A STRUCTURAL MODEL OF THE MATH COURSE SELECTION PROCESS IN THE EIGHTH GRADE IN PUBLIC SCHOOLS

by

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(ABSTRACT)

Although enrollment in advanced mathematics courses is a significant determinant of mathematics achievement, the majority of public school students are not enrolled in advanced mathematics courses in high school. Policy makers are interested in the dynamics of the math course selection process in the eighth grade because it is viewed as a pivotal transitional point when students are confronted with the decision to either enroll in algebra, the first course on the advanced math track, or in regular math. Approximately one third of eighth grade students enroll in algebra, in spite of general availability of the course. Enrollment patterns vary among the four major race/ethnic subgroups - Asian, Hispanic, Black and White.

This study constructed and tested a structural equations model that examined the factors influencing math course choice and the course selection process in the eighth grade in public schools. There were three sources of influence in the model: 1) math achievement; 2) school policies and practices; and 3) parents. The model consisted of three exogenous and five endogenous

variables. The model was tested five times. It was tested on a nationally representative sample of 7,648 eighth grade public school students. It was also tested separately on the four race/ethnic subgroups comprising the full sample.

The study used data from student and parent files of the base year survey of the National Education Longitudinal Study of 1988 (NELS 88), a major national study conducted under the auspices of the National Center for Education Statistics (NCES).

For the full sample, the major school and parental factors influencing a student's math course choice were math track placement, parents' educational expectations and school-parent algebra push. Of the two achievement influences, standardized math test scores had the stronger influence on the outcome variable. Prior math grades influenced math course choice, but to a lesser extent and was influential largely due to an indirect effect. Although these factors were important for each of the subgroups, the influence of the factors varied among the subgroups. The model fitted the data fairly well for the full sample and the Asian and White subgroups, but less well for the Hispanic and Black subgroups.

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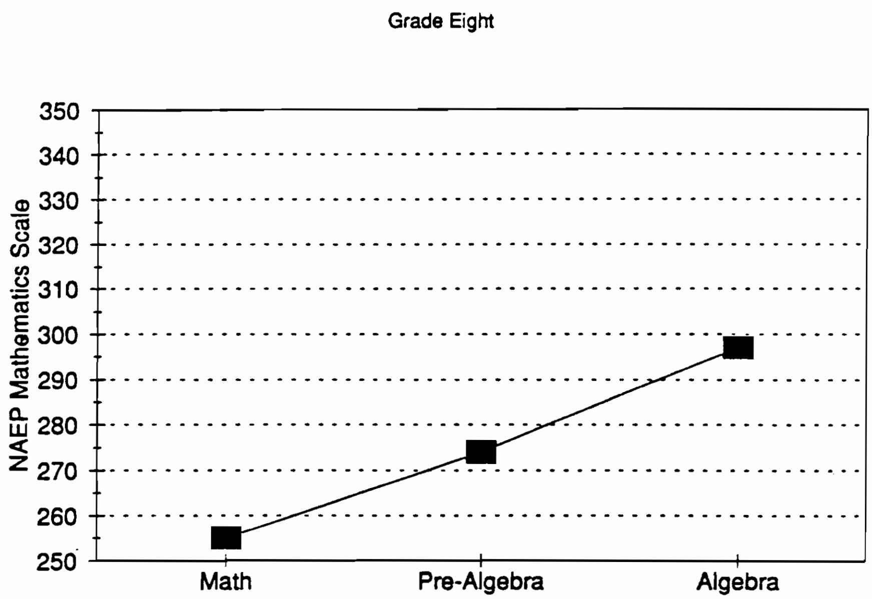
CHAPTER ONE: INTRODUCTION

One of the most significant determinants of math achievement at the secondary school level is enrollment in advanced math courses (Ekstrom, Goertz & Rock, 1988; Horn & Walberg, 1984; Reynolds & Walberg, 1992). The 1990 National Assessment of Educational Progress (NAEP) reported that American eighth graders who have taken pre-algebra and algebra have higher math proficiency levels than those who have taken regular math and seniors who have taken courses from algebra through calculus demonstrate progressively higher math achievement (Mullis, Dossey, Owen, & Phillips, 1991, see Figure 1). Studies have suggested that differences in enrollment patterns in math courses are largely responsible for gender (Pallas & Alexander, 1983) and race/ethnic differences in high school math achievement (Moore & Smith, 1985).

