Meritocracy of Middle School Mathematics Placement

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Abstract

Eric Sparks: Meritocracy of Middle School Mathematics Placement
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This study measured the impact of race and gender on merit in placement in the advanced mathematics track at the beginning of 6th grade and is a middle school replication of Stone’s (1995) research on high school math placement. The placement process was meritocratic if neither race nor gender nor their combination impacted student placement in the advanced track.

The sample for this study included 51,413 9th grade students in 2010-11 from across the state of North Carolina who had a 70% or better projection for success in algebra I in 8th grade as they entered 6th grade in 2007-08. Success was defined as scoring level III or IV on the North Carolina End of Course test. A logistic regression model was used to analyze the data.

Data analysis revealed that, after controlling for prior achievement, race was a significant factor. Asian, Black, Hispanic and Multi-Racial students had greater odds of being placed in the advanced track than White students, while American Indian students had lesser odds compared to White students. In addition, gender was also a significant factor in the placement of students in the advanced track in middle school, with the odds of female students being placed in the advanced track greater than for male students. Therefore, the mathematics placement process was not based on merit alone.
The findings of this study complicate previous literature that suggests minority students have less access to rigorous curriculum in schools. An additional logistic regression was completed without controlling for prior achievement, demonstrating that odds of all races other than Asian being placed in the advanced mathematics track in middle school were lower than for White students. These results together suggest meritocracy does not exist in mathematics placement, with demographic factors such as race and gender influencing placement in varied ways.

Recommendations for education leaders include a need to understand issues related to meritocratic fairness in the mathematics placement process and to actively work to eliminate achievement gaps that impact preparation for rigorous opportunities for students.
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CHAPTER 1

Introduction

Academic tracking, the educational practice of categorizing students by curriculum rigor, educational and career aspirations, and/or ability levels, is a highly controversial topic in American schools (McGrath & Kuriloff, 1999a). While tracking appears to be a simple and logical manner of structuring course offerings within a school to meet the varied educational needs of students, the topic of tracking has been linked to challenging discussions of equity and access for all students (Akos, Lambie, Milsom, & Gilbert, 2007a). These discussions can place educational leaders in challenging situations, requiring them to take on societal issues such as culture and gender equity as well as difficult political situations with district leaders, parents, and school staff. As tracking is nearly universal in schools in the U.S., tracking is a reality that should be understood and well planned, especially in the transition to middle school (Akos, Lambie, Milsom, & Gilbert, 2007a; Callahan, 2005).

Tracking most often affects coursework in English and mathematics, but in some schools, sciences, social studies, world languages and career and technical courses are tracked as well (Hallinan, 2000; Heck, Price, & Thomas, 2004) (Hallinan, 2000; Heck, Price, & Thomas, 2004). Particularly in middle schools, tracking in these latter courses may be unintentional and often occurs when students are limited by scheduling options, as availability of one subject area is dictated by
the track assignment of another. For example, in McGrath and Kuriloff (1999a), an assistant superintendent reported that mathematics tracking in middle school creates groups that travel together throughout the day, so top mathematics students travel together to other courses even though the other courses were not tracked. In this school, as in many schools, other educational opportunities are dictated by the student’s track in mathematics. For example, language arts may be taught three periods of the day, so a group of 30 advanced mathematics students grouped for mathematics abilities would only have two other possible options for language arts during the school day. If another course or elective conflicts with one of the language arts courses, this group of students may only have one class period where language arts can be scheduled. It is likely that these students will travel together to language arts class, thus creating de facto tracking for a course that was designed for heterogeneous grouping. To further understand the influence of mathematics tracking, it is important to note that in many middle schools, mathematics may be the only subject with formal tracks (McGrath & Kuriloff, 1999a).

**Statement of the Problem**

Academic tracking in middle school is a complex issue that has a direct impact on immediate student success as well as the opportunities a student may access in high school, post-secondary schools, and in their career (Callahan, 2005). If factors such as race or gender impact the placement of students in middle school mathematics courses, then the mathematics placement process is not based on student merit and access to rigorous curriculum in mathematics may be unfairly
denied to students based on factors other than academic achievement (Southworth & Mickelson, 2007).

Tracking in middle school frequently occurs in mathematics (Callahan, 2005). For example, in the Wake County Public School System (NC), 5th grade students preparing for the transition to middle school have only one option for coursework in language arts, science, social studies, and healthful living. However, these students have two options in mathematics: 6th grade mathematics or advanced 6th grade mathematics (Wake County Public School System, 2009).

Research shows that tracking often dictates the type of post-secondary options available to students, and the decisions made about student tracking in the transition to middle school become increasingly important for every student’s future (Gamoran, 2009; Mayer, 2008). For example, career and technical education tracks are often designed to prepare students for jobs that require only a high school diploma and possibly some additional training. These tracks tend to have less demanding coursework than other academic tracks, and a student who participates in this track may have fewer or lower-income career options than a student in an advanced academic track (Akos et al., 2007a).

The sequence of mathematics that is taken in middle school essentially determines what track options students will have in high school (ACT, 2005). For example, if a student is enrolled in the advanced mathematics track in middle school, which allows him or her to complete algebra I before 9th grade, the student will have fewer courses to complete in order to qualify for the North Carolina College/University Course of Study and more time to take rigorous mathematics
courses such as Advanced Placement Calculus (North Carolina Department of Public Instruction, 2009). If a student enters high school in the low mathematics track and does not complete algebra until 10th grade, the student would only have two years to complete geometry, algebra II, and an additional advanced mathematics course to qualify for the College/University Course of Study.

In many cases, students entering high school in the low mathematics track will only have the option of the Career Prep Course of Study diploma, based on the number of mathematics courses that must be completed each year (Holly Springs High School, 2009). Students in the high mathematics track in middle school most often have the option of completing any course of study, where students in the low mathematics track most often have only one option. As a result, students in the high mathematics track are most often prepared for college entry, where the post-secondary graduation options for students in the low mathematics track are further limited. It is important to note that the NC State Board of Education has approved a new set of graduation requirements, the Future-Ready Core Course of Study, which requires all students to complete the equivalent mathematics of the College/University Course of Study. These new requirements are effective with students entering ninth grade in 2009-10 (North Carolina Department of Public Instruction, n.d.b)

**Research Question**

The purpose of this study was to investigate if gender and race impacted the placement of students who were predicted to be successful in the advanced mathematics track, by examining the variables of race and gender. The study is a
middle school replication of Stone’s (1995) research on high school math placement which found that admission of students into gateway courses in high school did not meet a meritocratic definition of fairness based on gender, socioeconomic status, school assignment and the combination of the three. However, race was not a significant factor.

The software system used to identify the sample was the Education Value Added Assessment System (EVAAS). Developed by SAS Institute, Inc. (SAS), EVAAS is a customized software system that provides diagnostic reports to districts and school staff that predict student success and reveal patterns in subgroup performance. Through an agreement with the North Carolina Department of Public Instruction (NCDPI), SAS provides access to EVAAS for all public schools in North Carolina (North Carolina Department of Public Instruction, 2010).

The research question studied was:

Were 6th grade students predicted to be successful in algebra I placed in the advanced mathematics track in middle school without regard to race, gender or any interaction between race and gender after controlling for academic achievement?

Overview of Methodology

This study involved reviewing the academic records of all 9th grade students in North Carolina in 2010-11 to determine which students had an EVAAS projection of 70% or greater probability of success in algebra I at the beginning of the 6th grade in 2007-08. The 6th grade EVAAS prediction was calculated with the EOG scores from all subject areas in 3rd through 5th grades. The EVAAS projection methodology
provides an estimate of a student’s academic achievement level at a selected point in the future based on the assumption that the student will have an average school experience. For students who had an EVAAS projection of 70% or better, the researcher then determined the mathematics course taken as 8th graders in 2009-10. Students who took the highest mathematics sequence would have completed algebra I as 8th graders.

The study employed descriptive statistics as a first level of analysis, including race and gender of the students with a 70% or better projection of success in algebra I. For a secondary level of analysis, logistic regression was used. Logistic regression was chosen as the method of analysis as it provided the ability to compute the probability of which variables influenced the likelihood of a student being placed in the advanced mathematics track, ending with algebra I in 8th grade. Logistic regression also allowed the researcher to examine the degree to which the variables of race and gender predicted mathematics placement through the calculation of an odds ratio of being placed in the advanced mathematics track.

Definition of Terms

- Meritocracy: The idea that merit and individual effort, rather than one’s family or social background (including race, gender, class and legacy), determine one’s success, one’s social and economic position (Young, 1994).

- EVAAS: Education Value Added Assessment System is billed as “the most comprehensive reporting package of value-added metrics available in the educational market” (SAS Institute, Inc., 2010). The system was created to assist states in measuring student achievement and was prompted largely by
authorization of the *No Child Left Behind Act of 2001* (NCLB) (Amrein-Beardsley, 2008). Value-added systems analyze gains, growths in scores, or the amount of knowledge added each year. In theory, value-added methodologies create a richer analysis of test score data, following students and assessing their learning trajectories as they progress through different classrooms and schools (Amrein-Beardsley, 2008; Goldhaber & Hansen, 2010; Sanders, Wright, Rivers, & Leandro, 2009). For the purpose of this study, the projection analysis report was used for data analysis.

- **EVAAS projection:** EVAAS projection analysis predicts scores for elementary and middle school students three years in the future, allowing states, districts or schools to determine if students are on track to meet proficiency standards in the near future (Government Accountability Office, 2006). The projection is based solely on the student’s entire test score history and is not based on student characteristics such as race, gender or socio-economic status. The student must have at least three scores before a projection is made, and the projections are based on the assumption that the students will receive an average schooling experience throughout the period of the prediction (Ballou, Sanders, & Wright, 2004; Wright, White, Sanders, & Rivers, 2010). Thirteen states have been approved by the US Department of Education to use this growth model as a part of their accountability efforts in reporting for the *No Child Left Behind Act*. Four US Department of Education peer review committees have approved the reliability of the SAS projection model (U.S. Department of Education, 2009).
Limitations

This study has several limitations. First, merit was defined by academic ability as measured by test scores alone. The EVAAS projections were created using previous test scores for students and did not include any additional information. While a student must have a minimum of three test scores in order for a projection to be created, this definition of academic ability was narrowly defined. Other factors, such as classroom performance and student motivation, were not considered in the EVAAS projection.

Second, the design of this study defined placement in the advanced track by the existence of an algebra I EOC score by the end of 8th grade. By using these data as the determining factor for placement, it is possible that a student could have been placed in the advanced track in 6th grade but moved into the lower track at some point between 6th and 8th grade. While the use of the EOC may not be the ideal indicator for placement in the advanced track, it was considered the best and most efficient method for determining placement in the advanced track as schools do not always use a specific course code for the advanced track, and all students in the regular and advanced track take the same 6th and 7th grade EOG.

