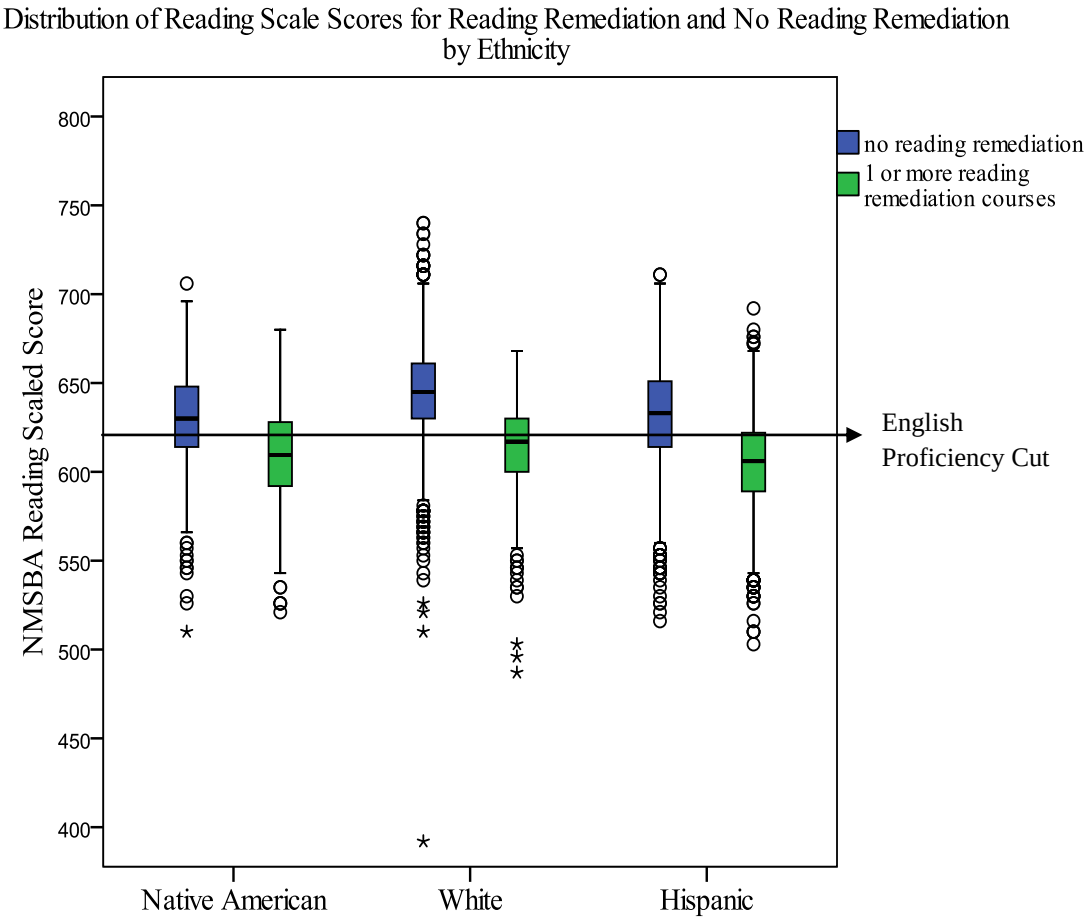
Figure 3.



For all three groups in figure 3, nearly all who enroll in math remediation scored below proficient in math in the NMSBA. For Native American and Hispanics, however, the cut score is not a tidy predictor. Over half of the Native Americans who scored below proficient did not

enroll in a remediation math course and the same is true for their Hispanics peers. The means depicted in Figure 3 were submitted to a two-factor ANOVA in order to determine if any of the visible differences were also statistically significant. (See Appendix D for details.) Those analyses revealed a significant interaction effect for ethnicity and math. When there were no remediation enrollments, all ethnic groups differ significantly from one another. That is, the mean math scale score in the non-remedial category for Whites was significantly different from Hispanics and Native Americans and Native Americans and Hispanics differed significantly from one another. When there were remedial enrollments, Hispanics and Native Americans differ significantly from Whites but not from one another.

Figure 4.



The Proficiency cut for English appears more equitable across the ethnic groups than it was in figure 3. For all groups, particularly Whites, those students with no reading remediation enrollments scored above proficient in English on the NMSBA. Interestingly, almost half of Whites and a number of Native Americans who scored above proficient enrolled in one or more reading remediation course. The means depicted in Figure 4 were submitted to a two-factor ANOVA in order to determine if any of the visible differences were also statistically significant. (See Appendix D for details.) Those analyses revealed that there was a significant main effect of ethnicity with different ethnic groups scoring differently, and English remediation with those who had no remedial courses outscoring those who did. There was also a significant interaction

effect with ethnicity and English remediation. When there were no remediation enrollments, all ethnic groups differ significantly from one another. That is, the mean reading scale score in the non-remedial category for Whites was significantly different from Hispanics and Native Americans while Native Americans and Hispanics differed significantly from one another. When there were remedial enrollments, Hispanics and Native Americans differ significantly from Whites but not from one another.

While this descriptive look certainly illuminates important information about these data it does not specifically address the research questions at hand. To explicitly understand the capacity of the NMSBA to predict remediation enrollment outcomes, analysis of the associated logistic regressions were conducted. The following section focuses on the results of those procedures and reports on the findings as they relate to the specific questions that guided this study.

Logistic Regression Results

As indicated in the methods section, three logistic regression models were created to address the four research questions of this study. The Math Remediation Model was created to explore research question one and four, the English Remediation Model to explore research question two and four, and the Any Remediation Model to explore research question three and four. The following section provides an evaluation of those models and is followed by the actual results of those models according to each of the research questions.

Model Evaluation

Assumptions were addressed as part of the analysis. Model specification was considered to ensure the models were properly specified in terms of the functional relationship between the predictors and the conditional probability of taking remedial classes. The absence of

multicollinearity was evaluated by calculating the Variance Inflation Factor (VIF). The VIF were all found to be under two which is well below the recommended VIF value of 10 (Cohen, Cohen, West, & Aiken, 2003) for each of the logistic regression models employed.

For each logistic regression the models grew first from block zero (intercept only) to block one (gender and NMSBA scores). To address research question four, each model was expanded to include block two (ethnicity) and three (ethnicity/NMSBA interaction). The -2 Log Likelihood statistic, the Hosmer-Lemeshow test, and the classification tables were reviewed to assess for improvement over the intercept only model and over the previous blocks to determine if the final model (including the specified predictor variables) gives better predictions than the no-predictor model. Within each model the -2 Log Likelihood decreased for each block, indicating that adding the blocks increased the model's capacity to predict the outcome.

The Hosmer–Lemeshow test, however, was significant ($p < .05$) at each block in all three models suggesting that they may not fit the data well. Because of the fairly large sample size it is possible that the differences between values within the groups are comparatively small. According to the authors of *Size Matters to a Model's Fit,* "a significant Hosmer-Lemeshow test does not necessarily mean that a predictive model is not useful or suspect" (Marcin & Romano, 2007 pg. 2212). Further analysis of the contingency and classification tables showed that each model improves with the addition of the gender, NMSBA, and ethnicity predictors while the ethnicity/NMSBA interaction predictor showed very little improvement in block three.

Math Remediation Model

Within the Math Remediation Model there is an increase in the percent of cases the model correctly classified from 61% in the empty model to 69.2% with the additional predictors NMSBA score and gender. With ethnicity and the interaction added that increased to 70.3%.

From the intercept only model the overall probability of being in a remedial class is *P* = 2819/7233 = .389, or 39%. The empty model therefore appropriately classified 61% of the cases. Prediction for students who did not enroll for developmental math was more precise than for those who did. The magnitude of sensitivity (55.9%) (the proportion of correctly classified as enrolled) compared to the magnitude of specificity (79.4%) (the proportion of correctly classified as those who did not enroll), also supports this observation. At 70.3%, the overall correction prediction shows an improvement over the chance level. The Cox and Snell of .21 and Nagelkerke *R* Square of .29 are on the lower end of the maximum level for these two statistics.

English Remediation Model

Within the English Remediation Model the addition of the gender and reading NMSBA predictors there was an increase in the percent of cases the model correctly classified from 69.7% in the empty model to 74.6%. With the additional ethnicity and interaction predictors that increased to 75.2%. The classification table was reviewed to assess the validity of predicted probabilities. From the reduced model the overall probability of being in a remedial class is *P* = 2190/7233 = .303, or 30%. The empty model therefore appropriately classified 70% of the cases. Prediction for students who did not enroll for developmental English was more precise than for those who did. The magnitude of sensitivity (41%) compared to the magnitude of specificity (90%) supports this observation. At 75.2%, the overall correction prediction shows an improvement over the chance level. The Cox and Snell of .22 and Nagelkerke *R* Square of .31 may also cautiously suggest that this model is adequately describing a fair amount of variance.

Any Remediation Model

Within the Any Remediation Model the addition of the gender and reading and math NMSBA predictors there was an increase in the percent of cases the model correctly classified

from 51.2% in the empty model to 74.1%. With the additional ethnicity predictor that increased to 74.4%. The classification table was reviewed to assess the validity of predicted probabilities. From the reduced model we see the overall probability of being in a remedial class is P = 3533/7233 = .488, or 49%. The empty model therefore appropriately classified 51% of the cases. The magnitude of sensitivity (75.4%) compared to the magnitude of specificity (73.3%) supports this observation. At 74%, the overall correction prediction shows an improvement over the chance level. The Cox and Snell of .29 and Nagelkerke R Square of .39, may also cautiously suggest that this model is adequately describing a fair amount of variance.