The middle school years, grades five through eight, comprise a critical transitional period for American students in mathematics course taking and mathematics achievement (Reynolds, 1991). Although middle school students are learning to make choices (Thornburg, 1986), they are confronted with math course options that have educational and career consequences (National Council of Teachers of Mathematics [NCTM], 1989). Math in the eighth grade is organized around a differentiated curriculum, with students enrolling in either algebra, pre-algebra, or regular math (Hoffer,1992). If students enroll in algebra,



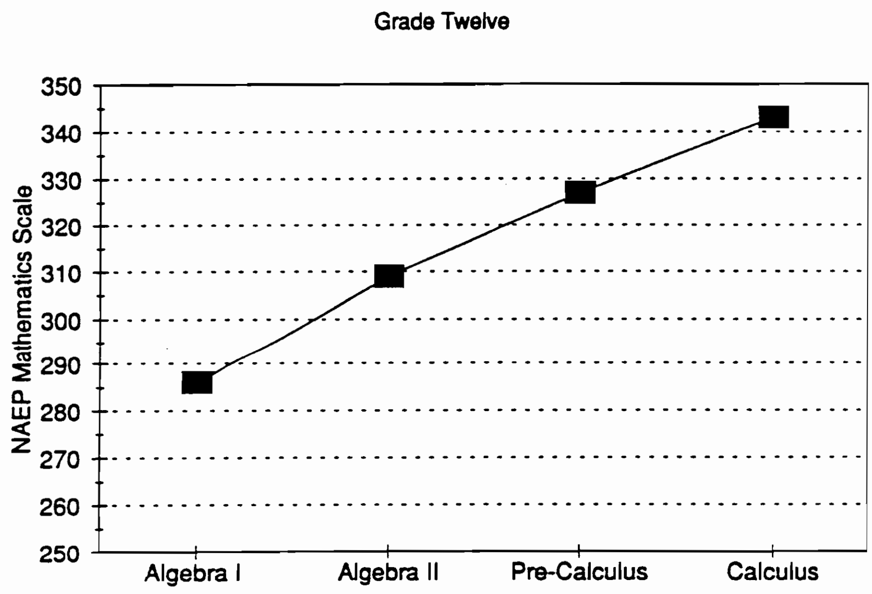


Figure 1. Average math proficiency of students in grades eight and twelve assessed at the highest level of math course attained. Data from tables in The State of Mathematics Achievement: NAEP's 1990 Assessment of the Nation and the Trial Assessment of the States (pp. 24 & 33) by I.V.S. Mullis, J.A. Dossey, E.H. Owen and G.W.Phillips.

they usually continue on a math track in high school that provides several advantages - the opportunity to take advanced math courses, concluding with calculus in the senior year, participation in classes with motivated peers and access to the best teachers (Useem, 1991a). In addition, students are better prepared to take the admission and placement tests required by many colleges. On the other hand, when students enroll in regular math, a course that is arithmetic-oriented and repetitious of earlier instruction (Becker, 1990; Flanders, 1987), this curricular trajectory does not occur, and consequently, students do not gain the benefits derived from enrollment in the advanced math track. "Algebra is a critical discriminator in this country for a student's future" (Lodholz, 1990, p.26).

Taking calculus in high school has several advantages. Calculus on high school transcripts is viewed as a competitive advantage for admission to selective colleges and universities (Useem, 1992a). Moreover, students who are not in the advanced math track are frequently ill-prepared to take calculus in college (Malcolm & Treisman, 1988) where classes, much larger than those in high school, (Kolata, 1988) are usually taught by teaching assistants and part-time faculty (Cipra, 1988; Reed, 1988). As a result, students who take calculus in the freshman year of college encounter a 25 - 50% attrition rate (Ferrori, 1988; Kolata, 1988) - a daunting statistic in view of the fact that over half of all college majors now require calculus (Steen, 1988).

In addition to the opportunity to take calculus in high school, students in the advanced math track have received instruction in more of the topics evaluated by the college admission and placement tests in math. For example, the SAT II Level I achievement test required by many colleges, evaluates students over topics from trigonometry and functions. Students who are not in the advanced math track usually are not exposed to these curricular areas by the time they take the test.

The majority of American eighth grade students attending public schools do not enroll in algebra, despite its general availability (Mullis et al., 1991). Conversely, in many other industrialized countries all students take algebra in the seventh and eighth grades (Usiskin, 1987) where calculus is considered a standard high school course (McKnight et al., 1987).