A third limitation is that factors other than race and gender may impact placement in the advanced track. As research indicates, socioeconomic status has been found to impact student placement, but these data were not available for this study. In addition, other factors including but not limited to motivation, parent advocacy, and school or district resources could also impact placement in the advanced track.
CHAPTER 2

Review of Literature

Meritocracy is a belief that is embedded in the American Dream. The idea that individual hard work and achievement leads to success and opportunity is essential to the dominant discourse of the American Dream that often goes unchallenged in the United States (McGinnis, 2009). If public schools are committed to fostering a society that nurtures and reinforces the American Dream, education leaders must adopt policies and practices that reflect that philosophy (Pappas & Tremblay, 2010).

Tracking is a practice that is firmly rooted in secondary schools in the U.S. (Callahan, 2005). The following review of literature will discuss how tracking has become incorporated in secondary schools throughout the U.S and how race and gender impact tracking. If merit is the criteria for placement and race and gender have no impact on tracking, a meritocracy exists.

Meritocracy and Tracking

The main focus of this inquiry is the meritocracy of tracking by academic ability levels. Callahan (2005) describes the theory behind tracking for ability level as the belief that low-performing students must be separated from other students and taught a simplified curriculum, allowing high-performing students to move ahead without being held back by their lower-performing peers. Remedial curriculum and
instruction is then delivered to low-performing students in order to bring them up to par with their peers.

Meritocracy also applies to the equity with which students are assigned to mathematics tracks. While the theory behind tracking is that students are sorted by ability level to support academic achievement, in application, little evidence supports the claim that tracking or grouping by ability level produces higher academic achievement than heterogeneous grouping (Biafora & Ansalone, 2008; Gamoran, 2009). In the few cases that support tracking, researchers reported that students of all performance levels were hindered when placed in heterogeneous classes and that tracking produced a significant decline in performance of at-risk students in the lowest quartile (Schweiker-Marra & Pula, 2005). Argys, Rees, and Brewer (1996) also reported that high-achieving students experienced slower gains in heterogenous classes.

However, other studies showed little effect from ability grouping in middle school mathematics and science, revealing that tracking does not substantially benefit high achievers but places low achievers at a disadvantage (Darling-Hammond, 2004; Hoffner, 1992). Burris, Heubert, and Levin (2006) found low-track classes and tracking in general to be ineffective, and Calahan (2005) reported that low-track placement often resulted in students receiving a less rigorous curriculum and access to fewer course offerings than students in a high-track placement. The result is that low-track students fall further behind.

History of Tracking
Tracking has not always been a part of the American educational experience. Mayer (2008) recounted how, as a result of an increase in population during the industrialization period between 1890 and 1940, schools moved from one-room school houses to organizations that sorted students to accommodate the increased numbers - particularly the increase in immigrant students. As administrators have earnestly attempted to accommodate all students regardless of background and ability level, tracking has become a long-standing organizational practice in U.S. schools (Abu El-Haj & Rubin, 2009; Mayer 2008).

The merits of tracking have been widely debated in education. Abu El-Haj and Rubin (2009) report that supporters of tracking contend that tracking by ability level makes it easier for teachers to provide appropriate instruction designed to meet specific student needs. However, critics of tracking argue that the practice is inherently unfair and that it creates inequalities within our society. In essence, tracking serves as a back door device to sort students by race and class. Additionally, critics maintain that students in lower tracks do not receive the same quality of education as students in higher tracks and that curriculum, teaching, and social interactions in the classroom are all negatively influenced by tracking (Gamoran, Nystrand, Berends, & LePore, 1995).

Despite educational reform efforts, the practice of tracking continues (Mayer, 2008). In a review of tracking research, Burris and Welner (2005) reported that the persistence for tracking is rooted in the fact that tracking is based not only on values, beliefs, and politics, but also technical, structural, or organizational needs. Schweiker-Marra and Pula (2005) reported that academic tracking is used in more
than 95% of middle and high schools in North America. In fact, the U.S. implements tracking in elementary and middle school much more extensively than most other countries. Even countries that differentiate high schools typically offer a common core curriculum in the grades that precede high school. In the U.S., less-formal tracking often starts in elementary school with the designation of instructional groups and programs such as gifted and talented classes based on test scores and recommendations. These groupings generally become highly formalized by middle school (Darling-Hammond, 2004; Cogan, Schmidt, & Wiley, 2001).

In what may appear to be contradictory research, recent reports have suggested that tracking is no longer widely practiced in American schools (Lucas, 1999). Because of research critical of tracking, many schools have instead changed to a policy of ability grouping, which is described as the placement of students course-by-course as determined by perceived ability and prerequisites. While some educators consider ability grouping to be different from tracking, as students are not necessarily tracked into a series of courses, Yonezawa, Wells and Serna (2002) argued that these course structures simply mask the continued existence of low and high level tracks. Therefore, ability grouping has become de facto tracking (Mickelson, 2001).

**Bias in Tracking**

With tracking firmly entrenched in the U.S. educational system, education leaders must consider whether decisions related to tracking are based on merit or impacted by bias from school staff, students or parents. To shed light on this issue, consideration should be given to how students enter school as well as their progress
during school and through graduation. Farkas (2003) reports that, on average, African-American, Latino and American Indian students enter kindergarten with lower language, reading and math skills than White and Asian students. It has been estimated that at least half of the gap in Black-White achievement would be eliminated if the gap in skills was closed before kindergarten. While this gives credence to the argument for increased pre-school education, the remainder of the gap occurs between 1st and 12th grade. Specifically, Jacobson, Rice, Sweetland and Ralph (2001) report that African American students begin school one year behind Whites in vocabulary knowledge but finish high school approximately four years behind. Since the same students enter school with less knowledge and fewer skills, educators may not consider themselves part of the problem. Consequently, educators often write students off before they come to school and demonstrate little willingness to look for solutions from within the educational system itself (Garcia & Guerra, 2004).

As a result of these and other findings, researchers have looked for discrimination from teachers and school administrators that may contribute to the gap. Farkas (2003) concludes that “at least partly because students enter low-income and ethnic minority elementary schools with lower skills and maturity, a less demanding curriculum is taught in these schools” (p. 1123). In addition, lower grades are given in these schools and a higher percentage of students are retained or placed in special education. These patterns occur not just between schools, but also within schools, revealing that students in lower tracks are taught a less demanding curriculum (Farkas, 2003).
Achievement is also impacted by teacher expectations. Flanagan, Cumsille, Gill, and Gallay (2007) report that teacher expectations have a stronger effect on African-American students than they do on White students. When teachers have low expectations for their African-American students, these students tend to disengage from school. Rubie-Davies (2010) found negative correlations with achievement when students were assigned to teachers who held low student expectations. Low expectations, in combination with the greater impact of low-expectations on African-American students, can lead to a significant negative impact on these students’ achievement.

While it has been demonstrated that achievement is related to bias in schools, access to opportunities is another. Farkas (2003) goes on to report that there is little doubt that ethnic minorities and low-income students have access to fewer opportunities than White children, and the issue is compounded by the fact that the parents of minority students often have lower levels of education. In addition, minority and low-income students frequently attend schools with more lower-performing children and teachers, and no matter what school they attend, minority students are typically overrepresented in lower curriculum tracks and ability groups. Many scholars suggest prejudice and discrimination most likely impact these outcomes (Farkas, 2003; Ferguson, 1998). If prejudice and discrimination do not appear through overt actions, they may occur through more subtle actions such as low expectations and less encouragement than students in majority populations.

Race and Impact on Tracking
Issues related to race have been a challenge for the U.S. from its formation, and education has not been spared of these struggles. From a historical perspective, races other than White, and particularly African American, have been portrayed by some as inherently and culturally inferior throughout U.S. history (Brown, 2010). The 1954 Supreme Court decision in Brown vs. Board of Education, an example of efforts to change this dynamic, was a piece of educational policy of extreme importance and was designed to give all students equal access to a public education (Reber, 2005).

Although the progress that has been made in the U.S. in race relations may have come at a slower pace than some hoped, many educators believe that the racial inequalities in education have been resolved (Darling-Hammond, 2004). Therefore, any differences in outcomes in achievement must be functions of the individual, perhaps due to innate ability or lack of will. However, research shows that educational policies and attitudes continue to discriminate against minority students and students of lower-socioeconomic backgrounds (Oakes & Wells, 1998; Spielhagen, 2006). These barriers must be removed before achievement gaps will be reduced.

In researching math placement in the transition to middle school, Akos et al. (2007b) identified common myths related to mathematics. Often race, gender, and physical ability are seen as insurmountable barriers to achieving success in mathematics. If not confronted, this myth is likely to continue and may have long-term consequences for many students in the U.S. including high dropout rates and fewer students prepared for higher education that lead to competitive fields in
science, technology and engineering and mathematics (National Governors Association, 2008).

Racial factors impacting placement in mathematics reflect issues that have plagued the U.S. throughout its history. In 1996 Fenwick reported a chilling reality that continues to face American schools: “Our educational system (from kindergarten to the postdoctoral level) still views and treats many minority, poor, and female students as undeserving of quality mathematics and science instruction” (p. 3). If not addressed, race, class and gender will continue to influence placement in mathematics and will likely have a lasting effect on student achievement.

For at least 15 years, researchers have published that African American students were more likely to be placed in remedial courses and less likely to be placed in advanced mathematics despite prior achievement (Daubner, Alexander, & Entwisle, 1996). In a California school district in 1999, researchers found discrepancies in who was admitted to algebra I by race. Of students who demonstrated the ability to be admitted to algebra, 100% of the Asians, 88% of the whites, 51% of the Blacks, and 42% of the Latinos were admitted (Stone & Turba, 1999). More recently, Akos et al. (2007b) reported that middle school students may be inequitably distributed among mathematics tracks on the basis of race and economic background. In 2008, Mayer found that Latino and African American students who had similar percentile scores on standardized achievement tests were less likely than Asian and White students to be enrolled in college prep mathematics classes. Finally, Conger, Long and Iatarola (2009) revealed that while the number of students taking the most rigorous courses is increasing in the U.S., the increase has
been larger for Asian, White and non-poor students compared to African American, Latino and poor students, increasing the gap between racial and socio-economic groups. Clearly, race plays a significant role in how students are placed in mathematics courses.

According to Burris et al. (2006), the continuation of tracking has denied many opportunities to many students. The lack of opportunities for minority students is one of the underlying reasons that the achievement gap has remained so persistent in the U.S. If students are assigned to courses based on socially constructed norms rather than merit, it is very possible, if not likely, that the historical contexts of racial segregation and individual beliefs about culture will undermine the intent of tracking by academic ability. The research indicates that educators have much work to do in order to truly achieve a system of meritocracy in relation to course placement (Ferri & Connor, 2005; Mayer, 2008; Oakes, Wells, Jones, & Datnow, 1997; Rumberger & Palardy, 2005; Rubie-Davies, Peterson, Irving, Widdowson, & Dixon, 2010)

**Race and student assignment.**

Schools and districts frequently create policies, guidelines and procedures that impact mathematics tracking. Policies, guidelines and procedures vary by school and district, and even within a school and district, there may also be variation in implementation. While many schools and districts have written policies that support freedom of course choice for students, it is not unusual to find barriers to course choice despite those policies. In some cases, information is distributed unevenly to various groups of students. In a detailed study on choosing tracks, Yonezawa et al. (2002) found that one school depended on neighborhood networks
to inform students and parents of an open access policy to more advanced courses. While this system worked well for White students, it did not work for Black students and those students who lived in an isolated neighborhood that attended the school through a desegregation plan. In addition, another school held parent coffee hours to share information about course options and their implications, but few African-American parents attended. At other schools, educators rarely informed students that they could petition to be in an advanced course or relied on word of mouth to inform students of the school’s petition for advanced level courses. In still other schools, policies were reported to be well known by the students whom educators assumed would use them to advance their own education (Yonezawa et al., 2002).