Block three was designed to explore the effect of interactions for math and reading by specific ethnic groups testing the predictive ability of the interaction above and beyond the contributions of the main effect. In the Math Remediation Model, the interaction block showed a statistically significant improvement over block two (χ^2 (5, N = 7233) = 21.83, p < .001) indicating that the additional predictors added significantly to the model. The percent predicted, however, did not increase and the Hosmer & Lemeshow test was significant. In the reading model the interaction block showed a statistically significant improvement over block two (χ^2 (5, N = 7233) = 30.58, p < .001) indicating that the additional predictors added significantly to the model. Like the Math Remediation Model the percent predicted did not increase and the Hosmer & Lemeshow test was significant. In the Any Remediation Model the interaction block showed no statistically significant improvement (χ^2 (10, N = 7233) = 15.5942, p = .101) indicating that the additional predictors did not add significantly to the model. Therefore block two was the final step from which results are reported for the Any Remediation Model. The math and English remediation models are reported from block three. A full reporting of each model can be found

in Appendices A (Math Remediation Model), B (English Remediation Model, and C (Any Remediation Model). Table 8 shows the progression over the growth of each model.

Table 8

Estimation and Model Fit for Logistical Regression Analysis of 7,233 New Mexico Students Enrollments

	Block 0	Block 1	Block 2	Block 3
Math Remediation Model				
-2 Log Likelihood		7983.9	7963.68	7941.85
Hosmer & Lemeshow		132.46	141.72	107.04
Percent Predicted	61.00%	69.20%	70.30%	70.30%
English Remediation Model				
-2 Log Likelihood		7286.4	7145.21	7114.63
Hosmer & Lemeshow		78.97	108.8	76.05
Percent Predicted	69.70%	74.60%	75.20%	75.20%
Any Remediation Model				
-2 Log Likelihood		7570.3	7521.56	7505.62
Hosmer & Lemeshow		116.27	105.87	90.257
Percent Predicted	51.20%	74.10%	74.40%	74.50%

Results for Research Question 1 (Math Remediation Model)

Do student scale scores in math (while controlling for gender) predict student enrollment in developmental course work in math upon entry to college? Results for research question one are derived from block one of the Math Remediation Model which used math NMSBA scores as predictors and enrollment in math developmental course as the outcome variable.

According to the block one math NMSBA predictor, the likelihood that a student enrolls for remedial math courses is connected to his or her math NMSBA scores. Specifically, the

probability of a student enrolling for developmental math was negatively related to his or her math NMSBA scores while controlling for gender. The gender predictor shows that given the same math NMSBA score, the odds for females to enroll in developmental courses is greater than for males. The Wald statistic indicates that math scale scores (χ^2 (1, N = 7233) = 1111.30, p < .001) and gender (χ^2 (1, N = 7233) = 36.47, p < .001) are significant predictors in the overall model for math remediation. Gender has a positive relationship (Exp(B) = 1.40) with the outcome variable revealing that the odds of remedial enrollment for females is 1.40 times larger than the odds for males. Further, math has an inverse relationship with the outcome variable indicating that as math scores increase the likelihood of enrolling in remediation decreases (Exp(B) =.96). Table 9 shows the logistic regression results of student enrollments for math remedial courses.

Table 9

Logistic Regression Analysis of New Mexico Student Enrollments for Math Remedial Courses

	Block 0				Block 1			
Predictor	B	S.E.	Wald	Exp(B)	B	S.E.	Wald	Exp(B)
Intercept	-0.45	0.02	345.51*	0.64	24.42	0.75	1061.57*	4.03
Math SBA					-0.04	0.00	1111.30*	0.96
Gender[1]					0.33	0.06	36.47*	1.40

[1]Female=1, Male =0,

The Math Remediation Model provides evidence that student scale scores in math predict student enrollment in remedial course work in math upon entry to college. While the odds ratios for NMSBA in this model is nearing one, it is important to consider the scaling of the measure at hand, that is, for NMSBA there is a one point increase on a scale with 999 possible points. For each one point increase on the math score, the odds of enrolling for remedial math decrease from one to .96. So while the strength of the association between NMSBA scores and remediation

could be interpreted as weak, odds ratios for continuous independent variables tend to be close to one. As such this finding does not suggest that the coefficients are not weak. A one point increase on a ten point scale is much more dramatic than the subtlety of a one point increase on a 0-999 scale. So, if the increase on the math score is ten points the odds decrease because you raise *e* to the power of the logistic coefficient (from one to $e^{10*(-0.04)}$). Therefore, it is reasonable to conclude that as math NMSBA scores increase, the chance for enrollment in remediation is reduced according to this model. This model also provides evidence that females have greater odds of enrolling than males even if they have similar scores on the math NMSBA as their male peers.

Results for Research Question 2 (English Remediation Model)

Do student scaled scores in reading (while controlling for gender) predict student enrollment in English developmental course work upon entry to college? Results for research question two are derived from block one the English Remediation Model which used reading NMSBA scores and gender as predictors and enrollment in English remediation as the outcome variable.

According to the block two reading NMSBA predictor, the likelihood that a student enrolls for developmental courses is connected to his or her NMSBA scores, while controlling for gender. Specifically, the likelihood of a student enrolling for developmental English was negatively related to his or her NMSBA reading scores while controlling for gender. Again, the English Remediation Model shows that given the same score, females have greater odds of enrolling for developmental coursework than males. The Wald statistic indicates that reading scale scores (χ^2 (1, N = 6915) = 1124.05, $p < .001$) and gender (χ^2 (1, N = 6915) = 33.08, $p < .001$) are significant predictors in the overall model for English remediation. Gender has a

positive relationship (Exp(B) = 1.33) with the outcome variable revealing that the odds that females will enroll is 1.33 times greater than for males. Further, English has an inverse relationship with the outcome variable indicating that as reading (Exp(B) =.96) scores increase the likelihood of enrolling in remediation decreases. As was discussed in the Math Remediation Model results, the odds ratios for NMSBA in this model is nearing one and could be interpreted as weak, however, the same discussion from the Math Remediation Model applies here. Odds ratios for continuous independent variables tend to be close to one. As such this finding does not suggest that the coefficients are not meaningful. For each one point increase on the reading score, the odds of enrolling for remedial English decrease from one to .97. So, if the increase on the reading score is ten points the odds decrease because you raise *e* to the power of the logistic coefficient (from one to $e^{10*(-0.04)}$). Therefore, it is reasonable to conclude that as reading NMSBA scores increase, the chance for enrollment in remediation is reduced according to this model. Table 10 shows the logistic regression analysis of student enrollments for English remedial courses.

Table 10

Logistic Regression Analysis of 7,233 New Mexico Student Enrollments for Reading Remedial Courses

	Block 0				Block 1			
Predictor	B	S.E.	Wald	Exp(B)	B	S.E.	Wald	Exp(B)
Intercept	-0.83	0.03	1061.74	0.43*	22.57	0.70	1043.79*	6.36
Read SBA					-0.04	0.00	1124.05*	0.96
Gender[1]					0.34	0.06	33.08*	1.40

[1]Female=1, Male =0

The English Remediation Model provides significant evidence that student scale scores in reading predict student enrollment in remedial course work in English upon entry to college. Significant Wald statistics together with the odds ratios for reading NMSBA provide the

evidence to this end. The significant gender results add to the understanding of how this prediction varies by female and male NMSBA score by demonstrating that despite similar NMSBA scores, the odds a female will enroll in remediation is greater than their male peers who score similarly on the math NMSBA. This follows the findings in the Math Remediation Model.

Results for Research Question 3 (Any Remediation Model)

Do reading and math scale scores from the eleventh grade NMSBA (while controlling for gender) predict student enrollment in developmental course work in English, math or both upon entry to college? Results for research question three are derived from block one of the Any Remediation Model which used math and reading NMSBA scores as predictors and enrollment in any developmental course as the outcome variable.

According to the block one reading and math NMSBA predictors, the likelihood that a student enrolls for remedial course work is related to his/her NMSBA scores, while controlling for gender. In detail, the probability of a student enrolling for developmental courses was negatively related to his or her NMSBA scores while controlling for gender. Given the same score however; females have greater odds of enrolling in a developmental course than males. The Wald statistic indicates that math scale scores (χ^2 (1, N = 7233) = 670.96, $p < .001$) reading scale scores (χ^2 (1, N = 7233) = 134.92, $p < .001$) and gender (χ^2 (1, N = 7233) = 31.26, $p < .001$) are all significant predictors in the overall model for any remediation. Gender has a positive relationship (Exp(B) = 1.36) with the outcome variable revealing that for females the odds of enrolling in any remediation are 1.4 times greater than for males.

Further, math and reading both have an inverse relationship with the outcome variable indicating that as math (Exp(B) =.96) and reading (Exp(B) =.99) scores increase the likelihood of enrolling in remediation decreases. As was discussed in the previous models, the odds ratios

for NMSBA are nearing one, particularly for reading and could be interpreted as weak, however, the same discussion from the previous models applies here indicating that the findings do not suggest that the coefficients are not meaningful. For each one point increase on the reading and math score, the odds of enrolling for a remedial course decrease from one to .96. So, if the increase on the NMSBA scores is ten points the odds decrease because you raise *e* to the power of the logistic coefficient (from one to $e^{10*(-0.04)}$). Therefore, it is reasonable to conclude that as reading NMSBA scores increase, the chance for enrollment in remediation is reduced according to this model. Table 11 shows the logistic regression analysis of student enrollments for any remedial course (i.e., math and /or English remedial courses). The significant results relating to this research question are bolded in the table.

Table 11

Logistic Regression Analysis of New Mexico Student Enrollments for Math and /or Reading Remedial Courses

	Block 0				Block 1			
Predictor	B	S.E.	Wald	Exp(B)	B	S.E.	Wald	Exp(B)
Intercept	-0.05	0.02	3.90*	0.96	33.43	0.88	1446.11*	3.31
Math SBA					-0.04	0.00	670.96*	0.96
Read SBA					-0.02	0.00	134.92*	0.99
Gender[1]					0.32	0.06	31.26*	1.38

[1]Female=1, Male =0

The Any Remediation Model provides significant evidence that student scale scores in reading and math predict student enrollment in remedial course work upon entry to college. Significant Wald statistics together with the odds ratios for math and reading NMSBA provide the evidence to this end. Again, the significant gender results add to the understanding of how this prediction varies by female and male NMSBA score.

Results for Research Question 4

Is there an interaction between NMSBA and ethnicity on remediation rates while controlling for main effects? Results for research question four are derived from block three of the models with significant interaction effects. This section will report results under the heading for each model.