Increasing the number of secondary students in the advanced math track is important for three primary reasons. First, educational and economic opportunity for individual students is limited if they fail to reach a level of math achievement necessary to compete successfully in college (National Research Council, 1989) and the work place (Johnston, & Packer, 1987) in a science and technology based global economy. Secondly, there is a concern that limited educational and economic opportunity for large numbers of students will intensify and accelerate the existing economic and social stratification of society (NCTM, 1989). Thirdly, there is a fear that if a greater proportion of the secondary student population does not achieve at the advanced levels of mathematics proficiency, the competitiveness of the future American workforce might be threatened in a global economy (National Research Council, 1989). For example, the MIT Commission on Industrial Productivity (Dertouzos, Lester, Solow, & MIT Commission of Industrial Productivity, 1989) argued that American colleges turn out an inadequate number of engineers. According to the MIT study, six percent of college degrees in the United States are in engineering in comparison to 20% in Japan and 37% in Germany. Following this line of reasoning, the Second International Mathematics Study (SIMS) suggested an analysis of the factors influencing enrollment in advanced math courses (McKnight et al., 1987).

The large number of American students who are not on the advanced math track should not be attributed to the lack of math ability on the part of students. Programs and projects over the years have demonstrated that "average" students have learned algebra earlier than the ninth grade (Mason, Schroeter, Combs, & Washington, 1992; Usiskin, 1987) and calculus in high school (Sells, 1978). In spite of such evidence, Taylor (1990) asserted that it is commonly believed that a large proportion of students are incapable of learning algebra and succeeding at higher math, thus preventing them from achieving at the higher levels of math proficiency.

There is not a consensus as to why some students, but not others, enroll in algebra in the eighth grade when the course is available. Current theories suggest the importance of several influences: differences in prior math achievement (Becker, 1990; Reynolds, 1991); differences in parental involvement in course selection (Baker & Stevenson, 1986; Lareau, 1989; Useem, 1992b); inequitable access to information from counselors and teachers (Commission on Precollege Guidance and Counseling, 1986; Lee & Ekstrom, 1987; Powell, Farrar, & Cohen, 1985); and tracking policies and practices (Gamoran, 1987, 1989; Hoffer, 1992; Oakes, 1985; Vanfossen, Jones & Spade, 1987). In order to develop, refine and implement policies that lead to increased enrollment in demanding math courses and subsequently to higher math achievement, policy makers need research they can draw upon that provides insight into the math course selection process at critical transitional points, such as the eighth grade.

Problem

A majority of American students do not take algebra in the eighth grade even when the course is available (Mullis, 1991) although it is the entry point for the secondary school advanced math track, a program of studies traditionally associated with higher levels of math achievement (Useem, 1992a). As a consequence of a decision made in the eighth grade, the majority of students cannot take the sequence of courses in high school that culminates with calculus or another fifth year math course (Useem, 1991b). This situation contributes to both a suppression of overall math achievement (Ekstrom et al., 1988; Horn & Walberg, 1984; Reynolds & Walberg, 1992) and a restriction of individual educational and economic opportunity (NCTM, 1989).

Significance of Study

This study contributes to an understanding of mathematics achievement in public schools by examining the math course selection process that occurs at a critical juncture in a student's secondary school career. Within a larger context, it contributes to the substantial body of status attainment research by examining the school and parental influences that are integral to a decision-making process that has long-term educational and career consequences. This study makes an important contribution because it uses a quantitative approach to examine both school and parental factors that are influential in a course selection process that occurs early on in a student's educational career.

Many prior studies on the course selection process in math have been qualitative. Basing their studies on a relatively small number of parent interviews, Useem (1992b) and Baker & Stevenson (1986) suggested that parents influence a student's enrollment in advanced math courses by managing a student's school career at critical decision points. Other reports and studies have suggested that students with parents of limited education do not receive course selection assistance from either parents or school, so consequently enroll in less demanding courses (Commission on Precollege

Guidance and Counseling, 1986; Powell et al., 1985). In contrast, this study uses a quantitative approach to examine the process. There have been numerous quantitative studies from the body of status attainment research, but many have analyzed the effects of course and track placement on various outcome variables while giving little attention to the process leading to placement (Gamoran, 1992).

Furthermore, there is a need for studies that focus on both school and parental influences in the course selection process. Many studies on parental involvement have ignored the influence of parents in the course selection process (Useem, 1991b). Lareau (1989) argued that models of educational performance should include these parental influences. Likewise, Garet and Delany (1988) encouraged researchers to investigate the school level processes that result in the pairing of students with courses. Adopting the theory that both school and parental factors influence a middle school student's math course choice, this study examines both sources of influence.