Another institutional barrier is a concept referred to as selective flexibility, where schools selectively alter their course offerings to match the socioeconomic and racial characteristics of their students (Oakes & Guiton, 1995). In a study of selective flexibility, cultural norms and expectations were found to sway decisions about course creation and placement, creating situations were educators were more open to the requests of high-track White, Asian and upper-income students, and less open to requests of low-track students, many of whom were Latino, African American and low-income. While selective flexibility occurred to some degree in all schools in Yonezawa’s et al. (2002) study, it appeared strongest in the schools with the most low-income, African-American and Latino students and fewest White and wealthy students.

A third institutional barrier is the hidden prerequisite. Yonezawa et al. (2002) found that prerequisites varied from high school to high school, but the outcomes
were the same – some students were prevented from choosing advanced courses. One school claimed to have an open-door policy for advanced courses, but many students found that they needed another course or a higher grade before they were allowed to take the course. In some cases, students learned that the course had to be taken at the previous school. In another case, students with low standardized test scores were required to take a mini-reading comprehension test before being allowed into more advanced courses.

**Race and teacher perceptions.**

Teacher interactions with students play a critical role in mathematics placement. Mayer (2008) found that 43% of schools used teacher recommendations as the primary criteria for course placement. The study reported that teachers believed student intelligence to be static, innate, easy to measure, and distributed along a bell shaped curve, and they used this view of intelligence to justify placing students into different curricular tracks. In addition, the teachers rationalized that students’ abilities had already been measured by past performance on standardized tests and were not likely to change at the high school level regardless of the teachers’ efforts (Mayer, 2008).

Mayer (2008) found that what seemed to have the most impact on placement decisions was first the teachers’ perceptions of student characteristics and secondly, the teachers’ perceptions of what students needed. Both of these perceptions had a negative impact on minority students. Research has revealed that when educators used grades to inform course placement decisions, grades were more influential for some students than for others. For example, Mickelson (2001) found that when
comparing 12th graders with standardized test scores in the 90th-99th percentile, 52% of white students and only 20% of Black students were enrolled in AP English. Mickelson attributed her findings to the combination of racial segregation and social and educational dynamics. In her conclusion, she concisely states “race matters” (p. 242).

Hallinan (2000) reported that another factor that influenced placement was the teachers’ concern of challenging students beyond their ability. As self-confidence and self-esteem can be negatively affected when students are challenged beyond their ability, the loss of confidence or fear of failure, also referred to as discouragement, may cause students to disengage from learning. Some students may become discouraged more easily than others, and there is concern that students with lower ability are more vulnerable to discouragement than students who more often experience academic success. However, Hallinan (2000) reported that educators were far more likely to err on the side of assigning less challenging coursework rather than discouraging students by assigning work that was overly challenging. Since educators always have the option to reassign students to a lower ability group, the potential benefits gained from placing students in a higher ability group outweigh possible consequences of discouragement resulting from placing them in the higher ability group (Hallinan, 2000).

As with teachers, research shows that school counselors were subject to allowing race to influence decisions related to placement. In the absence of professional guidelines, school counselors were found to have relied on their personal beliefs when deciding what was right for each student. Depending on the
school counselors’ personal beliefs, academic achievement may be less related to track and placement than race and socio-economic background (Mayer, 2008).

In addition, Cross and Burney (2005) found that school counselors were unfamiliar with the research that found the quality of the high school curriculum had more impact on a student’s completion of a bachelor’s degree than either test scores or grade point average. These studies also show that finishing a course beyond algebra II more than doubles the chances that a student will graduate from college. While school counselors reported that they wanted to get their students into college, some were not aware of the importance of specific high school preparation in predicting which students would complete college. This information can be very influential as school counselors encourage students and parents to participate in the most rigorous courses that will prepare them for college (Cross & Burney, 2005). In addition, Sciarra (2010) concludes that school counselors can play a critical role in reducing the achievement gap among racial groups by being more proactive in intensifying a student’s academic curriculum, and particularly, their math curriculum

**Race and student decisions.**

While there are multiple factors which impact placement in mathematics that are outside their control, students also have some decision-making opportunities in course selection. Arguments have been made that low-tracked students choose the low-track courses because they believe the courses are easier and success would be more likely. Yonezawa et al. (2002) found that some students’ self-perceptions discouraged them from moving up to a higher level course. In addition, some students were not willing to give up their peer group to move to another track as they
would be isolated from their friends if they moved to a higher track. Students often form bonds of friendship with students who are assigned to their track, and racial segregation has been found to increase as students move from elementary to secondary schools. Track structures then increase social segregation in schools and may cause entire groups of students to miss out on opportunities that can only be accessed by participation in high track courses.

While these issues impact self-selection of the higher academic track, researchers caution against putting too much emphasis on this line of thought. Although this explanation may be appealing, the data from research shows that it is too simplistic. As seen in previous sections of this paper, complicated issues of culture and politics, intertwined with issues of race and class, often inhibit minority students from being moved into higher-track classes (Yonezawa et al., 2002).

‘Choosing respect’ is another student behavior that impacts tracking. Yonezawa et al. (2002) report that research shows that some low- or middle-track students bypassed more rigorous courses because they wanted to be in ‘places of respect’ - classrooms that were not racially isolated and where cultural backgrounds were valued. Oppressed students feel secure and liberated in these places, and they feel that they can restore dignity that has been denied to them by the outside world. Therefore, it may not be accurate to label low-track classes as oppressive places, but simply moving students out of low-track classes to high-track classes without addressing school climate issues where students do not feel respected or safe may not result in improved student achievement (Yonezawa et al., 2002).
Student concern for grade point average (GPA) can also affect course selections. In a study of small, rural schools, researchers found a strong competition for the award of valedictorian, and students reported that the expected grade of the course was more important than the course content (Cross & Burney, 2005). While this issue may be more readily evident in high school, states such as North Carolina are now allowing courses taken in middle school to receive high school credit (North Carolina State Board of Education, 2009), so the valedictorian issue now may be relevant to students in middle school. In schools where credit is not granted for high school mathematics courses taken in middle school, students who are academically ready to take algebra in seventh or eighth grade may decide to wait to take it in later years as starting the high school mathematics sequence in middle school would require students to take Calculus by grade 11 or 12. Cross and Burney (2005) found that some students worried that Calculus might be too difficult and decided not to take the advanced mathematics course in middle school in order to protect their future high school GPA.

**Race and socioeconomic.**

Researchers believe that variables such as socioeconomic status may influence placement of students in tracks as much as academic ability. If a minority student is from a low-socioeconomic background, the student may face additional barriers to school opportunities. For example, Marks, Cresswell, and Ainley (2006) reported that students with poor grades and average test scores from low-income families were often placed in lower academic tracks. However, students with similar academic records but from middle income families were often placed in higher
academic tracks. Study after study supports the finding that socioeconomic status directly effects track assignment (Abu El-Haj & Rubin 2009; Akos et al., 2007a; Alvarez & Mehan, 2006; Calahan, 2005; Cooper, 1999; Gamoran, 2009; Marks et al., 2006; Mayer, 2008; Rubin, 2006).

This trend continues in high school and beyond. Rojewski and Kim (2003) revealed that high school sophomores in the lowest socio-economic quartile were three times more likely to be enrolled in a vocational track and four times more likely to be unemployed two years after high school graduation than students in academic tracks. Conversely, adolescents in the highest socio-economic quartile were four times more likely to be college-bound rather than work-bound or unemployed compared to students in lower socio-economic classifications.

Mayer (2008) reported similar socio-economic findings, but in this case, there were school-wide implications based on the level of affluence of the school. Schools that were considered working class schools had fewer course offerings compared to middle class and affluent schools. In affluent schools, teachers and parents were more involved in course planning. Students and staff took the course selection process more seriously in affluent schools and reported a greater understanding of the impact that placement decisions had on future opportunities. In contrast, teachers, students and parents in middle and working class schools took a small role in the scheduling process and were less concerned about the scheduling process as a whole.

While issues related to socioeconomics and race impact school funding, tracking systems exacerbate inequalities that further impact school funding. The
connections between tracking and social stratification play out in two ways. First, schools with predominantly low-income and minority students tend to be “bottom heavy,” offering academic tracks with fewer options and larger remedial and vocational programs than schools with higher proportions of White and affluent students. Second, in racially mixed schools, a higher proportion of African-American and Latino students are assigned to low-track classes (Darling-Hammond, 2004).

Low-track programs tend to receive less funding, and students in these programs have less access to computers, science labs, and other resources that are often available in high-track programs. Schools with higher concentrations of minority students and smaller academic tracks tend to receive less funding than other schools in their district. Disparity in funding leads to additional issues such as the legality of these funding discrepancies. Many legal challenges have been filed over funding issues, and in some cases, courts have found state funding systems to be unconstitutional (Darling-Hammond, 2004).

**Gender and Impact on Tracking**

While the effect of race on tracking has been studied extensively, much less attention has been given to the effect that gender may have on tracking, and even less has been given to racial differences in the role of gender on tracking (Southworth & Mickelson, 2007). The limited amount of research on the intersection of tracking and gender provides mixed results. Southworth and Mickelson’s (2007) historical perspective reported that Catsambis (1994) found gender equity in middle school math achievement and placement. Catsambis, Mulkey and Crain (1999) found that being placed in the lower level track was more detrimental to test scores
for females than males. However, Gamoran and Mare (1989) reported that females were more likely than males to be placed in college tracks. In a study of 9th grade tracking, Kubitschek and Hallinan (1996) found that females and non-White males were more likely to remain in the same track in 9th grade as in 8th grade and that females were less likely than males to be placed in the high track in math placement despite test scores.

To further confuse the picture of the differences in gender, some recent K-12 studies suggest that girls have essentially caught up with or even surpassed boys in mathematics and science (Buchmann, DiPrete, & McDaniel, 2008; Else-Quest, Hyde, & Lynn, 2010; Kenney-Benson, Pomerantz, Ryan, & Patrick, 2006), whereas other studies report that girls are still less likely than boys to be ready for college-level mathematics (Long, Iatarola, & Conger, 2009; Viadero, 2009). Hyde and Mertz (2009) found that, despite gains that girls have made in mathematics and science, gender inequality is the main reason fewer females than males have been identified as excelling in mathematics. Gender inequality can create biased climates where teachers provide more attention to boys; school counselors advise females against taking engineering courses; girls are under-identified as mathematically gifted; and women rarely become role models in mathematics-intensive careers leading girls to believe that they do not belong in them (Hyde & Mertz, 2009).