Any Remediation Model

For the Any Remediation Model ethnicity is a significant predictor (χ^2 (5, N = 7233) = 47.89, $p < .001$) however, the addition of NMSBA/ethnicity interaction did not add significantly to the model (χ^2 (5, N = 7233) = 9.27, $p = .099$). As such, the main effects from block two are reported here. The results reveal differences in ethnicity controlling for NMSBA and gender with significant main effects for Native Americans (χ^2 (1, N = 594) = 40.53, $p < .001$) and Hispanics (χ^2 (1, N = 3566) = 11.79, $p < .001$). In the Any Remediation Model with a one point increase on the NMSBA scale, with reference to Whites, the odds of enrolling in remediation decreases by a factor of 2.0 for Native Americans and 1.2 for Hispanic. That is, the odds of remediation enrollment for Native Americans were two times greater than for Whites and 1.2 times greater for Hispanics. Table 12 shows the logistic regression results of student enrollments for remedial course by ethnicity.

Table 12

Logistic Regression Results from Block 2 of the Any Remediation Model

	Ethnicity	Native American	Hispanic	Black	Asian
B		0.71	0.22	0.26	-0.17
S.E.		0.11	0.06	0.19	0.25
Wald	47.89*	40.53*	11.79*	1.96	0.48
Exp(B)		2.04	1.24	1.30	0.84

Math Remediation Model

In the Math Remediation Model there was a significant math NMSBA and ethnicity interaction (χ^2 (5, N = 7233) = 21.78, p < .001). In order to explore the interaction, each dichotomously coded ethnic category was entered in interaction with math NMSBA scores. There was a significant interaction effect for both Native Americans (χ^2 (1, N = 594) = 16.55, p < .001) and Blacks (χ^2 (1, N = 181) = 5.43, p < .001). These findings reveal that as NMSBA scores increase the odds ratios for these two groups do not decrease as quickly as do the odds ratios for White students. That is, as the scores increase the odds of enrolling in remediation decreases but not at the same rate for Native Americans and Blacks as for Whites. Block three interaction results for the Math Remediation Model are reported in Table 13.

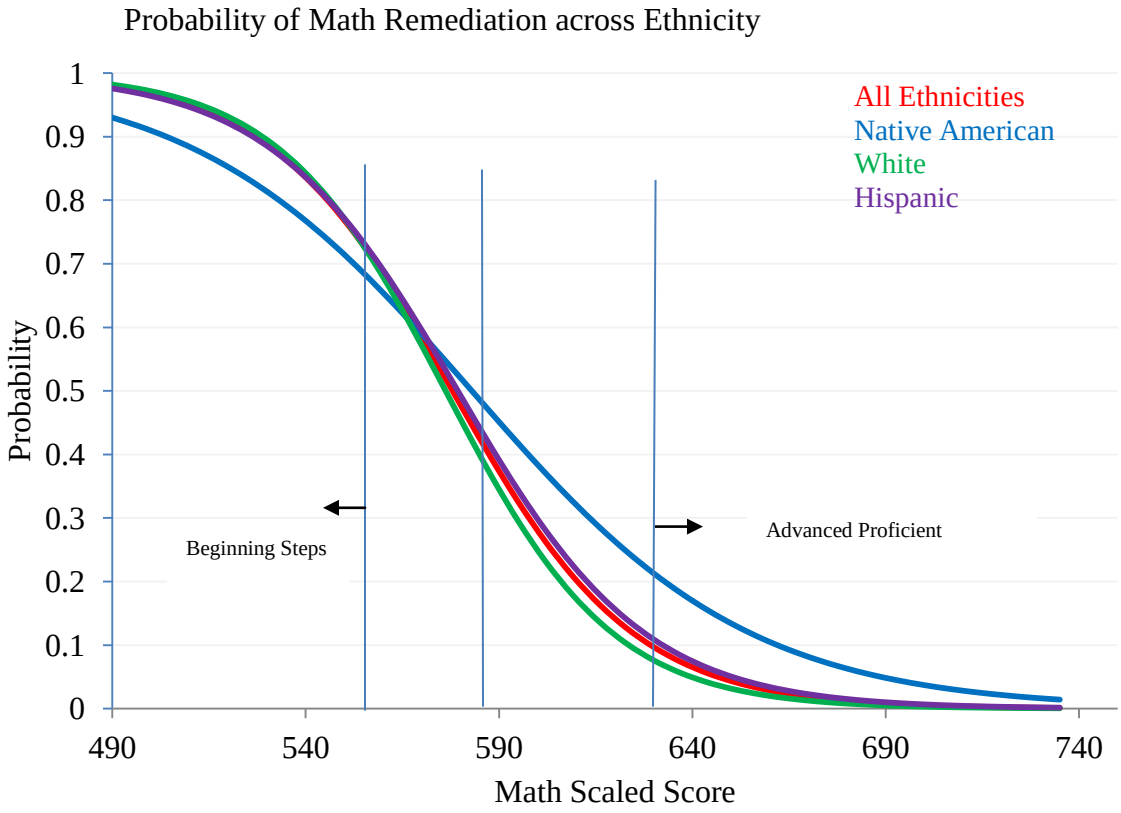
Table 13

Logistic Regression Interaction Results from Block 3 of the Math Remediation Model

	Ethnicity	Native American	Hispanic	Black	Asian
B		0.019	0.005	0.016	-0.004
S.E.		0.01	0.00	0.01	0.01
Wald	19.95*	16.55*	2.65	5.43*	0.12
Exp(B)		1.019	1.005	1.016	0.996

Figures 5 illustrate the probability of math remediation across ethnicity. Note that only the primary ethnic sub groups (Native American, Hispanic, and White) are illustrated separately in the figure. The horizontal axis values represent math scaled scores, and the vertical axis values represent the probability of a student with that score taking at least one remedial math class. The vertical lines represent the proficiency cut scores. Cut scores are selected points on the score scale of the NMSBA used to determine whether a student is sufficiently proficient in the subject.

Figure 5.



Notice how all groups except Native Americans cluster together throughout the slope, even at the point of "Advanced Proficiency". At the lowest scores Native Americans have a decreased probability of remediating compared to all other groups until they near the proficiency cut, at which time the probability of remediation for this group increases compared to all others with the odds not decreasing as quickly for Native Americans as they do for Whites with increased NMSBA scores.

English Remediation Model

In the English Remediation Model there was a significant reading NMSBA and ethnicity interaction (χ^2 (5, N = 7233) = 30.67, p < .001). In order to explore the interaction, each dichotomously coded ethnic category was entered in interaction with reading NMSBA scores. There was a significant interaction effect for both Native Americans (χ^2 (1, N = 594) = 27.608, p

< .001) and Hispanics (χ^2 (1, N = 3566) = 15.351, p < .001). These findings reveal that as NMSBA scores increase the odds ratios for these two groups do not decrease as quickly as do the odds ratios for White students. That is, as the scores increase the odds of enrolling in remediation decreases but not at the same rate for Native Americans and Hispanics as for Whites. Block three interaction results for the English Remediation Model are reported in Table 14.

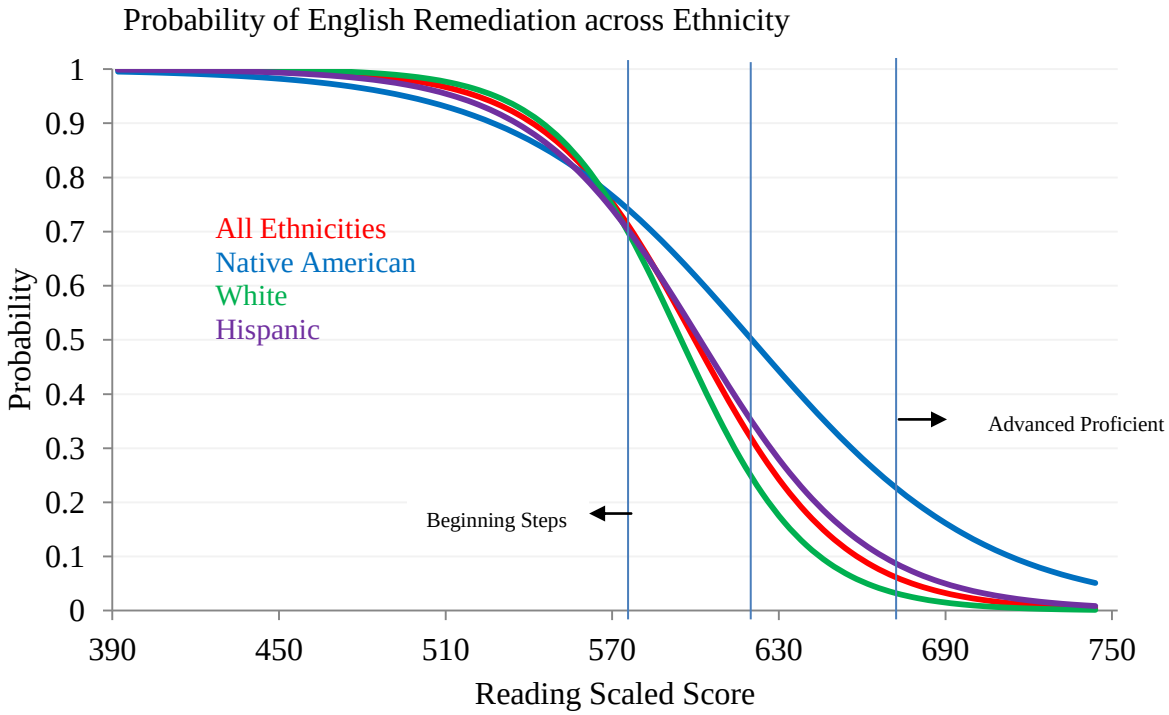
Table 14

Logistic Regression Interaction Results from Block 3 of the English Remediation Model

	Ethnicity	Native American	Hispanic	Black	Asian
B		0.021	0.011	0.003	0.006
S.E.		0.004	0.003	0.008	0.010
Wald	138.78*	27.608*	15.351*	0.198	0.332
Exp(B)		1.021	1.011	1.003	1.006

Figures 6 illustrate the probability of English remediation across ethnicity. Note that only the primary ethnic sub groups (Native American, Hispanic, and White) are illustrated separately in the figure. The horizontal axis values represent reading scaled scores, and the vertical axis values represent the probability of a student with that score taking at least one remedial English class. The vertical lines represent the proficiency cut scores. Cut scores are selected points on the score scale of the NMSBA used to determine whether a student is sufficiently proficient in the subject.