Many prior studies in status attainment research have focused on the course selection processes that occur at the high school and college levels. This study examines the process that occurs in the middle grades, a critical decision-making period that has consequences for high school and college.

Purpose of Study

The purpose of this study is to construct and test a model of the math course selection process in the eighth grade in public schools. The primary objective is to examine the impact of parental and school influences on a student's math course choice while controlling for parents' education level, standardized math test scores and prior math grades. A secondary objective is to examine the influence of parents' education level, standardized math test scores and prior math grades in the math course selection process. The model which is well grounded in research and theory is illustrated in Figure 2. The following research questions provide the framework for this study:

1. While statistically controlling for parents' education level, prior math grades and standardized math test scores, how do school and parental factors influence a student's math course choice?
2. How do the factors, parents' education level, standardized math test scores and prior math grades, influence the math course selection process?

All of the variables included in the model are hypothesized to directly or indirectly affect the outcome variable, math course choice. Furthermore, each variable is hypothesized to be important in the math course selection process because of its influence on one or more of the other variables. In addition to analyzing the data for the full sample, separate analyses of the data are done for the four major race/ethnic population subgroups (Asian or Pacific Islander, Hispanic, Black and White).

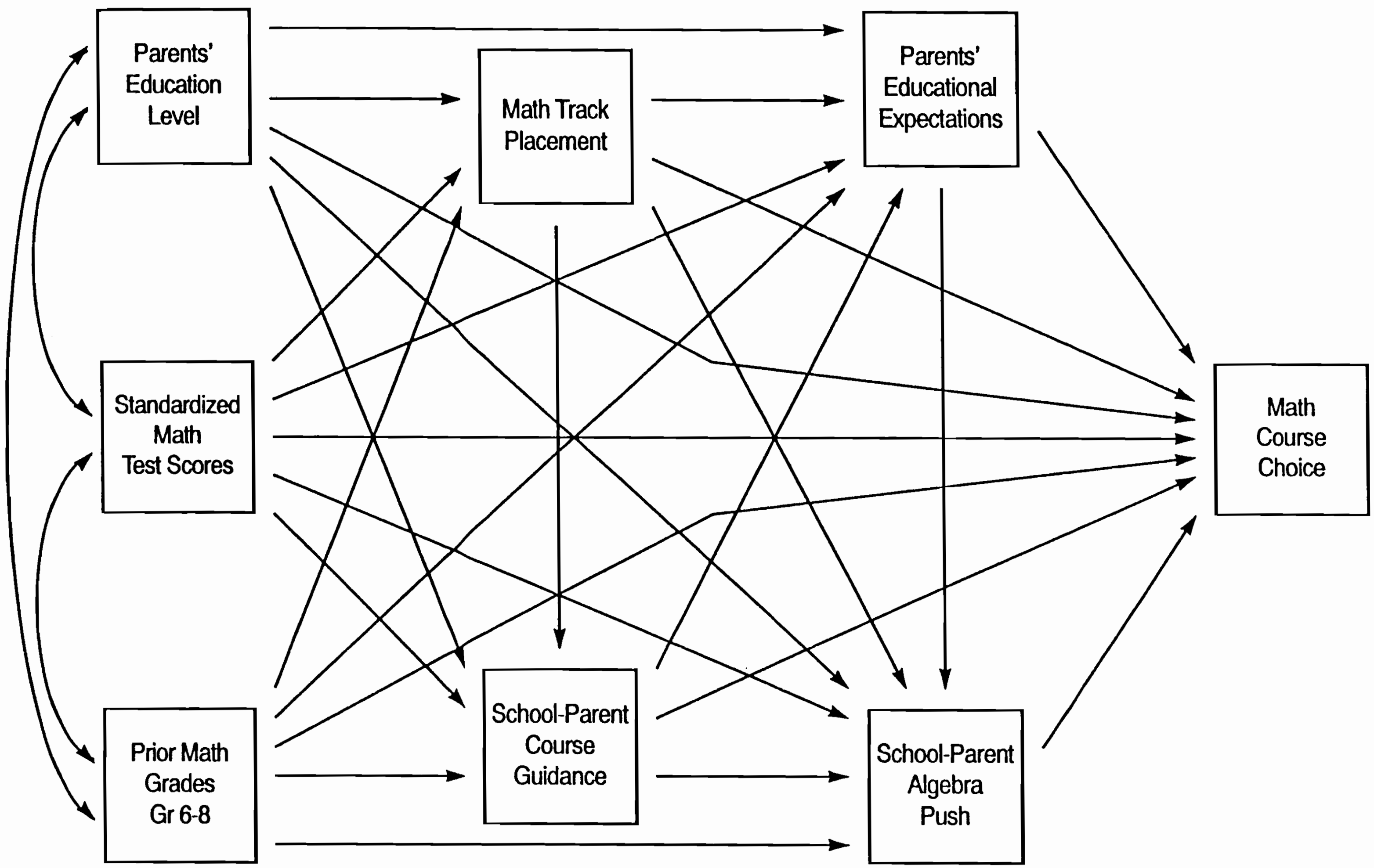


Figure 2. Structural model of the math course selection process in the eighth grade in public schools.

Definitions for Research

The variables in the study's model are described in detail in Chapter Two (see Table 1, p. 42). In addition, details on the construction of the variables is provided in Appendix A (see Table A-1, p. 104). This section provides brief definitions and background information on the variables used in this study.

There are two indicators of math achievement used in the model. The variable, prior math grades, refers to the math grades students reported in the survey they had received from grade six to the time in the eighth grade when they were completing the survey. The variable, standardized math test score, refers to the results of a timed standardized math test comprised of 40 items that assessed mathematical knowledge. The thirty-minute math test was given to eighth grade students as part of the survey. It is being used as a proxy variable to represent a standardized test administered to students at the end of the seventh or beginning of the eighth grade.

School influences are represented by two variables in the model reflecting school policies and practices that have an impact on the math course selection process: 1) math track placement; and 2) school-parent course guidance contacts. Math track placement refers to a student's math ability group assignment as reported by the student. School-parent course guidance contacts refers to the frequency with which school personnel contacted parents regarding the academic program and specifically, high school course selection.

It is a composite variable created for this study from three survey items completed by parents.