Beilock, Gunderson, Ramirez, and Levine (2009) studied female students’ early experiences in math with female math teachers and found a small but significant effect. Female math teachers’ math anxieties altered the girls’ gender ability beliefs, which had a negative effect on math achievement for female students.
However, the math achievement of boys with these same teachers was not impacted. Beilock et al. (2009) concluded that female teachers’ math anxiety has consequences on girls’ achievement in early elementary math and speculated that female teachers modeled gender stereotypes to their female students through their math anxieties. However, more research is needed to further clarify the influences on girls’ math achievement such as previous teachers, parents, peers, and siblings.

Middle school is a critical time for girls’ experiences in mathematics. Issues such as low personal aspirations and attitudes may impact decision-making, including course levels and career-track choices (Mendez, Young, Mihalas, Cusumano, & Hoffman, 2006; Wiest, 2008). From a review of research, Akos et al. (2007b) reported that girls may be less likely to aspire to higher level mathematics due to developmental or environmental influences that lower mathematics self-efficacy, and girls often experience significant decline in their self-described ability in mathematics during the transition to middle school. If left unaddressed, these factors are likely to continue the trend of fewer women entering science, technology, engineering and mathematics (STEM) fields (Ceci, Williams, & Barnett, 2009; Dee, 2007).

Education and political leaders such as the National Governors Association emphasize the importance of a strong work force in STEM related fields, calling for an increase in student achievement and attainment in K-12 STEM subject areas in order to ensure state and national economic growth. The U.S. may experience long-term consequences if gender factors discourage girls from taking the most rigorous
middle school mathematics courses appropriate (Else-Quest, Hyde, & Lynn, 2010; National Governors Association, 2008).

**Importance of Transition**

In addition to its function of sorting students, tracking has also been used as a tool to assist in the transition from one school to the next (Rubin, 2003). Transitions can be difficult times in a student’s life, and the transition from elementary to middle school can be especially difficult as there is significant school and personal change. Middle school environments are considerably different from elementary schools as the new environment includes different students, staff, rules and expectations. In addition, the difficulty of transition to middle school is increased by personal change such as physical, emotional and social changes that occur during puberty (Berk, 1993; Kingery & Erdley, 2007). Issues of attachment to parents, anxiety, and feelings of insecurity are typical changes that occur during puberty and make the transition to middle school a more complex issue (Duchesne, Ratelle, Poitras, & Drouin, 2009).

The importance of a positive transition experience during the early adolescent years cannot be overemphasized. Students who experience stress in transition often earn lower grades, experience decreased academic motivation and eventually drop out of school (Cauley & Jovanovich, 2006). According to research reported by the Triangle High Five Regional Partnership (2008), dropping out of school has been found to have a negative impact on income and increases the potential for criminal activity and poor health. High school dropouts earn 37 cents compared to every dollar earned by individuals with more education. They are more likely to be
unemployed, need public assistance and enter the criminal justices system, all of which cost taxpayers $260,000 per person over the course of a lifetime. In addition, high school dropouts have been found to have a life expectancy that is 9.2 years shorter than high school graduates (Sum, Khatiwada, McLaughlin, & Palma, 2009; Triangle High Five Regional Partnership, 2008). Schools can help students avoid these lifelong negative consequences by planning prevention and intervention activities that will address those needs during critical transition periods (Cauley & Jovanovich, 2006).

While much of the dropout research on transition is focused on middle school to high school, the transition to middle school is an important period which will create the foundation for opportunities in high school, college and career (Wimberly & Noeth, 2005). The U.S Department of Education (1999) recommends that students begin planning for college as early as sixth grade. In addition, Wimberly and Noeth (2005) recommend that schools begin delivering education and postsecondary planning information to sixth graders to help them to meet their educational goals. In order to plan and focus on long term goals such as post-secondary education while in sixth grade, it is important for middle school students to align their educational goals with their course selection. Achieving successful academic experiences in the most rigorous courses appropriate for the student in sixth grade is dependent on making a successful transition to middle school (ACT, 2004).

While the transition to middle school is an important period of academic development, it is particularly important in mathematics. Through an extensive review of research, Akos, Shoffner, and Ellis (2007b) reported that there are
significant declines in academic achievement after the transition to middle school or junior high, and students’ self-concept of ability and motivation also suffer. Most significantly, these negative effects have been found to be most prominent in students’ achievement and attitudes toward mathematics.

**Policy Issues**

With tracking and transition as significant aspects in education, and gender and race bias present in schools, education leaders have an obligation to act to improve the educational environment. One of the most important actions to promoting success for all students is the development and implementation of policy to address any potential bias with key policies such as tracking and at key time points, such as the transition from elementary to middle school.

As research has revealed gaps in achievement, policymakers have turned their attention to strengthening the high school curriculum across the U.S., including increasing both the number and rigor of courses required for graduation (Conger, Long, & Iatarola, 2009). The reauthorization of the 2001 *No Child Left Behind Act* reinforced that attention, calling on schools to better prepare students for post-secondary education by offering more rigorous coursework (U.S. Department of Education, 2007).

School and district policy related to course placement can have a significant impact on both access to rigorous curriculum as well as increased student achievement. Burris et al. (2006) reported dramatic changes in student outcomes through a policy change to heterogeneous grouping in math placement procedures at the district level. The researchers found that as a result of a policy change
allowing access to the advanced 8th grade math course to students who have been previously identified as low-achieving, student achievement scores increased significantly for all sub-groups as did the student’s probability of completing advanced math courses later in high school (Boaler, 2008). However, it is significant to note that before the policy change, it appeared that factors other than prior math achievement were used to determine course placement. After the policy change, these non-achievement factors no longer impacted student placement and participation in the advanced curriculum increased for low, middle and high achieving students (Burris et al., 2006).

In addition to increasing access to rigorous curriculum for all students, policy can also prevent students from being misplaced in an academic track when tracking occurs. White, Gamoran, Porter and Smithson (1996) found a high degree of track misplacement in a study of high school tracking. While analyzing student participation in the various tracks, average achievers were found in the low, middle and high track mathematics courses. However, results in math completion were very different for the students who had the same academic performance. The chance of completing two college-preparatory math courses for the average achieving students placed in the low-track math course was 2%. However, the chance of completing two college-preparatory courses for students with the same previous math performance placed in the middle math track rose to 23%. More dramatically, the chance of the same level student placed in the high-track math course rose to 91%. Had policy existed to use data to identify students for the
appropriate track existed, very different outcomes could have occurred for many students in this study.

**Summary**

Tracking is a practice that is firmly rooted in the American education system. However, a review of literature has raised concerns about whether or not tracking is a meritocratic process that places students in the appropriate level of curriculum based on student achievement and without the influence of the non-academic factors such as race and gender.

Placement in the advanced mathematics track in the transition to middle school provides students with opportunities for advanced curriculum in middle school, high school and beyond. Students who complete algebra I before entering high school have access to the highest levels of mathematics and sciences courses in high school, which may provide the student additional post-secondary opportunities that are denied students who are placed in the lower mathematics track in middle school. Therefore, the meritocracy of math tracking in the transition to middle school is an issue that deserves further exploration. The following sections of this study will provide the results of investigation of this issue that was designed to further inform this discussion.
CHAPTER 3
Methodology

This study was designed to determine if race and gender of students with similar merit impacted student enrollment in the mathematics course sequence as they transitioned from elementary school (5th grade) to middle school (6th, 7th and 8th grade). The study is a middle school replication of Stone’s (1995) research on high school math placement. Archival data for a cohort of North Carolina students were analyzed to determine if race and gender, or the interaction were related to placement in the advanced mathematics track.

Research Question and Null Hypothesis

A research question was developed to investigate if factors other than merit impacted the placement of students in the advanced mathematics track, by examining the variables of race and gender. The research question was:

Were 6th grade students predicted to be successful in algebra I placed in the advanced mathematics track in middle school without regard to race, gender or any interaction between race and gender after controlling for academic achievement?

The following null hypothesis was tested:
HO1: Race and gender are not statistically significant predictors of placement in the advanced mathematics track in middle school after controlling for academic achievement.

Definition of Variables

The advanced mathematics track in middle school was defined by the student taking algebra I in 8th grade. A typical course sequence for this track was advanced 6th grade mathematics in 6th grade, compacted 7th and 8th grade mathematics or pre-algebra in 7th grade, and algebra I in 8th grade. Students in the less rigorous mathematics track took 6th grade mathematics, 7th grade mathematics and 8th grade mathematics, potentially leading to algebra I in 9th grade. While the less rigorous mathematics track was taught throughout the state of North Carolina, there may have been some variation in the courses taken in the advanced track in 6th and 7th grade based on local board discretion. However, algebra I was the standard advanced mathematics course that students in an advanced track took in 8th grade (Fair, 2010).

Algebra I in 8th grade was the factor used to determine whether or not a student was placed in and remained in the advanced track in middle school mathematics for two reasons: 1) research revealed that students do not often move out of the advanced track once placed in it (Spielhagen, 2006) and 2) it was not possible to obtain data that would distinguish between advanced and regular courses taken in 6th or 7th grade. While NCDPI collects data on the level of courses taken each year, these data are stored for only one year. Therefore, the level of course taken in 6th or 7th grade was not available to the researcher (Pond, 2010). In
addition, since students took the same EOG at the end of regular 6th grade mathematics and advanced 6th grade mathematics, it was not possible to determine what level of the course the student took based on the 6th grade EOG test scores. Likewise, all 7th graders took the same EOG regardless of the course taken. However, in 8th grade, students who took algebra I had an EOC score for algebra I. Therefore, completion of algebra I was the factor used to determine which students were on the advanced track all through middle school and which students were on the standard track in middle school.

Each student’s merit was defined based on their projected algebra I score at the beginning of 6th grade. This projection was calculated using EVAAS methodology based on the individual student’s EOG scores from 3rd through 5th grade. The projections were made based on prior achievement scores from all subject areas and have been documented to be more accurate than a single EOG score (SAS Institute, Inc., 2010). The projection score provided a precise measurement of student progress over time and a reliable diagnosis of opportunities of growth based on as much as three years of EOG data in all subject areas for an individual student. EVAAS has been populated with historical test data from NCDPI and followed the student through all NC schools (North Carolina Department of Public Instruction, 2010). The projected score can be converted into the probability of achieving a particular performance level.

Rivers (2010) conducted research on the EVAAS methodology to determine long-term outcomes for students based on merit. Across all grade levels, Rivers found that 96% of students with 70% -100% probability of attaining proficiency
scored a level III or IV on the EOG/EOC test. Therefore, we would expect 96% of the 6th graders who were predicted with 70% or greater probability for success in 8th grade algebra to succeed if they were placed in the advanced math track leading to algebra I in the 8th grade. Based on this research, we would expect 4% of any subgroup of 6th graders who were predicted to be successful in algebra I in 8th grade to be unsuccessful either in 6th or 7th grade, thus creating a need to move back to the standard track (Rivers, 2010).