Figure 6.



Notice how Native Americans and Hispanics deviate from Whites throughout the slope and particularly across all proficiency categories. Again, at the lower end of the range of scores, Native Americans have a decreased probability of remediating compared to all other groups. That is until they near the proficiency cut, at which time the probability of remediation for this group increases compared to all others with the odds not decreasing as quickly for Native Americans as they do for Whites with increased NMSBA scores. These images show that a good number of Native American students scoring proficient and advanced proficient on the NMSBA are enrolling in remediation in college while their White peers with similar scores are not.

Results Summary

The specific ethnic groups added to all three models providing evidence that ethnicity matters when determining the potential of the NMSBA to predict student future enrollment in remedial courses. Significant Wald statistics in all three models for Native Americans and

Hispanics, together with the related odds ratios provide the evidence to this end. These results illuminate the predictive capacity of the NMSBA for remedial enrollments the semester following high school graduation but they are by no means conclusive, demonstrating varying predictability by gender and specific ethnic groups. The odds ratio for math and reading NMSBA in every model is nearing one and while the case is made that continuous independent variables tend to be close to one and therefore should not necessarily be interpreted as weak, the association should also not be interpreted as strong. As noted in the report of results for the math and reading models above when you consider that the odds of enrolling in remediation continues to decrease as math and reading NMSBA scores increase by more than one point.

Given that the purpose of this research was to better understand the relationships among New Mexico secondary student scale scores on the eleventh grade NMSBA and subsequent developmental education enrollment, specifically mathematics and English remediation, these results are illuminating. The data show that high school achievement test scores in this sample can predict whether students are likely to enroll in developmental math and/or English. The odds of enrollment, however, deviate by gender and by ethnicity. The results support that the likelihood that a student enrolls for developmental course work is related to his or her NMSBA Math score, NMSBA Reading Score, gender, and ethnicity**.**

Chapter Four

Discussion

Introduction

This chapter begins with a brief overview of the study. Findings and conclusions are presented in the context of the research literature. Recommendations are then proposed to inform policy and practice, and suggestions are made for future research inquiries.

High school students are told regularly about the importance of going to college and they appear to be receiving those signals. In the United States roughly 70% of secondary school graduates go on to college or university the semester following their high school graduation (Hussar et al., 2010). As such, it is antiquated to consider completing high school as entirely separate from entering college. Therefore, the desire for a college education and the right to access is an important academic issue needing more attention. Not every high school graduate is academically prepared for enrollment in a four-year institution despite their expressed intent to enroll. Secondary and postsecondary education institutions are under considerable scrutiny as the heart of P20 policy is increasingly focused on determining the college and career readiness of students. The call to college readiness has generated interest in shoring up the junction between the secondary and postsecondary systems, with an emphasis on understanding the implications of high school assessments for entering freshmen.

The intent of this project was to add to the knowledge about educational outcomes in high school, specifically student standardized assessment outcomes and subsequent enrollment in college remedial courses. This study explored the ability of the NMSBA in high school to predict students' enrollment in remedial math and English in postsecondary institutions in New Mexico. The population for the study was defined as all New Mexico 11th graders who took the NMSBA,

graduated high school and enrolled in a state college or university directly after their high school graduation. The data, derived from archived students records, spanned three years, providing information on high school assessment outcomes and first semester college enrollment, specifically math and English remediation.

In addition to presenting a basic descriptive overview for students, this study captured assessment outcomes data and used it to predict the likelihood of remedial enrollments. These data points were combined and comparisons made between 1) math scores on the NMSBA and math remediation enrollments, 2) reading scores on the NMSBA and English remediation enrollments, 3) reading and math scores on the NMSBA and math or English remediation enrollments, and 4) the interaction between NMSBA and ethnicity on remedial enrollment rates while controlling for main effects.

Remember Miles, the average young man with average grades? The kid who assumed college was the next logical step after high school graduation. The kid who, despite confidence that his high school diploma certified his entrance into collegiate academics, found that he was not as prepared as he thought. Recalling Miles's story reminds us of the importance of identifying meaningful indicators of academic college readiness so the signals students receive about the importance of going to college and the signals they receive about how prepared they are to do so are not disconnected. As was pointed out in the introduction, Miles is not alone. For the many students who require some type of remedial course work when they get to college, the news comes as a discouraging surprise. Others, like Miles, do not understand that they will face placement exams or even what it means to need remediation. Thinking back to the definition of college readiness presented in the opening of this paper, the goal of identifying meaningful

indicators of college readiness is to increase the quality and clarity of signals we send students so as to impact access to and success in college credit-bearing classes.

Since this study investigated first semester remediation enrollment specifically, it is interesting to reiterate what the literature review outlined in this regard. For first-time freshmen in two and four year public institutions, depending on the source, enrollment in at least one remedial course has been as high as 63% and 40% respectively (Olson, 2006). The National Center for Education Statistics (Hussar et al, 2010) estimate is similar, reporting nearly 41% of students take at least one remedial course when they enter college. The trend has been consistently higher in New Mexico. So, how do we know if high school students are on track for college? If we agree that enrolling in remedial education is an indicator of insufficient academic preparation, then the results of this research contribute to our ability to answer that question, and to some degree perhaps predict the college readiness of students. The results however, make it clear that the power of the prediction is not equitable across ethnic groups.

Findings and Conclusions

Results support that as individual student scale scores in math and reading on the NMSBA increase, the likelihood decreases that the same student will enroll in remedial courses their first semester in college. When examined independently, low math NMSBA scores predicted math remedial coursework and low reading NMSBA scale scores predicted English remedial coursework. Interestingly, most everyone who enrolled in math remediation scored below proficient in math on the NMSBA but not everyone who scored below proficient enrolled in remediation. For English remediation, most everyone who scored above proficient in reading in the NMSBA did not enroll in English remediation but unlike math, a number of students who did enroll in remediation scored above proficient. Additionally, results were clear that the

relationship between NMSBA scores and remediation were not the same for males and females nor was it the same for students of different ethnicities, particularly for Native American and Hispanic students.

In this study, the females have greater odds of enrolling in remediation than males. This finding is consistent with other research (e.g. Bailey, 2009; Boroch, Hope, Smith, Gabriner, Mery, Johnstone, & Agera (2010); Boylan, 2002). The number of women enrolling in colleges and universities continues to exceed the number of men, with enrollments among minorities disproportionately favoring women; in 2005, women accounted for 65% of Black enrollments and 59% of Hispanic enrollments (Ryu, 2010). The results of the Community College Research Center's 2008 study for Achieving the Dream found that females, and African American and Hispanic students (in comparison to Caucasians) tended to need more developmental education courses in both reading and English (Bailey, 2009). Bailey, Jeong, & Cho (2010) also reported a greater tendency for women to enroll in remediation with greater odds of progressing through course sequences.

It is unclear from the results of the current study whether females need more remediation than men. The data show higher remediation enrollment for women in the sample but the data cannot tell us anything about need. Women may tend to seek advisory help more than men and perhaps they are more inclined to follow the recommendations of placement. It could also be that women are more likely than men to follow a course sequence according to a plan of study resulting in a greater likelihood to enroll in the first semester than their male peers. The need for further study to better understand the trend is noted in the recommendations section of this chapter.

While results support that as individual student scale scores in math and reading on the NMSBA increase the odds decreases that the same student will enroll in remedial courses their first semester in college, this result was not consistent across ethnic groups. The odds of remediation enrollment generally (Any Remediation Model) were 1.2 times greater for Hispanics and 2.0 times greater for Native Americans than for Whites. When the models given by the logistic regression are viewed graphically by ethnicity it was easy to see that the odds for Native Americans in particular do not go down as quickly with increased scores on the NMSBA as they do for Whites. These ethnic disparities were greatest in the English Remediation Model.

For Native Americans specifically, a sharp deviation from their peers can be seen in the probability of remediating in their first semester, mainly for those scores beyond the proficiency cut score in math and the beginning steps cut score in English. It is particularly striking to see the difference in English remediation between Native American and Whites with advanced proficient scores. With a score of advanced proficient a White student has a 3% probability of enrolling in English remediation while their Native American peers have a 20% probability of enrolling in English remediation. Interestingly, for English, at the lowest scores Native Americans have a decreased probability of remediating compared to all other groups until they near the proficiency cut at which time the probability of remediation for this group increases compared to all others.

One could conceive reasons why Native Americans (and Hispanics) may enroll in English remediation when their peers with similar academic performance do not. For example, if they are from a bilingual home or English is not their first language students and advisors may perceive a benefit from beginning college with the additional support of an English remediation course. On the other hand, a lot is known about the retention and graduation rates of students

who take remediation, so if some Native American students are taking remedial education courses they do not need then policy makers, educators, families and students should be aware of this institutional barrier. This study cannot address why such ethnic discrepancies exist so additional research is need to better understand these findings. A brief look at the current college and career readiness participation data collected in New Mexico reveals lower participation (generally speaking) for American Indians compared to the other ethnic groups (NMPED, 2013).

This study, together with other research highlights that ethnicity is a very important issue. While the literature on ethnicity is vast, situating these finding in the context of other literature is difficult. Very little is known about the use of high school assessments as a predictor of college remediation and even less is known about the experience of Native Americans in this regard. Census data shows a doubling of Native Americans student enrolling in higher education over the past 30 years (USDOE, 2008). Despite this positive trend, Native Americans remain less likely to pursue college compared with other ethnic groups. Generally speaking, there are significant differences in high school graduation rates, college entrance exam scores, and retention and completion rates for Native Americans compared to their White peers (National Center for Education Statistics, 2007). It is difficult, however, to draw conclusions since a number of researchers have pointed to the scarcity of longitudinal research studies on college retention that include an adequate representation of Native Americans (Benjamin, Chambers, & Reiterman, 1993; Falk & Aitken, 1984; Larimore & McClellan, 2005; Pavel & Padilla, 1993). Of those reporting on Native American retention the estimates have been as low as 15% (Astin, 1982; Tierney, 1992; Tijerina & Biemer, 1988).