Race was defined by six categories: Asian, Black, American Indian, Hispanic, White, and Multi-Racial. These categories were determined by NCDPI. Gender was defined by two categories: male and female.

**Design of Study**

EVAAS projections of all 9th grade students in North Carolina in 2010-11 were reviewed to determine which students had a 70% or greater probability of success in algebra I at the beginning of the 6th grade in 2007-08. The purpose of focusing on this population was to narrow the sample of the study to students who were viewed as meritorious for success in the advanced mathematics track.

The mathematics course these students took as 8th graders in 2009-10 was then determined. Students who took the highest mathematics sequence in middle school took advanced 6th grade mathematics, compacted 7th and 8th grade mathematics or pre-algebra in 7th grade and algebra I in 8th grade.

The study employed descriptive statistics to describe the race and gender of the students included in the merit-based sample. Logistic regression was chosen as the method of analysis as it provided the ability to compute the probability that
gender, race or the interaction of gender and race influenced the likelihood of a student being placed in the advanced mathematics track, ending with algebra I in 8th grade. Logistic regression also allowed the researcher to examine the degree to which race, gender and the interaction impacted math placement.

Participants

There were 105,081 students in North Carolina with a 2010 Math 8 EOG score. However, to answer the research question about merit, the sample was narrowed.

The file was first reviewed to determine which students had a 2010 Math 8, 2009, Math 7, 2008 Math 6, and 2007 Math 5 score at a non-charter school, ensuring that all students in the data set participated in courses that were a part of the NC Standard Course of Study. Removing students who did not meet these criteria left 82,423 students in the data set. The data were then analyzed to determine if the students were in the same district for grades 5 – 8. Students who moved to schools in other districts were removed from the sample to lessen the likelihood of the students experiencing different curriculum, methods and materials during the middle school year. Removing these students reduced the data set to 76,628. Of the students who had scores for all grade levels within the same district, 76,580 had race and gender values.

Of the students remaining in the data set, 73,458 also had EVAAS projections for 6th grade math and algebra I. This projection is important in that it indicated that the student had a minimum of three test scores available prior to 6th grade to make a projection of success in 6th grade. EVAAS projections were then analyzed for
students who were expected to be proficient in algebra I, defined as 70% or greater probability of being proficient in algebra I. Students below the 70% projection for proficiency are considered at-risk for scoring below grade level in the course (SAS Institute, Inc., 2007). There were 51,413 students with a 70% or higher probability of passing, and only these students were included in the sample. The following table provides selection criteria for the sample.
Table 1

Summary of Student Counts

<table>
<thead>
<tr>
<th>Description</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010 EOG Math 8 Score</td>
<td>105,081</td>
<td>100%</td>
</tr>
<tr>
<td>All of the following scores at a non-charter school: 2010 Math 8, 2009 Math 7, 2008 Math 6, 2007 Math 5</td>
<td>82,423</td>
<td>81%</td>
</tr>
<tr>
<td>All scores from the same district</td>
<td>76,628</td>
<td>73%</td>
</tr>
<tr>
<td>Race and gender indicator present</td>
<td>76,580</td>
<td>73%</td>
</tr>
<tr>
<td>Projections available to 6th grade math and algebra I</td>
<td>73,458</td>
<td>70%</td>
</tr>
<tr>
<td>Number of students with 70% probability of success in algebra</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I based on EVAAS projection (merit based sample)</td>
<td>51,413</td>
<td>49%</td>
</tr>
</tbody>
</table>

**EVAAS Methodology**

The EVAAS projection methodology provided an estimate of a student’s academic achievement level at 8th grade based on the assumption that the student had an average school experience (Rivers, 2010). Wright et al. (2010) described the statistical model used to create the projections as an analysis of covariance (ANCOVA) model.

EVAAS projections were computed for any student with any set of test scores. However, since there could be bias due to measurement error in the test scores, projections were made only for students who have at least three available scores. In addition to the projected score itself, the standard error of the projection was calculated. With a projected score and its standard error, the probability that a student will reach a specific benchmark was computed, which in this case was the probability of scoring proficient on the algebra I EOC. The probability calculation is
the area above the benchmark cutoff score using a normal distribution with its mean equal to the projected score and its standard deviation equal to the standard error of the projected score (Wright et al., 2010).

**Reliability and Validity**

The EVAAS projection model has been approved by the US Department of Education as a growth model pilot program (U.S. Department of Education, 2009). In order to achieve this approval, the EVAAS methodology was reviewed by four peer review teams. Prior to granting approval, one of the peer review teams required an analysis of the reliability of the projections. By using historical data, the projections made from earlier years were compared to the students’ scores on future tests taken. The review team documented that the projections three years in advance were more highly related to final test scores than a single score from the previous year (Sanders & Wright, 2008; Wright, Sanders, & Rivers, 2006).

Amrein-Beardsley (2008) points out that content-related validity was initially a significant issue for EVAAS as the model used norm referenced tests that were not aligned with state standards in calculating projections. However, this is no longer an issue as EVAAS uses criterion-referenced tests that are linked to state standards. In addition, assurances were obtained and exploratory analysis were conducted to verify that test scores used for projections were reliable and highly correlated with curricular objectives (Sanders & Wright, 2008).

**Data Collection Procedures**

The 6th grade EVAAS projection for success in algebra I was calculated by SAS for all 2010-11 9th grade students in the state of North Carolina. The historical
data for each student was provided to SAS by NCDPI, and included all subject area EOG scores from 3rd through 5th grade. Demographic information, including race and gender, was also provided to SAS by NCDPI. Note that the projection model did not use race and gender when predicting a student’s probability of success in algebra I.

Data Analysis

The data file was reviewed to identify students whose projection for success in algebra was 70% or higher after they took the 5th grade EOG tests in 2005-06. Once these students for the merit sample were identified, the researcher examined the data to determine if the student had an algebra I EOC score at the end of 8th grade. Students in the advanced mathematics track completed algebra in 8th grade, whereas students on the lower mathematics track completed 8th grade mathematics. Algebra I in 8th grade was the factor used to determine whether or not a student was placed in the advanced track in middle school.

Analyses were run using a logistic regression model to examine the effect of the race, gender and the interaction of race and gender on placement in the advanced mathematics track in middle school after controlling for academic achievement. Placement in the advanced mathematics track in middle school (yes/no) was modeled as a function of race and gender. In the estimates for race, White was used as the reference for race, and male was used as the reference for gender. If a specific race had an equal likelihood of being placed in the advanced mathematics track compared to White students, the estimate would be zero. If female students had an equal likelihood of being placed in the advanced
mathematics track compared to male students, the estimate would also be equal to zero. Chapter four provides complete results of the logistic regression.
CHAPTER 4

Data Analysis

Introduction

The purpose of this study was to investigate if gender and race impacted the placement of students in the advanced mathematics track in middle school. The results of the study are presented in this chapter, including descriptive characteristics of the sample, the relationship between gender, race and the interaction of gender and race on math placement, and a summary of the study’s findings.

Descriptive Statistics

The merit sample of 51,413 students was first analyzed by race, examining the EVAAS projection as the students entered 6th grade. The analysis revealed that 642 American Indians, 1431 Asian, 9223 Black, 3850 Hispanic, 1595 Multi-Racial and 34,672 White students were expected to pass the algebra I EOC based on EVAAS projections. Comparing the merit sample to the entire population in each race revealed that Asian and White students had the highest percentage of students expected to pass at 84.03% and 81.46%, respectively. Multi-Racial (69.77%), Hispanic (59.26%), American Indian (55.97%), and Black (47.88%) students had a considerably smaller percentage of the entire population (by race) expected to be successful in algebra I based on EVAAS projections.
To summarize these data, more than three out of four Asian and White students were expected to pass the algebra I EOC with a level III or IV in 8th grade. However, approximately one out of two Black and American Indian students was expected to achieve success at that same level, and the rate was only slightly higher for Hispanic students. This descriptive comparison of the EVAAS predictions or merit sample as compared to the entire population revealed an achievement gap between the races had developed before the students entered middle school. Clearly, a considerably higher percentage of Asian, White, and Multi-Racial students being projected for success in the advanced mathematics track in middle school. It is beyond the scope of this study to determine any causes of these differences, but studies examining racial achievement gaps in mathematics prior to middle school are needed to guide practitioners toward closing the achievement.

Of the 51,413 students in the sample, 25,663 were female and 25,750 were male. Comparisons by gender of the number of students expected to score proficient on the EOC in algebra I showed a virtually identical percentage of female and male students expected to be successful - 69.26% and 70.73%, respectively. These data provide support to the literature that suggests that gender gaps do not seem present between male and female students in math at least in the elementary school years.

The following table provides a complete description by race and gender.
Table 2

Expected to Pass (Merit Sample) by Race and Gender

<table>
<thead>
<tr>
<th>Race</th>
<th>N</th>
<th>Percentage of All Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Indian</td>
<td>642</td>
<td>55.97%</td>
</tr>
<tr>
<td>Asian</td>
<td>1431</td>
<td>84.03%</td>
</tr>
<tr>
<td>Black</td>
<td>9223</td>
<td>47.88%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>3850</td>
<td>59.26%</td>
</tr>
<tr>
<td>Multi-Racial</td>
<td>1595</td>
<td>69.77%</td>
</tr>
<tr>
<td>White</td>
<td>34,672</td>
<td>81.46%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Percentage of All Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>25,750</td>
<td>70.73%</td>
</tr>
<tr>
<td>Female</td>
<td>25,663</td>
<td>69.26%</td>
</tr>
</tbody>
</table>

**Research Question and Null Hypothesis**

A research question was designed to investigate the relationship between race and gender in regard to a meritocratic placement of students in the advanced mathematics track. The research question studied was:

Were 6th grade students predicted to be successful in algebra I placed in the advanced mathematics track in middle school without regard to race, gender or any interaction between race and gender after controlling for academic achievement?
To analyze the data, a logistic regression model was applied to the sample data set examining the effects of race and gender on placement in the advanced math track. Logistic regression provided the ability to compute the probability of a student being placed in the advanced track in middle school and also provided an odds ratio estimate of the variables that were associated with placement. The interpretation of these results revealed a significant relationship between both race and gender with placement in the advanced mathematics track in middle school. While there was no further significant relationship of the interaction of race and gender with completion of algebra I in middle school, the following null hypothesis was rejected:

\[ H_{01}: \text{Race and gender are not statistically significant predictors of placement in the advanced mathematics track in middle school after controlling for academic achievement.} \]

**Statistical Analysis**

Analyses were conducted using a logistic regression model to examine the effect of the race, gender and the interaction of race and gender on placement in the advanced mathematics track in middle school after controlling for academic achievement. The following table provides statistical significance of race, gender and the interaction of race and gender.
### Table 3
Type 3 Analysis of Effects

<table>
<thead>
<tr>
<th>Effect</th>
<th>DF</th>
<th>Wald Chi-Square</th>
<th>Pr&gt;ChiSq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race</td>
<td>5</td>
<td>446.6759</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Gender</td>
<td>1</td>
<td>19.5611</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Race*Gender</td>
<td>5</td>
<td>6.2789</td>
<td>.2800</td>
</tr>
<tr>
<td>Projected Score</td>
<td>1</td>
<td>11765.7093</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

Analysis of maximum likelihood estimates revealed that American Indian students had a negative estimate that was statistically significant (p<.0001), indicating a significant negative relationship between race and placement in the advanced mathematics track compared to White students. There was also a statistical significant relationship (p<.0001) between race and placement in the advanced mathematics track for Asian, Black, Hispanic and Multi-Racial students. However, the relationship was positive for these students, indicating that these races had a greater likelihood of placement in the advanced mathematics track compared to White students when controlling for academic achievement.

There was also a statistical significant relationship (p<.0001) between gender and placement in the advanced mathematics track, with female students having a greater likelihood of placement in the advanced mathematics track compared to male students in the sample when controlling for academic achievement. The
The following table provides complete information on the analysis of maximum likelihood estimates.

Table 4

Analysis of Maximum Likelihood Estimates

<table>
<thead>
<tr>
<th>Parameter</th>
<th>DF</th>
<th>Estimate</th>
<th>Standard Error</th>
<th>Wald Chi-Square</th>
<th>Pr&gt;ChiSq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1</td>
<td>-0.8734</td>
<td>0.0183</td>
<td>2280.6199</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>American Indian</td>
<td>1</td>
<td>-0.3075</td>
<td>0.1118</td>
<td>7.5616</td>
<td>.0060</td>
</tr>
<tr>
<td>Asian</td>
<td>1</td>
<td>1.0626</td>
<td>0.0723</td>
<td>216.2862</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Black</td>
<td>1</td>
<td>0.4973</td>
<td>0.0308</td>
<td>260.6693</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1</td>
<td>0.1659</td>
<td>0.0442</td>
<td>14.0486</td>
<td>0.0002</td>
</tr>
<tr>
<td>Multi-Racial</td>
<td>1</td>
<td>0.1528</td>
<td>0.0648</td>
<td>5.5650</td>
<td>0.0183</td>
</tr>
<tr>
<td>Female</td>
<td>1</td>
<td>0.3398</td>
<td>0.0225</td>
<td>228.2671</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Projected Score</td>
<td>1</td>
<td>.3495</td>
<td>0.00322</td>
<td>11767.7226</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

While the maximum likelihood estimates give a comparison of the likelihood of placement in the advanced mathematics track for each race compared to White students and for female students compared to male students, computing odds ratio estimates can give a clearer picture of how other races compared to White students and female students to male students.

The odds ratio was computed for all races compared to White students and for female students compared to male students. An odds ratio of one indicates that the odds of being enrolled in the advanced track for that race were comparable to the odds of being enrolled for Whites. Based on the odds ratio, all races except American Indian were more likely that White students to be placed in the advanced mathematics track when controlling for academic achievement. With an odds ratio
of one being equal to Whites, American Indian had the lowest odds at .735, or 73.5% odds of placement in the advanced mathematics track compared to Whites. Hispanic students’ odds of placement in the advanced mathematics track was 1.18 times more likely than White students, and Black students' were 1.644 times more likely to be placed in the advanced track compared to Whites. Asian students had almost three times the odds (2.894) of being placed in the advanced mathematics track as compared to White students. Female students were 1.4 times as likely to be placed in the advanced track as male students. The following table provides a comparison of odds ratios.
Table 5
Odds Ratio Estimate of Student Placement in the Advanced Mathematics Track in Middle School

<table>
<thead>
<tr>
<th>Effect</th>
<th>Point Estimate</th>
<th>95% Wald Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race Am Indian vs. White</td>
<td>0.735</td>
<td>0.591   0.915</td>
</tr>
<tr>
<td>Race Asian vs. White</td>
<td>2.894</td>
<td>2.512   3.334</td>
</tr>
<tr>
<td>Race Black vs. White</td>
<td>1.644</td>
<td>1.548   1.747</td>
</tr>
<tr>
<td>Race Hispanic vs. White</td>
<td>1.180</td>
<td>1.082   1.287</td>
</tr>
<tr>
<td>Race Multi-Racial vs. White</td>
<td>1.165</td>
<td>1.026   1.323</td>
</tr>
<tr>
<td>Gender Female vs. Male</td>
<td>1.405</td>
<td>1.344   1.468</td>
</tr>
</tbody>
</table>

While the findings for gender support literature that the gender gap is closing (Buchmann, DiPrete, & McDaniel, 2008; Else-Quest, Hyde, & Lynn, 2010), the results of the logistic regression provided results for minority students that were inconsistent with research literature reporting that minority students often have less access to opportunities such as the advanced mathematics track (Burris, et al., 2006; Conger et al., 2009; Mayer, 2008; Oakes & Guiton, 1995; Yonezawa et al., 2002). Although these data are encouraging, questions remain. It has been my observation that schools limit space in Algebra classes in 8th grade, and EVAAS prediction rates suggest that only around 50% of meritorious students actually end up enrolled in algebra in 8th grade.

Therefore, an additional logistic regression analysis was completed that did not control for prior achievement to further investigate the issue. Although students
in the sample demonstrated merit to be placed in the advanced track based on their EVAAS projection of 70% or higher for proficiency in algebra (SAS Institute, Inc., 2007), it appears an overrepresented number of minority students from this merit pool are not actually placed in algebra. The results of this logistic regression were remarkably different than when controlling for prior achievement.

Analysis of maximum likelihood estimates revealed that American Indian, Black, and Hispanic student groups had negative estimates that were statistically significant (p<.0001). American Indian students were the least likely to be placed in the advanced track compared to White students followed by Hispanic students and then Black students. There was a slight negative association of race and placement in the advanced mathematics track for Multi-Racial students, but this relationship was not statistically significant.

There was also a statistical significant relationship (p<.0001) between race and placement in the advanced mathematics track for Asian students. However, the relationship remained overwhelmingly positive for these students, indicating that Asian students had a greater likelihood of placement in the advanced mathematics track compared to White students.

In addition, there also was a similar statistical significant relationship (p<.0001) between gender and placement in the advanced mathematics track, with female students again having a greater likelihood of placement in the advanced mathematics track compared to male students in the sample. The following table provides complete information on the analysis of maximum likelihood estimates.
The odds ratio was computed for all races compared to White students and for female students compared to male students. All races except Asian were less likely than White students to be placed in the advanced mathematics track. With an odds ratio of one being equal to Whites, American Indian had the lowest odds at .404, or 40.4% odds of placement in the advanced mathematics track compared to Whites. Hispanic students’ odds of placement in the advanced mathematics track was 57.6% compared to Whites, and Black students’ odds was 62.8% compared to Whites. Asian students, however, had almost three times the odds (2.827) of being placed in the advanced mathematics track as compared to White students. The following table provides a comparison of odds ratios.

### Table 6
Analysis of Maximum Likelihood Estimates Without Controlling for Previous Achievement

<table>
<thead>
<tr>
<th>Parameter</th>
<th>DF</th>
<th>Estimate</th>
<th>Standard Error</th>
<th>Wald Chi-Square</th>
<th>Pr&gt;ChiSq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1</td>
<td>-0.5084</td>
<td>0.0215</td>
<td>559.0135</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>American Indian</td>
<td>1</td>
<td>-0.7285</td>
<td>0.0801</td>
<td>82.8135</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Asian</td>
<td>1</td>
<td>1.2165</td>
<td>0.0507</td>
<td>575.5845</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Black</td>
<td>1</td>
<td>-0.2881</td>
<td>0.0283</td>
<td>103.7663</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1</td>
<td>-0.3744</td>
<td>0.0361</td>
<td>107.8410</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Multi-Racial</td>
<td>1</td>
<td>-0.00258</td>
<td>0.0474</td>
<td>0.0030</td>
<td>0.9566</td>
</tr>
<tr>
<td>Female</td>
<td>1</td>
<td>0.0798</td>
<td>0.00914</td>
<td>76.3324</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>
Table 7

Odds Ratio Estimate of Student Placement in the Advanced Mathematics Track in Middle School Without Controlling for Prior Achievement

<table>
<thead>
<tr>
<th>Effect</th>
<th>Point Estimate</th>
<th>95% Wald Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race Am Indian vs. White</td>
<td>0.404</td>
<td>0.336</td>
</tr>
<tr>
<td>Race Asian vs. White</td>
<td>2.827</td>
<td>2.527</td>
</tr>
<tr>
<td>Race Black vs. White</td>
<td>0.628</td>
<td>0.598</td>
</tr>
<tr>
<td>Race Hispanic vs. White</td>
<td>0.576</td>
<td>0.536</td>
</tr>
<tr>
<td>Race Multi-Racial vs. White</td>
<td>0.836</td>
<td>0.753</td>
</tr>
<tr>
<td>Gender Female vs. Male</td>
<td>1.173</td>
<td>1.132</td>
</tr>
</tbody>
</table>

Students with a 70% projection for success in algebra are considered academically prepared for algebra in middle school, and students with less than 70% projection for proficiency are considered at-risk for scoring below grade level (SAS Institute, Inc., 2007). Despite evidence from SAS, it could also be argued that 70% is too arbitrary as a merit designation, and that if students were compared only at the higher ability levels, a smaller variance would occur in the odds of being placed in the advanced track.

To investigate this merit population further, figures 1 and 2 compare male and female students of each race at the 70%-80%, 80%-90% and 90%-100% probability ranges. Would the conclusion be different if 80% or 90% were the point considered as being prepared for algebra I? An education leader might assume, or at least hope, that the highest range of probability would reveal equality between the races. However, as seen in the figures below, the probability of enrolling is still not equal for
the races even as the 70% probability is raised to 80% or 90%. It is worth noting that the difference between races does decrease as the probability range increases from 70% to 80% to 90%. However, races never completely reach meritocracy, and it is only in the 95%-100% probability ranges do we begin to see a steep convergence of the races. Even at the highest range for probability of success, 99% - 100%, meritocracy in placement in the advanced track does not occur.

The figures below illustrate the percentage of students placed in the advanced track by race. Figure one is for females, and figure two is for males.
Figure 1

Comparison of Minimum Probability of Enrolling in Advanced Track in Middle School for Female Students Without Controlling for Prior Achievement
Figure 2

Comparison of Minimum Probability of Enrolling in Advanced Track in Middle School for Male Students Without Controlling for Prior Achievement
Limitations

This study has several limitations:

First, academic ability was measured only by test scores. The EVAAS projections were created using previous test scores for students and did not include any additional information. While a student must have a minimum of three test scores in order for a projection to be created, this definition of academic ability was narrowly defined. Other factors, such as classroom performance and student motivation, were not considered in the EVAAS projection.

Second, the design of this study defined placement in the advanced track by the existence of an algebra I EOC score by the end of 8th grade. By using this data as the determining factor for placement, it is possible that a student could have been placed in the advanced track in 6th grade but was moved into the lower track at some point between 6th and 8th grade. While the use of the EOC may not be the ideal indicator for placement in the advanced track, it was considered the best method for determining placement in the advanced track based on available data.