Research from Guillory and Wolverton (2008) reports college persistence factors such as support from family and faculty, belief in their institutions commitment to their success, and an

active involvement in their home communities as essential to postsecondary success. A recent study built off these findings by adding K-12 variables and perspectives into the work of supporting Native American students (Bosse, Duncan, Gapp, Newland, 2011). Their work discusses the importance of strong academic preparation so that Native American students can avoid remedial work which can slow their progress. Native American students enter into higher education with culturally specific needs and often face institutional barriers. In order to increase the potential for success, educators must be aware of these important issues which impact the success or failure of students.

While the results of this study show greater enrollment in remediation they do not tell us that Hispanics and Native Americans necessarily require remediation at greater rates. There could be potential methodological reasons for these differing rates of remediation. Colleges and universities in New Mexico use a variety of tests for making remediation placement recommendations. Since they are largely recommendations and not placement policies, as such, the role of student choice cannot be overlooked. Figures 1 and 2 illustrate the role of student choice pointing out that many students who score well on the NMSBA still enroll in remediation while many who score below proficient do not.

In addition to placement tests, college freshman and their advisors may also consider other factors when making placement decisions such as SAT and ACT scores. SAT's have been critiqued for perceived ethnic and social class bias. Average national SAT scores have been falling for years with average scores by race, ethnicity, and income varying widely (College Board, 2012). There are important political and educational reasons to better understand these ethnic gaps. The number of colleges making the SAT optional is on the rise because of expressed discomfort with these differences. Considering the widening achievement gap with SAT scores

over time it is conceivable that the NMSBA has ethnic and social biases that should be considered in light of these results.

Recent research on supporting Native American students' transition to college found that high school counselors pointed to the strong connection among adherence to a college-preparatory curriculum and subsequent student success in college when they were asked to describe the value of academic preparation (Bosse, Duncan, Gapp, & Newland, 2011). Unfortunately, children of color have a greater likelihood of attending a school where a majority of the population is poor and for Native American students this is particularly true (Faircloth, 2009; O'Hare & Mather, 2008). In poor and rural schools resources are often shifted to provide remedial instruction and manage discipline issues. Similarly, poor children more often attend low performing schools that offer fewer advanced classes in reading, writing, and math which is exactly the subject matter that the SAT tests for. Even in schools that do offer advanced classes, poor kids may not be guided to take them as often as White students. It is conceivable that there are methodological issues with course taking such that patterns differ between ethnic groups. Indeed, studies have shown that White and Asian student are more likely to take advantage of Advanced Placement courses and dual credit and bridge programs (Radford, Pearson, & Ho, 2011). This contextual information is helpful and it underscores the importance of learning more about the result of this study and its implications on the Native American and other ethnic populations. Particularly considering prior research has so frequently pointed to ethnic disparities among the current indicators used by colleges to assess readiness – classes required for college admission, test scores, and grade point averages.

So, what can be done with this information and who are these results going to help? The results of this research will mean different things to different groups of people. The general

finding that high school assessments have some utility in the college readiness discussion should interest policy makers in the state. These results provided some evidence that the efforts that have been underway for some time in New Mexico to align high school exit requirements with post-secondary entrance requirements are working. This research and continuations of it will add to the ability of law makers to make more and better data driven policy decisions about the future of P20 efforts in the state. Policy makers should however, take caution to apply any policy which could discriminate as more work needs to be done to better understand why the remediation prediction capacity of the NMSBA varies across different ethnic groups.

The results of this study, in terms of the potential of high school assessments to serve as an indicator of college readiness, are in line with the trend in the literature showing that states are increasingly studying high school examinations to scrutinize the degree to which these exams can be used to help educators, parents, and the public at large understand more about student academic outcomes and potential. The results grow the evidence that indicators of college readiness can be developed from existing test data sources. If the NMSBA is in line with standards of college success, and this study provides some evidence that it is, then logic holds that schools that prepare kids to do well on the assessment (particular issues with that aside) are also preparing them to succeed in college. This suggests that in New Mexico, policy makers may not have to worry about choosing between state exam priorities and college readiness priorities.

Limitations and Future Research

Among the strengths of this data set is the noteworthy sample size, particularly considering that the research question is specific to the NMSBA and not to high school assessments generally. Given the size of the data set, there are few concerns about having sufficient power for meaningful analysis. This sample was more than adequate to test the

prediction strength of the NMSBA scale scores. The boundaries of the dataset, however, present limitations of design that impact the application of the results and influence the interpretation of the results of this study. The sample was drawn exclusively from New Mexico colleges and consists of first-time college freshmen only. Consequently, inferences about other segments of the college student population (e.g., returning students) and inferences to other state college systems should be made cautiously in light of the constraints of these data.

Furthermore, these data do not follow students beyond their first semester enrollments. Without additional enrollment data from multiple semesters and associated grade attainment we cannot determine who completes remediation courses and who goes on to enroll in and complete a remediation sequence. Also, retention and graduation rates as they relate to first semester remediation enrollment cannot be analyzed. The results of this study therefore, fall short of telling us anything about NMSBA scores as they relate to successful course completion and student retention and graduation. Given the resources and collaboration required to develop the data set, this limitation could not be overcome in time to add additional semester data prior to commencing this study.

One of the aims of this study is to create a political discussion so that key stakeholders have more information to consider when determining what kinds of change should occur. The recent attention being paid to college readiness by secondary and postsecondary educators and policy maker's calls for deeper investigation of the indicators which could be consider most valuable at predicting college readiness. A lot can be said about how many high school students take remedial courses in college and what types of courses those are. There is an intermediate understanding about what happens to students who take remedial classes but now, as a result of this study, more can be said about the relationship between student performance in high school

and college readiness in New Mexico. For instance, with evidence that higher NMSBA score can predict future enrollment in remediation at the post secondary level we can say that high school redesign efforts in New Mexico aimed at streamlining the college readiness of students is to some degree working. Much, however, remains unknown.

In light of the evidence that ethnic/racial differences in the rates of remediation enrollment exist, there remains the need to better understand these differences. More studies at the secondary and postsecondary levels are needed to uncover the source(s) of these differences. In the secondary system, research should be conducted to better understand the potential for systematic social and ethnic bias of NMSBA. Additionally, analysis of transcript data could point to significant differences in course taking that could reveal another important indicator of college readiness already at our disposal. At the postsecondary level, research to more fully understand how remediation placement decisions are made and how consistent those procedures are across campuses would be prudent.

And of course, collaborative cross system research will be required to answer the vast number of questions that are situated at the juncture between the systems. As the New Mexico Higher Education Department continues to collect the state issued student identification number into its databases the opportunity will exist to conduct similar studies with current data. Additionally, the opportunity to track enrollment beyond the first semester of college would provide valuable information about whether students who score below proficient and do not enroll in remediation ultimately do in a future semester and whether they retain and graduate.

As the potential for cross system analysis expands, a similar design to that applied in this study could be utilized with different populations. Learning about deficiencies in the eleventh grade could arguably be too late to apply timely and effective intervention. With that in mind,

looking at the predictive capacity of eighth grade NMSBA math and reading scores on future remediation enrollment could be very practical though it could take some time for this data to become readily available.

There are other areas that the results of the study imply would be useful for future research. Policy makers are beginning to consider the value of high school assessment scores to inform decisions about the structure of a student's 12 grade year, the selection process for college, and the worth of assessment score to signal to students the importance of doing well in high school. Many other important and related questions remain unanswered. Such as, what can be done in the middle and high school systems to improve the college readiness of students? What can be done within the post-secondary system to ensure that more students succeed in college? How will strengthening the alignment of these educational subsystems impact the number of college freshman taking remedial course? Other important policy considerations include the potential impact of new legislation related to this issue. What are the related costs?

Recommendations

As mentioned in the beginning of this chapter the results of this study mean different things to different people and so it follows that the recommendations resulting from this work will target different audiences. Policy makers, educators, researchers, and families all have a role to play in the growing conversation about college readiness.

With gender and ethnic variation in the results, researchers and administrators at colleges and universities should design studies that reveal if and when these students eventually enroll and if they persist and eventually graduate or transfer. Why does the math proficiency cut score predict better for White students than for their non-White peers? What role does advisement play in enrollment decisions? What role do placement exams and placement decisions play in the

fuller understanding of these disparities? Researchers and administrators should critically examine their remediation testing and placement practices as well as the counseling and advisement patterns to better understand the disproportionate rate of Hispanics and Native Americans enrollments in remediation. Particularly for those who have scored at or above proficient in math and or reading on the NMSBA. Testing and placement policies should be reviewed along with institutional rates of remediation by ethnicity controlling for high school academic performance. Likewise, high schools should review how they discuss NMSBA performance with students. Sharing research outcomes such as those presented here might prove helpful. Likewise, parents and students have to begin asking better questions about what tests mean if they are to get to better answers.

For policy makers and educators there are clear impacts of this research on assessment and instruction in high school and college. Considering the high school redesign legislation currently in place in New Mexico, particularly chapter 22 article 2c calling for a statewide college and workplace readiness assessment system, this research can help educators, researchers, and policy makers to design and adhere to the components of the legislation. Within the existing suite of college and career readiness statistics collected in New Mexico, for example, scale scores and proficiency levels in math and reading could be added. At a minimum this kind of data could be considered as educators use more assessment data to guide and individualize instruction and create next step plans for high school students. This would call for another study utilizing current NMSBA scale scores and college enrollment data to validate this approach to identifying appropriate and useful indictors for college readiness in New Mexico.

Collaboration between high school and college officials will be critical to aligning the systems to facilitate this type of data collection. This will include colleges sharing placement test

results and college performances of their graduates back to the secondary systems. Likewise, high schools will need to look deeper at the variety of indicators for college readiness that exist as well as the clarity of the signals they are sending students about what being college ready means. The importance for high school assessments to be tied to college readiness is underscored by this work. That is, high school completion and college entrance should be better aligned so adequate signals are sent to teachers and student about what is important to teach and learn. The findings from this research add to the evidence that P20 reform efforts in New Mexico have resulted in some degree of alignment. More research to that end is needed.