While it is possible that some students in any probability range enrolled algebra I in middle school but did not take the EOC, it is important to note that schools are penalized if fewer than 95% of students enrolled in the course on the 20th day of school are tested in the subject area (North Carolina Department of Public Instruction, 2003). Schools which test fewer than 95% of students in the subject area are not eligible to receive incentive awards or recognition, and a school which violates this rule for two consecutive years may be identified as low-performing in the ABC accountability model by the State Board of Education (North
Carolina Department of Public Instruction, 2010). While this method of identifying students who have completed algebra I is a limitation of the study, it is likely that nearly all students who are enrolled in the algebra I on the 20th day of school are tested and will have an EOC score in their file.

A third limitation is that factors other than race and gender may impact placement in the advanced track. As research indicates, socioeconomic status is a significant factor that has been found to impact student placement, but these data were not available for this study. In addition, other factors including but not limited to motivation, parent advocacy, and especially school or district resources could also impact placement in the advanced track.

**Summary of Findings**

The purpose of this study was to investigate if race, gender, or the interaction of race and gender impacted the placement of students in the advanced mathematics track in middle school. The results of the study revealed that, race was a significant factor for all races compared to White students in both logistic regressions (controlling for prior achievement or not). Asian, Black, Hispanic and Multi-Racial students had greater odds of being placed in the advanced track than White students, and American Indian students had lesser odds compared to White students when controlling for prior achievement. When prior achievement is not included in the logistic regression, odds of all races other than Asian being placed in the advanced mathematics track in middle school were lower than for White students. The complexity of the findings for race is discussed further in Chapter Five.
Gender was also a significant factor in the placement of students in the advanced track in middle school, with the odds of female students being placed in the advanced track greater than for male students no matter if prior achievement is controlled or not in the logistic regression.
CHAPTER 5

Discussion

Introduction

Academic tracking is a topic that has generated much debate in American schools. While tracking may appear to be a straight-forward system to structure course offerings to meet student needs, research has shown that tracking has not always been a meritocratic process that benefits all students (Callahan, 2005; Hallinan, 2000). Discussions about tracking can leave the education leader with difficult issues of fairness that must be addressed, particularly related to inequities in access to rigorous opportunities for students of similar academic ability.

Building on the literature of tracking, this study was designed to shed light on the meritocracy of tracking for students entering 6th grade across the state of North Carolina. The study specifically investigated the impact of race and gender on student placement in the advanced mathematics track in 6th grade. This chapter summarizes the results of the study, considers the impact on student achievement, identifies areas for further research, and provides recommendations to end the bias in the placement process.

Summary of Results

The results of this study reveal that race and gender were significantly related to placement in the advanced mathematics track in middle school for students entering 6th grade in 2006-07. While the findings of the study related to gender
support literature that the gender gap may be closing (Buchmann, DiPrete, & McDaniel, 2008; Else-Quest, Hyde, & Lynn, 2010), the findings for race were more complex and at times inconsistent with previous research (Burris, et al., 2006; Conger et al., 2009; Mayer, 2008; Oakes & Guiton, 1995; Yonezawa et al., 2002). A clear finding consistent with previous research suggests that American Indian students have significantly lower odds of being placed in the advanced mathematics track in middle school as compared to White students. However, when controlling for prior achievement, it appears Latino and African-American students have greater odds of being placed in the advanced mathematics track in middle school as compared to White students. It appears that math placement in middle school can be an advocacy tool by promoting opportunity when considering prior achievement.

As the results of the study were inconsistent with the review of literature, an additional logistic regression was run without controlling for prior achievement. The results of this logistic regression were remarkably different than when controlling for prior achievement, revealing that the odds of all races other than Asian being placed in the advanced mathematics track in middle school were lower than for White students. Although all students in the sample demonstrated merit to be placed in the advanced track based on their EVAAS projection of 70% or higher for proficiency in algebra (SAS Institute, Inc., 2007), an overrepresented number of minority students from this merit pool were not placed in algebra. These data suggest that achievement gaps prior to middle school may still serve to limit the overall opportunity for Latino and African-American students in math placement. Even though mathematic placement in middle school can be an advocacy tool for talented
minority students, lower achievement gains emerging from elementary school still serve to preclude advanced mathematics opportunity for minority students overall.

By contrast, results for both Asian students (as compared to White) and female students (as compared to male) suggest greater odds of placement in the advanced track. These data suggest being Asian or female serves as a type of asset as it relates to placement regardless if prior achievement is considered.

To be deemed a meritocratic process, placement in the advanced mathematics track in middle school would occur without influence of the student’s race or gender and solely on the student’s demonstrated ability. To align with meritocratic principals, students in this sample would have been placed consistently in the advanced mathematics track in 6th grade leading to algebra in middle school and opportunities to take many other advanced level courses in high school and beyond (Callahan, 2005; Sciarra & Seirup, 2008; Young, 1994). Therefore, the placement of students in the advanced track in middle school did not adhere to a meritocratic definition of fairness. The following discussion presents significant findings from this study.

**Denied Opportunity to the Advanced Track**

Regardless of race or gender, many students across North Carolina with a projection for success in algebra (merit sample) were denied access to the advanced mathematics track in middle school. According to EVAAS projections, 51,413 students across the state had a 70% or better probability for success in algebra. However, only 40% of those students were placed in the advanced mathematics track based on 8th grade EOC scores. Therefore, 30,665 students of
all races across the state of North Carolina were denied the opportunity to participate in the advanced mathematics track in middle school.

Reviewing the ranges of probability of success in EVAAS provides additional information to understand this issue. In the 70%-80% range for success, only 6.6% of the students were placed in the advanced track. In the 80%-90% range, only 13.5% of the students were placed in the advanced track, and even in the highest range of projection of success, 90%-100%, only 54.2% of the students were placed in the advanced track. Through all ranges of success in the sample of this study, more than half of the students predicted to be academically prepared for algebra were not placed in the advanced track.

The following table shows the percent of students in the sample who were placed in the advanced track in each probability range.

These data indicate that many students likely would have been successful in algebra in middle school but were not allowed access to the advanced track, effectively denying them the long-term benefits often associated with the advanced track such as advanced courses in high school that lead to college preparedness. In addition, students in the sample who were not challenged to their ability may achieve less in their high school experience than their peers who were placed in the advanced track. As Burris et al. (2006) found, students with the same academic ability who were placed in the highest math track successfully completed more college preparatory college math classes than their peers who were placed in the lower math track. These students could face long-term consequences such as graduating without the skills necessary for success in college-level course work,
inability to meet college readiness benchmarks in mathematics or lack of preparation for high level math and science related careers (ACT, 2004).

With an increased emphasis on STEM education (National Governors Association, 2008), the findings of this study may foretell significant consequences. As problem solving and high-level mathematical reasoning are essential skills for success in life and in STEM careers (Hyde & Mertz, 2009), these students are at a great disadvantage to access to higher levels of education as well as to making the most significant contributions to STEM careers. It is impossible to determine what may have been lost in contributions to society by limiting these students’ access to the most rigorous education. Future research is needed to determine why so many students are not offered the opportunity for advanced study, and the impact on students who were not placed in the advanced track but identified as academically prepared.

Gaps from Elementary School

By the time this cohort of students entered middle school, a significant achievement gap had already developed, resulting in fewer American Indian, Black, Hispanic, and Multi-Racial students being prepared for enrollment in the advanced track compared to White and Asian students. Based on elementary school test scores, more than 80% of Asian and White students were predicted to be proficient in algebra, while only 59% of Hispanics, 56% of American Indian and 48% of Black students were expected to achieve the same level of success. Of course, poverty, discrimination, and a host of other systemic factors may produce opportunity and achievement differences prior to elementary school, but the gap found at the
beginning of 6th grade gives support to research showing a significant achievement gap occurred in elementary school (Conger et al., 2009; Farkas, 2003).

These findings also support Farkas’ (2003) conclusion that the achievement gap existing or emerging in elementary school may have the most consequential long-lasting penalties for students. Farkas’ review of research found that the achievement gap actually increased during the elementary years and described the schooling experience as “the rich get richer, and the poor get poorer” (p. 1121). American Indian, Black, Hispanic, and Multi-Racial students entered school with lower academic skills than White and Asian students, and those gaps increased each year. For example, Black students entered elementary school one year behind White students, but finished high school approximately four years behind Whites, learning less than White students each year. These students were taught a less-demanding curriculum in elementary school, given lower grades and retained at a higher rate compared to White and Asian students (Farkas, 2003).

If the achievement gap grows as students move through school, these gaps may be exacerbated by tracking and the significant consequences of placement in mathematics in middle school. From the sample of this study, far fewer percentages of American Indian, Black, Hispanic, and Multi-Racial students were prepared for the advanced track compared to White students. Although Black, Hispanic and Multi-Racial students had higher odds of being placed in the advanced track when controlling for academic achievement, inexcusably, far fewer of these students were prepared for the opportunity.
Advocating for Minority Students

Given that the results of this study illustrate the complexity and may appear to contradict research related to tracking, the education leader may question how Black, Hispanic and Multi-Racial students in the sample had greater odds than White students of being placed in the advanced mathematics track. While this study did not investigate any rationale for placement decisions and further research is needed, a plausible explanation is that parents, teachers, school counselors or administrators understood the importance of participation in the advanced track in middle school and may have advocated for more students to be placed in the advanced track. As Spielhagen (2006) found, parents who understood the importance of placement in the advanced track in middle school overrode the school’s placement of the student in the lower track in order for the student to take algebra in middle school.

Education leaders working to increase the number of minority students enrolled in the advanced track could benefit from understanding the results of this study. Leaders must consider the moral obligation to address achievement gaps, and may use mathematics placement in middle school to advocate for minority students. Providing additional education about the benefits of participation in the advanced mathematics may increase the interest of parents and stakeholders in enrolling more minority students in the advanced track. In addition, several studies have found that students placed in the advanced track are most often successful in the advanced track (Burris et al., 2006; Marks et al, 2006; Spielhagen, 2006). Educating parent and stakeholders about the success of students in the advanced
track may also increase levels of interest in enrolling more students in the advanced mathematics track.

**Restricted Opportunities and Impact on Minority Students**

As revealed by the results of this study, only the brightest and best students of any race were placed in the advanced track at a consistently high rate, resulting in restricted access to the advanced track for all students. However, this restricted access had a stronger impact on American Indian, Black, Hispanic, and Multi-Racial students.

For students with as high as a 90% projection for success in algebra, only 72% of Asian students and 56% of White students were enrolled in the advanced track. The situation was worse for students in other groups. Only 55% of Multi-Racial students, 54% of Black students, 45% of Hispanic students, and 38% of American Indian students with a projection for success in algebra at 90% were placed in the advanced track.

This disparity in the sample was compounded by issues related to the achievement gap. The achievement gap revealed that fewer American Indian, Black, Hispanic, and Multi-Racial students were prepared for the advanced track, which created a smaller group of students likely to be successful in the advanced track. However, even when students in these groups demonstrated the merit to be placed in the advanced track, only the brightest of the brightest students were enrolled. At 99% projection of success, the gap in placement in the advanced track between the races did not close. While access to algebra in middle school was
restricted for students of all races, American Indian, Black, Hispanic, and Multi-Racial students were disproportionately affected.

Although the odds of Asian, Black, Hispanic and Multi-Racial students being placed in the advanced track were greater than White students when controlling for prior achievement, the higher placement rate does little to create equal access by race to the most rigorous courses. When comparing the odds of placement in the advanced track without controlling for previous achievement, it is clear that American Indian, Black, Hispanic, and Multi-Racial students were placed in the advanced track at a much lower rate than White and Asian students. The cumulative effects of achievement gaps, achievement profiles, and restricted access to the advanced track appear to have a much greater impact on American Indian, Black, Hispanic, and Multi-Racial students than it did on White and Asian students.

With the disparity between races in the percentage of students prepared for proficiency in algebra, placing slightly more students in the advanced track is unlikely to ever close the opportunity gap until the achievement gap is closed. With the established achievement gap in many schools across the U.S., appropriate placement by merit becomes an even more significant issue that could be considered a strategy to promote success for all academically talented students regardless of race.

Impact of Gender on Mathematics Placement

The findings of this study revealed that gender also had an impact on placement in the advanced math track. As seen in the previous figures, slightly more female students in the sample were enrolled in the advanced track compared
to males. These findings support the literature that the gender gap in math is closing (Buchmann, DiPrete, & McDaniel, 2008; Else-Quest, Hyde, & Lynn, 2010). However, the findings also give education leaders and researchers a new concern to consider. What has caused boys, who historically have been more successful in the mathematics and science courses, to fall behind as evidenced by placement in the advanced math? Was this change caused by an increase in academic achievement for girls or a decrease in academic achievement for boys? Have gains been made in encouraging girls to participate in higher levels of mathematics at the expense of boys, or are there other factors that have brought about inequity? More research is needed to answer these and other questions related to meritocracy in placement in the advanced track for boys and girls.

**Impact on Student Achievement and Long-Term Consequences**

While tracking may be thought to be a helpful tool for school organization, the combination of tracking, achievement gaps and restricted access to rigorous curriculum may have long-term implications for students, communities, and the nation. The education leader must consider the long-term impact on student opportunities and outcomes when making decisions especially related to placement in the advanced track, advocating for and leading efforts to prevent the disparities found in this study.

With the reauthorization of the *No Child Left Behind Act*, student achievement issues such as improved test scores and decreased dropout rates receive continuous focus. Around one million students drop out of school each year in the U.S., and fewer than half of the students who do graduate from high school are
prepared for college-level math and science (Corbishley & Truxaw, 2010; U.S. Department of Education, 2007). Particularly in high poverty urban schools, student disengagement intensifies during the middle school years, which, if not addressed, is likely to lead to an increased dropout rate (Balfanz, Herzog, & Mac Iver, 2007). The results of this study show that tracking, combined with academic achievement and restricted access to rigorous courses compounds the issue.

In a survey of high school dropouts, Bridgeland, Dililuio and Morison (2006) found that 69% of former students reported that they were not motivated or inspired to work hard in school, 80% did one hour or less of homework each day, and 66% would have worked harder in school if more had been expected of them. Students who were misplaced in a lower track than appropriate for their academic ability are more likely to experience similar issues related to motivation and expectations, leading to more dropouts and loss of post-secondary opportunities. If the inequities of this study are not addressed, North Carolina can expect a continuation of the achievement gap between the races and high dropout rates particularly among minority students. Economic implications are profound for individuals, the community, state and nation as high school dropouts are three times more like to be unemployed and earn about $1 million less over a lifetime than college graduates (Doland, 2001; National Center on Education Statistics, 2005).

Burris et al. (2006) reported that higher student achievement may very well be a result of exposure to rigorous curricula and high expectations. Through their review of literature, students who participated in more rigorous curriculum had access to better qualified and more experienced teachers, and students who had the
same academic performance completed more college-preparatory math courses by being enrolled in the higher track compared to those enrolled in the lower track. By ensuring that all students are placed appropriately based on demonstrated academic ability, schools can expect improved student achievement outcomes (Farkas, 2003; Spielhagen, 2006).

In international competition, the U.S. has much to gain by closing achievement gaps and providing access to all students to rigorous curriculum. Schmidt et al. (2011) report that most nations endorse the idea that all children should have equal educational opportunities and have created public policy that supports this notion. Nearly all of the countries that participated in the Third International Mathematics and Science Study (TIMSS) focus on algebra and geometry in 8th grade, leaving the U.S. behind with no coherent standard for 8th grade math and often focusing on 6th grade math skills in the 8th grade (Cogan et al., 2001). Not only is there a disparity in student access by race and gender to rigorous curriculum in the U.S., the majority of U.S. students are being short-changed in opportunities in mathematics compared to other countries. As research has shown that more demanding math curriculum leads to higher student achievement, disproportionally denying the opportunity to learn challenging mathematics curriculum to student groups, particularly with students who are academically prepared, conversely leads to lower student achievement (Boaler, 2008; Chiu & Khoo, 2005).

Schools, districts and states working to increase the percentage of students attending post-secondary education would benefit from preparing and placing more
students in the advanced track in middle school. ACT (2005) reports a review of research revealing that successful completion of a challenging and rigorous curriculum is often the strongest predictor of not only college entrance, but also degree completion. Rigorous curriculum is needed throughout the K-12 experience to best prepare students for post-secondary education, but access to the most rigorous curriculum, through appropriate tracking based on academic ability, often begins in middle school mathematics. Sciarra and Seirup (2008) note that as more and more employment opportunities require post-secondary education, increasing rigorous academic preparation to a larger group of students creates a better prepared workforce in the future. In addition, as the U.S. population continues to diversify and becomes increasingly minority majority, employers will become increasingly dependent on members of current racial minorities to fill jobs.

Appropriate math placement in middle school has long-term implications for the U.S.

**Limitations and Need for Further Research**

This study has several limitations:

First, academic ability was measured only by test scores. The EVAAS projections were created using previous test scores for students and did not include any additional information. While a student must have a minimum of three test scores in order for a projection to be created, this definition of merit was narrowly defined. Other factors, such as classroom performance and student motivation, were not considered in the EVAAS projection.

Second, the design of this study defined placement in the advanced track by the existence of an algebra I EOC score by the end of 8th grade. By using this data
as the determining factor for placement, it is possible that a student could have been placed in the advanced track in 6th grade but was moved into the lower track at some point between 6th and 8th grade.

A third limitation is that factors other than race and gender may impact placement in the advanced track. As research indicates, socioeconomic status is a significant factor that has been found to impact student placement, but these data were not available for this study. In addition, other factors including but not limited to motivation, parent advocacy, and school or district resources could also impact placement in the advanced track.

As this study does not identify factors other than race and gender that may have impacted decisions about students who were adversely affected in placement in the advanced track, further research is needed to gain more knowledge in this area. Future research could include answering questions such as:

1. How were placement decisions made for these students?
2. Were data available to assist educators and parents in making the appropriate placement decisions for these students?
3. How does motivation in classroom behavior, homework completion, etc. impact students of varying ability levels when placed in the advanced track?
4. What impact does socio-economic status have on the placement of students?

**Conclusion and Recommendations**

The results of this study provide support to education leaders who argue that schools reproduce the problems of society (Heck et al., 2004). While the results do not support research that claims the continuation of tracking alone has denied
opportunities to American Indian, Black, Hispanic and Multi-Racial students (Burris et al., 2006; Heck et al., 2004; Mickelson, 2001), it appears that the combination of tracking, academic achievement, and restricted access to the advanced track had a disproportionately negative impact on these student groups.

If students groups are disproportionately impacted because of socially constructed norms, the education leader must question whether the historical context of racial segregation and individual beliefs about culture are undermining the intent of the educational system to provide rigorous education to all (Ferri & Connor, 2005). If achievement and access to opportunities is impacted by race, can education leaders truly say that they are attempting to educate all students equally? These questions have profound implications which are left to the education leader to address (Schmidt, Cogan, & McKnight, 2011).

The results of this study should give cause to education leaders to closely examine the outcomes of the educational system. In doing so, important questions arise related to student achievement and opportunities. How do education leaders effectively address issues related to achievement and opportunity gaps? How do education leaders ensure that all students have the opportunity to participate in rigorous coursework? These questions point to critical issues that require additional research. If public schools are committed to fostering a society that nurtures and reinforces the American Dream for all students regardless of race and gender, education leaders must adopt policies and practices that reflect that philosophy and ultimately improve outcomes for all students (Pappas & Tremblay, 2010).
In order to address the disparities found in this study, school and district-wide planning is needed to examine policies and procedures related to closing achievement gaps and access to rigorous curriculum for all students. This planning should include specific strategies for educators and stakeholders to ensure that all students have equal access to rigorous curriculum and opportunities that lead to academic achievement. Similar to Stone’s (1995) findings, strategies might include:

1. Provide rigorous curriculum opportunities in K-5 mathematics curriculum that enhance student learning, close achievement gaps and prepare all students for placement in the advanced track.

2. Provide additional support such as remediation or acceleration to any student who achieves below grade level, with particular awareness that achievement gaps may exist as student enter school and may grow throughout the schooling experience (Farkas, 2003). Review the outcomes of remediation and acceleration to determine if achievement gaps exist and address any gaps through additional intervention and support.

3. Review school or system data to determine outcomes of placement in mathematic tracks. Disaggregate data by race, gender, or other appropriate characteristics.

4. Use objective data, such as EVAAS projections, to inform decisions about placement in mathematics tracks and correct any inequities in access to rigorous curriculum. Share this information with students and parents so that they are fully aware of all available data.
5. Actively encourage all high achieving students, with particular emphasis on American Indian, Black, Hispanic and Multi-Racial and male students, to enroll in the advanced track as early as available to maximize educational opportunities.

6. Provide professional development to help educators understand and process issues related to student achievement. Clearly define issues of equity in student placement in academic tracks and assist educators in the development of strategies that will eliminate any inequalities in the placement process.

7. Increase collaboration among educators and education stakeholders to eliminate any bias in the placement process. Develop committees or task forces charged specifically with ending bias in the placement process.

8. Develop district wide data-driven guidelines that provide educators, parents and students specific instructions for appropriate placement in the advanced track.

Students, regardless of background or demographics, have a right to a rigorous education that will prepare them for opportunities and success in future endeavors. While Black, Hispanic and Multi-Racial students had higher odds than Whites of being placed in the advanced track, the cumulative effects of achievement gaps, achievement profiles, and restricted access to the advanced track appear to have a much greater impact on these students than it does on White and Asian students. Only through strict adherence to the principals of meritocracy can we provide this
type education to all students, closing achievement gaps and preparing all students to become global learners and leaders for our future.
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