Asking high schools to be accountable for their graduates' college performance requires that colleges help them develop unambiguous indicators of readiness and clear standards for those indicators. Kolajo (2008) reminds us in her research about moving from developmental education to gradation that the "partnership between high school and college authorities in sharing test results, placement results and college performance of their graduates may help to sensitize the need for review and improvement in both systems." Developing strong articulation agreements and better understanding the business sectors need for skilled workers would also help foster improvement across the whole system.

Other states can offer examples of how coordinating this type of reform systemically across educational levels can improve academic opportunities and chances for success. As mentioned in Chapter 1, many states are working to smooth the transition for students between high school and college. Texas and the six states in the New England region for example, have defined processes for defining college readiness and describing the related standards to key stakeholders (students, parents, educators. In 2008, Maryland also developed a college readiness index with seven key indicators of readiness for their students (Von Secker, 2009). New Mexico

is well on the way to having this kind of information given the College and Career Readiness additions made to the Assessment and Accountability Act. Two-thousand and thirteen is the first year New Mexico is collecting and reporting school, district, and state level college and career readiness participation data. Perhaps there is a place for NMSBA scores in the suite of indicators for college readiness in the state? The next critical step will be articulating the information back to students, families, educators and policy makers so that the clarity and quality of the signals sent about what is important to know and be able to do in order to access and succeed in college credit baring courses is clear to everyone.

Conclusion

The authors of College Readiness for All (Rodrick *et al*, 2009) remind researchers and policy makers the importance of focusing on a set of four essential skills when determining the college readiness of students: content knowledge and basic skills; core academic skills; non-cognitive, or behavioral skills; and "college knowledge," the ability to effectively search for and apply to college. The current study does not address the full breadth and depth of what being college ready really means and as such the research is presented modestly. While this study looked at one important indicator of college readiness the number and combinations of indictors that contribute to a person's readiness for college is seemingly infinite. With that said, no definition of college readiness is absent academic preparedness. The need for indicators of a student's ability to move into credit baring college-level course work is an important part of a fuller understanding. In that regard, I present this work as a contribution of a piece to a larger puzzle and a commitment to quality and timely signals for all the Miles's in New Mexico.

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Appendix A

Logistic Regression Analysis of 7,233 New Mexico Student Enrollments for Math Remedial Courses

	Block 0				Block 1				Block 2				Block 3			
Predictor	B	S.E.	Wald	Exp(B)	B	S.E.	Wald	Exp(B)	B	S.E.	Wald	Exp(B)	B	S.E.	Wald	Exp(B)
Intercept	-0.448	0.02	345.51*	0.639	24.420	0.75	1061.57*	4.032	23.651	0.78	910.03*	1.869	26.352	1.39	387.85*	2.783
Math SBA					-0.043	0.00	1111.30*	0.958	-0.042	0.00	988.80*	0.959	-0.046	0.00	415.80*	0.955
Gender[1]					0.334	0.06	36.47*	1.397	0.329	0.06	35.20*	1.390	0.329	0.06	35.20*	1.390
Ethnicity[2]											19.95*				20.91*	
Native Amer.									0.297	0.10	8.33*	1.346	-10.676	2.69	15.64*	0.000
Hispanic									0.192	0.06	9.69*	1.212	-2.636	1.73	2.33	0.072
Black									-0.089	0.18	0.25	0.914	-9.452	4.01	5.56*	0.000
Asian									-0.254	0.26	0.96	0.775	2.342	7.64	0.09	10.398
Math/Ethnicity															21.78*	
Native Amer.													0.019	0.01	16.55*	1.019
Hispanic													0.005	0.00	2.65	1.005
Black													0.016	0.01	5.43*	1.016
Asian													-0.004	0.01	0.12	0.996

[1]Female=1, Male =0
[2] White is the Reference group

Appendix B

Logistic Regression Analysis of 7,233 New Mexico Student Enrollments for Reading Remedial Courses

	Block 0				Block 1				Block 2				Block 3			
Predictor	B	S.E.	Wald	Exp(B)	B	S.E.	Wald	Exp(B)	B	S.E.	Wald	Exp(B)	B	S.E.	Wald	Exp(B)
Intercept	-0.834	0.03	1061.74	0.434*	22.573	0.70	1043.79*	6.360	20.821	.72	832.99*	1.103	26.354	1.472	320.73*	2.788
Read SBA					-0.038	0.00	1124.05*	0.963	-0.036	0.00	956.98*	0.965	-0.045	0.002	356.45*	0.956
Gender[1]					0.337	0.06	33.08*	1.401	0.283	0.06	22.78*	1.328	0.290	0.059	23.842*	1.336
Ethnicity[2]											138.78*				25.685*	
Native Amer.									1.151	0.11	116.30*	3.162	-11.793	2.462	22.945*	0
Hispanic									0.523	0.068	59.73*	1.687	-6.280	1.734	13.119*	0.002
Black									0.578	0.182	10.12*	1.782	-1.604	4.774	0.113	0.201
Asian									-0.429	0.293	2.15	0.651	-4.126	6.280	0.432	0.016
Read /Ethnicity															30.669*	
Native Amer.													0.021	0.004	27.608*	1.021
Hispanic													0.011	0.003	15.351*	1.011
Black													0.003	0.008	0.198	1.003
Asian													0.006	0.010	0.332	1.006

Appendix C

Logistic Regression Analysis of New Mexico Student Enrollments for Math and /or Reading Remedial Courses

	Block 0				Block 1				Block 2				Block 3			
Predictor	B	S.E.	Wald	Exp(B)	B	S.E.	Wald	Exp(B)	B	S.E.	Wald	Exp(B)	B	S.E.	Wald	Exp(B)
Intercept	-0.05	0.02	3.90*	0.955	33.433	0.88	1446.11*	3.309	32.275	.915	1243.99*	1.039	33.572	1.53	484.77*	3.803
Math SBA					-0.041	0.00	670.96*	0.959	-0.040	0.00	617.78*	0.961	-0.044	0.00	278.52*	0.957
Reading SBA					-0.015	0.00	134.92*	0.985	-0.014	0.00	122.85*	0.986	-0.012	0.00	31.47*	0.988
Gender[1]					0.321	0.06	31.26*	1.381	0.308	0.06	28.13*	1.360	0.309	0.06	28.17*	1.362
Ethnicity [2]											47.89*				11.25*	
Native Amer.									0.711	0.11	40.53*	2.035	-9.871	3.20	9.55*	0.000
Hispanic									0.215	0.06	11.79*	1.240	-0.589	1.20	0.09	0.555
Black									0.263	0.19	1.96	1.301	-2.001	5.37	0.14	0.135
Asian									-0.170	0.25	0.48	0.844	0.918	7.92	0.01	2.504
Math/Ethnicity															9.27	
Native Amer.													0.016	0.00	6.70*	1.016
Hispanic													0.005	0.00	1.80	1.005
Black													0.015	0.01	2.27	1.015
Asian													0.004	0.01	0.11	1.004
Reading/Ethnicity															3.41	
Native Amer.													0.002	0.00	0.18	1.002
Hispanic													-0.003	0.00	1.30	0.997
Black													-0.010	0.00	1.28	0.990
Asian													-0.006	0.00	0.360	0.994

[1]Female=1, Male =0
[2] White is the Reference group

Appendix D

ANOVA's

New Mexico Standards Based Assessments scores might contribute to enrollment in remedial education but that effect might differ across gender and ethnic groups. Two-factor analyses of variance (ANOVA) followed by Cohen's d, eta squared, and simple effects analyses for significant interactions were computed for gender and ethnicity on reading and math scale scores to see if the mean differences were statistically significant. Table 1 displays all means for gender.

Table 1

Mean Scale Score for English and Math by Remedial and Non-Remedial Students for Gender

		English		Math	
Gender		N	Mean(*SD*)	N	Mean(*SD*)
Female	Remedial	1295	607.9(*26.5*)	1774	575.6(*18.5*)
	Non-remedial	2762	639.7(*28.7*)	2283	599.0(*27.3*)
	All Females	4057	629.6(31.7)	4057	588.8(26.5)
Male	Remedial	895	605.1(*27.7*)	1045	576.4(*20.6)*
	Non-remedial	2281	634.4(*29.1*)	2130	605.2(*31.2*)
	All Males	3175	626.2(31.6)	3175	595.7(31.2)
Total	Remedial	2190	606.8(27.1)	2819	575.9(19.3)
	Non-remedial	5043	637.3(29.0)	4413	602.0(29.4)
	All	7233	628.1(31.7)	7233	591.8(28.9)

Table 2 displays all means for Hispanic, Native American, and White ethnicity groups.

Table 2

Mean Scale Score for English and Math by Remedial and Non-Remedial Students for Ethnicity

		English		Math	
Ethnicity		N	Mean(*SD*)	N	Mean(*SD*)
Hispanic	Remedial	1311	604.6(*26.8*)	1645	573.0(*17.9*)
	Non-remedial	2256	630.7(*28.5*)	1922	593.8(*27.0*)
	All Hispanics	3567	621.1(30.6)	3567	584.2(25.4)
Native American	Remedial	308	607.6(*28.9*)	297	575.2(*18.2*)
	Non-remedial	286	627.8(*30.5*)	297	589.8(*27.3*)
	All Native Americans	594	617.3(31.3)	594	582.5(24.3)
White	Remedial	482	612.7(*25.9*)	773	582.8(*20.4*)
	Non-remedial	2278	644.9(*27.0*)	1987	611.5(*28.3*)
	All Whites	2760	639.3(29.5)	2760	603.4(29.3)
Total	Remedial	2101	606.9(27.1)	2715	576.1(19.1)
	Non-remedial	4820	637.2(28.8)	4206	601.9(29.1)
	All	6921	628.0(31.6)	6921	591.7(28.6)

Two-way ANOVA's were conducted. The first examined the effect of gender and English remediation on NMSBA reading scores. There was a significant main effect of gender ($F(1,7230) = 30.274$, $p < .001$, d=0.1033) with females outscoring males, and English remediation ($F(1,7230) = 1726.189$, $p < .001$) with those who had no remedial courses outscoring those who did, at the $\alpha = .05$ level. There was no statistically significant interaction of the two variables ($F(1,7230) = 2.805$, $p = .094$).

The second ANOVA examined the effects of ethnicity and English remediation on NMSBA reading scores. There was a significant main effect of ethnicity ($F(2,6921) = 92.369$,

$p < .001$) with different ethnic groups scoring differently, and English Remediation ($F(1,6921) = 771.153$, $p < .001$) with those who had no remedial courses outscoring those who did, at the $\alpha = .05$ level. There was also a significant interaction effect with ethnicity and English remediation ($F(2,6921) = 11.914$, $p < .001$).

Because statistically significant interaction results were found, simple effects tests were performed and were followed-up, when warranted with Tukey's multiple comparisons. The simple effects analyses examined whether students' reading scores of a specific ethnicity who took remedial coursework differed from those of the same ethnicity who did not take remedial coursework, whether the reading scores of students who took remedial coursework differed also by the student's ethnicity, and whether the reading scores of students who did not take remedial coursework differed also by student's ethnicity. The analyses showed that students' reading scores of a specific ethnicity who took remedial coursework differed from those of the same ethnicity who did not take remedial coursework *(*$F(2,6915) = 15.444$, $p < .001$, $\eta^2 = .004$). The reading scores of students who took remedial coursework also differed by the student's ethnicity (White, $F(1,6915) = 539.945$, $p < .001$, $\eta^2 = .072$; Hispanic, $F(1,6915) = 741.616$, $p < .001$, $\eta^2 = .097$; Native American, $F(1,6915) = 78.978$, $p < .001$, $\eta^2 = .011$). The reading scores of students who did not take remedial coursework differed also by student's ethnicity *(*$F(2,6915) = 167.633$, $p < .001$, $\eta^2 = .046$).

When there were no remediation enrollments, all ethnic groups differ significantly from one another. That is, the mean reading scale score in the non-remedial category for Whites was significantly different from Hispanics and Native Americans while Native Americans and Hispanics differed significantly from one another. When there were remedial enrollments, Hispanics and Native Americans differ significantly from Whites but not from one another. In

Figure 1 the main effects are highlighted among the lines illuminating the ethnic category differences within remedial and non-remedial course takers.

Figure 1.

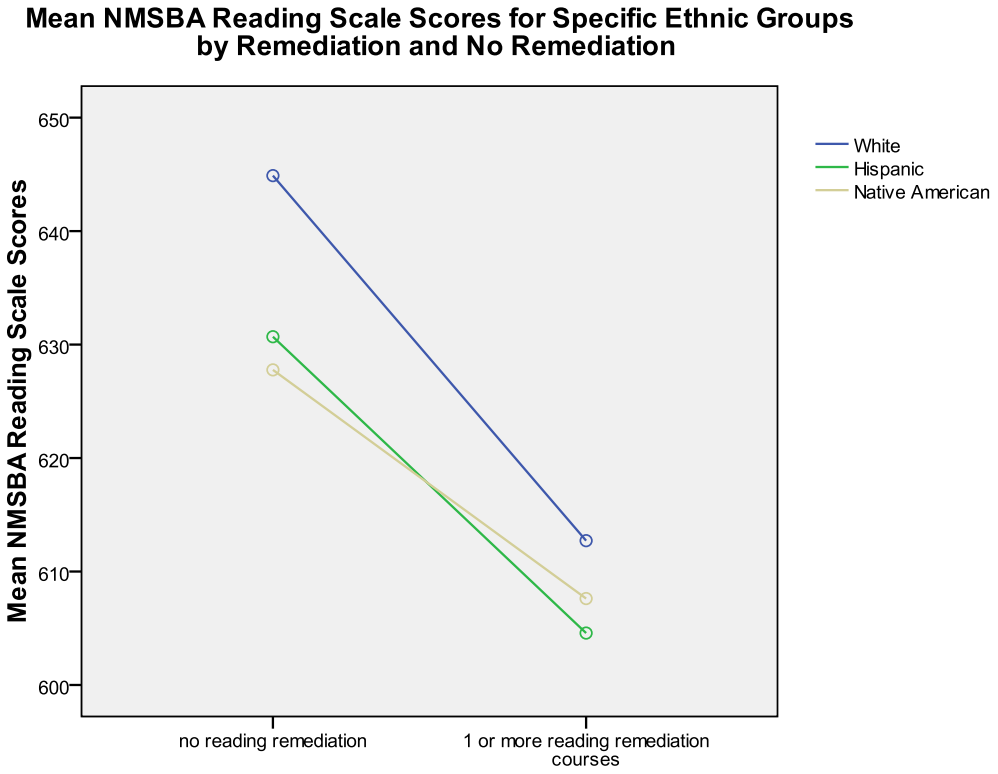
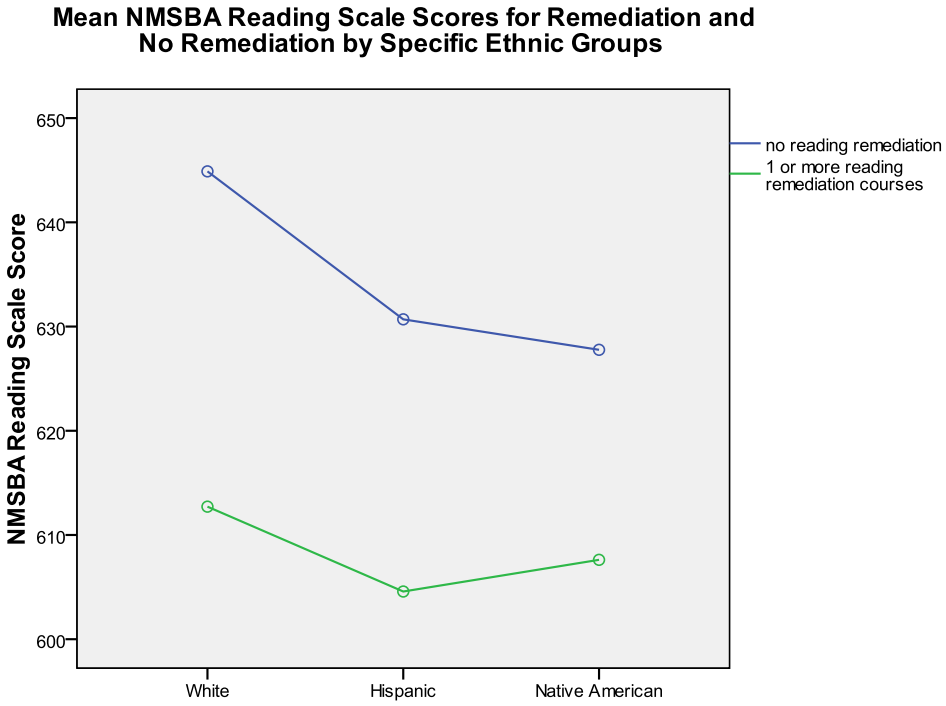


Figure 2 displays the differences between remediation and non remediation for each ethnic group. So, while Whites have significantly higher average scores among those who enroll in remediation and those who do not, within each ethnic group, the difference in mean scale score between those who enroll and those who do not, was significant, as would be expected.

Figure 2.



The third ANOVA examined the effect of gender and math remediation on NMSBA math scores. There was a significant main effect of gender ($F(1,7230) = 29.615$, $p < .001$, $d = -0.0409$, $\eta^2 = .004$) with males outscoring females, and math remediation ($F(1,7230) = 1679.158$, $p < .001$, $\eta^2 = .189$) with those who had no remedial courses outscoring those who did, at the $\alpha = .05$ level. There was also a significant interaction for gender and math ($F(1,7230) = 17.799$, $p < .001$, $\eta^2 = .002$).

Because statistically significant interaction results were found, simple effects tests were performed. The analyses examined whether students' math scores of a specific gender who took remedial coursework differed from those of the same gender who did not take remedial coursework, whether the math scores of students who took remedial coursework differed also by the student's gender, and whether the math scores of students who did not take remedial

coursework differed also by student's gender. The analyses showed that students' math scores who took remedial coursework differed from those of the same gender who did not take remedial coursework *(F*(2,7228) = .597, *p* = .440, η^2 = .000). The math scores of students who took remedial coursework also differed by the student's gender (male, *F*(1,7228) = 869.307, *p* < .001, η^2 = .107; female, *F*(1,7228) = 818.819, p < .001, η^2 = .102). The math scores of students who did not take remedial coursework differed also by student's gender *(F*(1,7228) = 62.429, *p* < .001, η^2 = .009).

In Figure 3 the main effects are highlighted among the lines illuminating the gender differences within remedial and non-remedial course takers. So, while males have significantly higher average scores among those who do not enroll in remediation, within each gender, the difference in mean scale score between those who enroll and those who do not was significant. *Figure 3.*

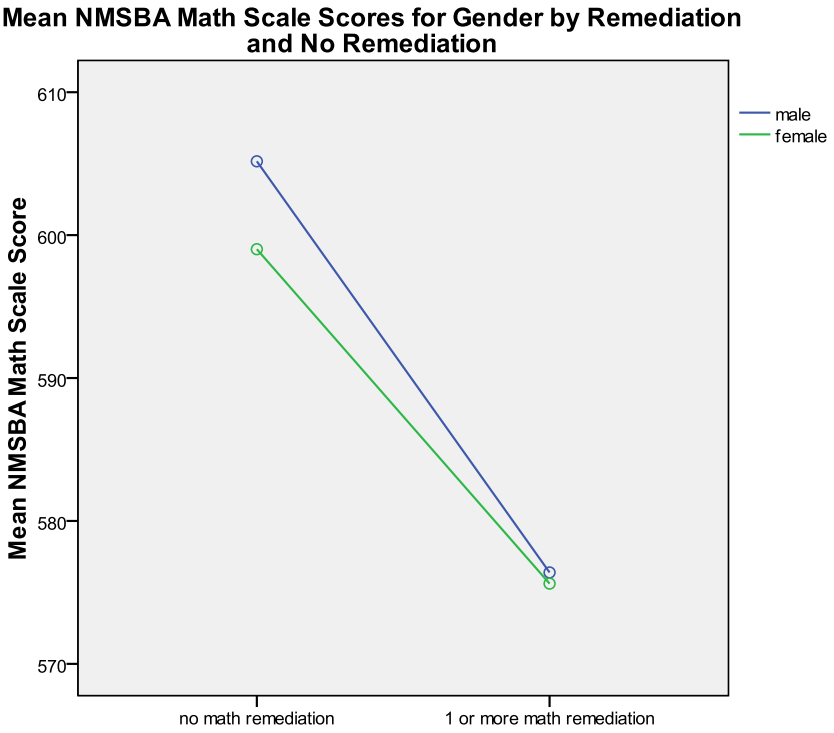
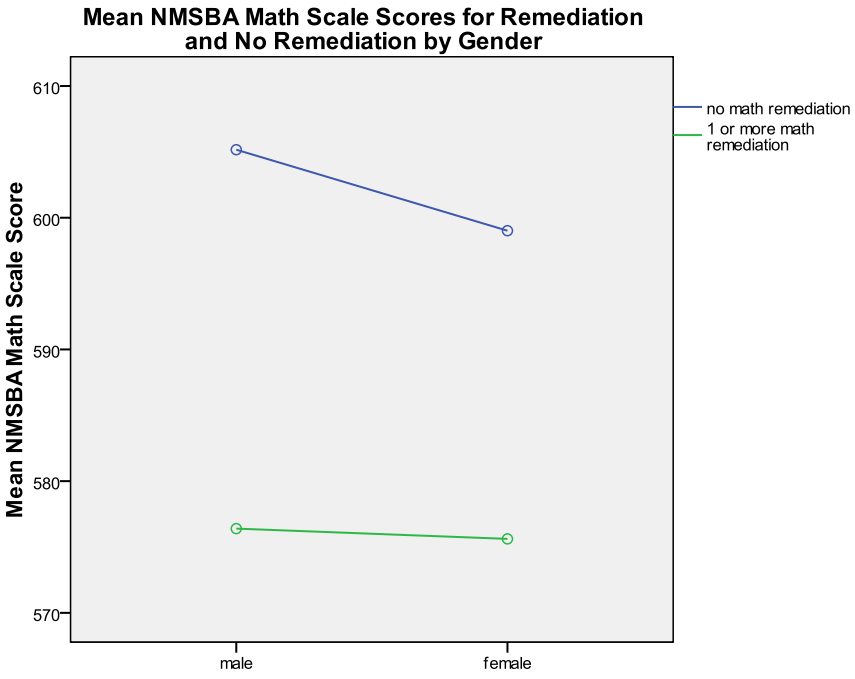


Figure 4 displays the differences between remediation and non remediation for males and females. So, there is a significant difference in the mean score between remedial math enrollment and no remedial math enrollment for males as well as for females, as expected.

Figure 4.



The last ANOVA examined the effects of ethnicity and math remediation on NMSBA math scores. There was a significant main effect of ethnicity ($F(2,6921) = 231.767$, $p < .001$, $\eta^2 = .063$) with different ethnic groups outscoring one another, and math remediation ($F(1,7230) = 706.311$, $p < .001$, $\eta^2 = .093$) with those who had no remedial courses outscoring those who did at the $\alpha = .05$ level. There was also a significant interaction effect for ethnicity and math ($F(2,6921) = 27.557$, $p < .001$, $\eta^2 = .008$) indicating that there was a difference in remediation depending on the ethnic group.

Because statistically significant interaction results were found, simple effects tests were performed and were followed-up, when warranted with Tukey's multiple comparisons. The

simple effects analyses examined whether students' math scores of a specific ethnicity who took remedial coursework differed from those of the same ethnicity who did not take remedial coursework, whether the math scores of students who took remedial coursework differed also by the student's ethnicity, and whether the math scores of students who did not take remedial coursework differed also by student's ethnicity. The analyses showed that students' math scores of a specific ethnicity who took remedial coursework differed from those of the same ethnicity who did not take remedial coursework *(F*(2,6915) = 41.888, $p < .001$, $\eta^2 = .012$). The math scores of students who took remedial coursework also differed by the student's ethnicity (White, *F*(1,6915) = 763.121, $p < .001$, $\eta^2 = .099$; Hispanic, *F*(1,6915) = 636.338, $p < .001$, $\eta^2 = .084$; Native American, *F*(1,6915) = 52.335, $p < .001$, $\eta^2 = .008$). The math scores of students who did not take remedial coursework differed also by student's ethnicity *(F*(2,6915) = 293.535, $p < .001$, $\eta^2 = .078$).

When there were no remediation enrollments, all ethnic groups differ significantly from one another. That is, the mean math scale score in the non-remedial category for Whites was significantly different from Hispanics and Native Americans and Native Americans and Hispanics differed significantly from one another. When there were remedial enrollments, Hispanics and Native Americans differ significantly from Whites but not from one another. In Figures 5 the main effects are highlighted among the lines illuminating the ethnic category differences within remedial and non-remedial course takers.

Figure 5.

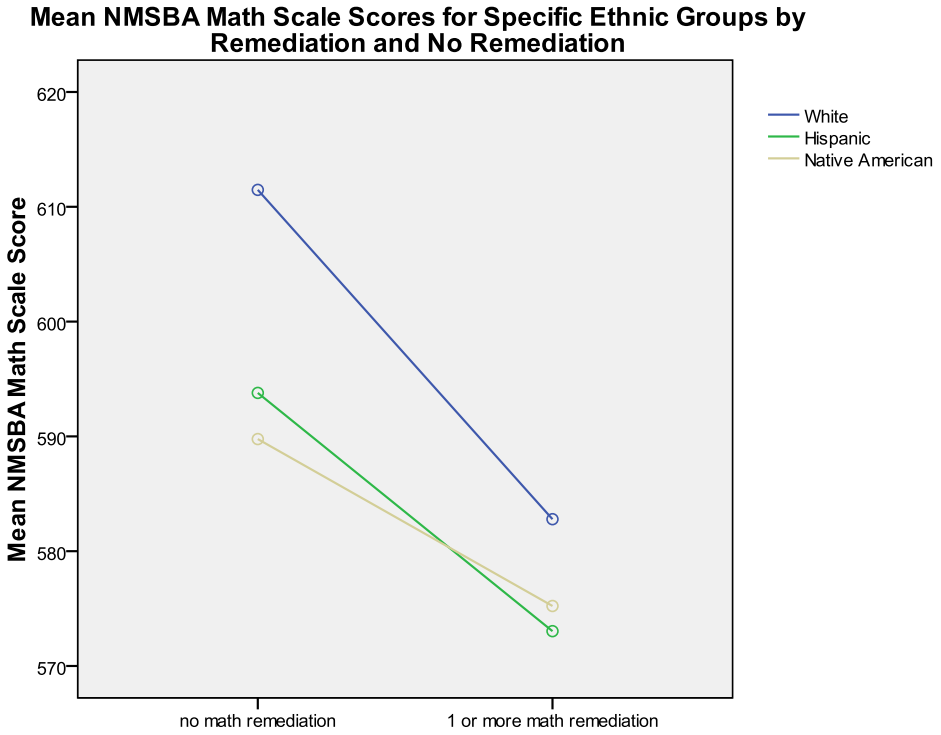
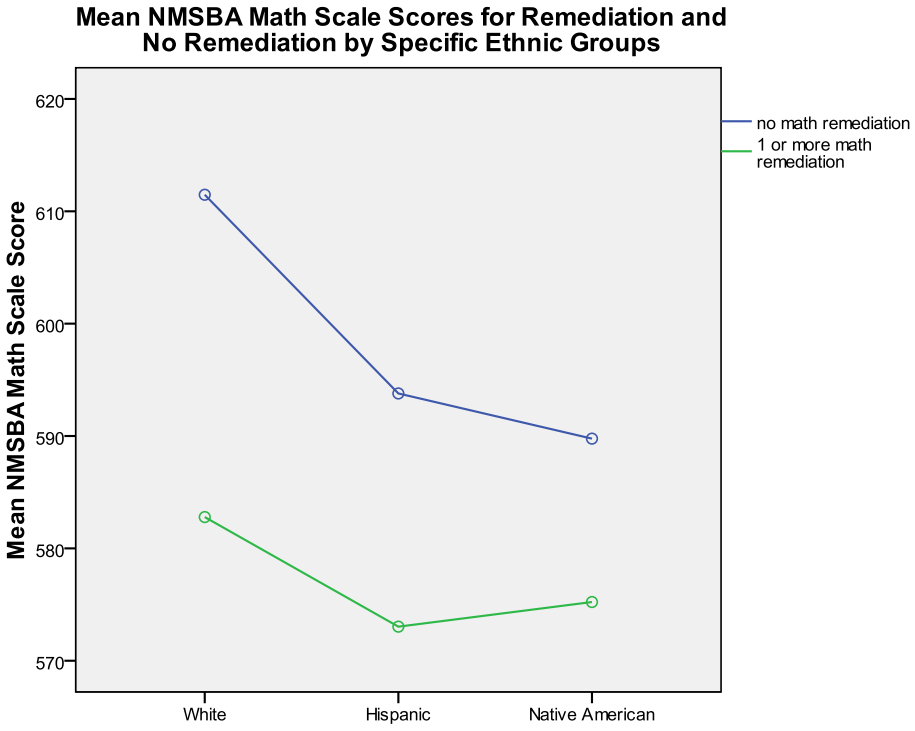


Figure 6 displays the differences between remediation and non remediation for each ethnic group. So, while Whites have significantly higher average scores among those who enroll in remediation and those who do not, within each ethnic group, the difference in mean scale score between those who enroll and those who do not, was significant, as expected.

Figure 6.



It is clear that the main effects in this analysis are alone incomplete. There are important interaction effects to consider in light of these data. We see from these analyses that there are differences in remediation depending on gender and specific ethnic groups. That is, the effect of English remediation changes depending on ethnicity while the effect of math remediation changes depending on gender and ethnicity.