Parental influences are represented by two variables in the model: 1) parents' education levels; and 2) parents' educational expectations. The variable, parents' education level, represents the highest level of education attained by either of the parents. The data were reported by the parents. Student data regarding parents' education level were used whenever parent data were missing. The highest valid value was used by NELS to create this composite variable. The factor, parents' educational expectations, refers to the level of education parents expect students to attain. The data were reported by parents.

The factor, school-parent algebra push, represents the encouragement and guidance a student had received from counselors, teachers and parents to take algebra. It is a composite variable created for this study from two survey items completed by students.

Math course choice, the model's outcome variable, represents the course choice that confronted eighth grade students at the beginning of the school year. The choice was whether to take algebra, the first step on the advanced math track, or regular math, the standard math course offering in the eighth grade.

Benefits and Limitations of Study

The study used selected data from the NELS 88 survey, a national survey of eighth grade students. There were numerous benefits in conducting a secondary data analysis with a large national data base. One, the survey was administered to a national representative probability sample of 19,396 public school students from 815 schools. The size and design of the sample used for the NELS 88 survey provided assurance with respect to the quality of the sample. Two, the questionnaires completed by students, parents and school administrators were developed and reviewed by professionals under contract to the U.S. Department of Education's National Center for Education Statistics (NCES). Three, one of the purposes of the NELS 88 surveys was to collect data that would benefit the development and evaluation of education policy and, specifically, address such issues as ability grouping and the role of parents in their children's educational success (NCES, 1990).

Any limitations imposed by doing a secondary data analysis with a national data base were minimal in comparison to the benefits. One limitation was that the survey questions came from an extant data base and were not created specifically for this study. For example, the standardized math test scores for students were derived from tests administered six to nine months after the beginning of the school year. In order to use a standardized math test score as an exogenous variable in the model for theoretical and control purposes, it was necessary to use the available test score as a proxy variable to represent a test score obtained at the end of the seventh or beginning of the eighth grade. A second limitation was that it was necessary to interpret the findings cautiously because the controls characteristic of an experimental study were not present.

An additional limitation is the cross-sectional nature of the study. By not using a longitudinal framework, the model's causal ordering of the variables is arguable on the grounds of temporal logic derived from prior research findings, not on the basis of a chronology of event occurrence.

Organization of Study

This study consists of five chapters.

Chapter One presents a background, a statement of the problem, the significance of the study, the purpose, definitions for research, benefits and limitations of the study and the organization of the study.

Chapter Two contains a review of the literature that was drawn upon to develop a conceptual and theoretical framework for the study's model.

Chapter Three focuses on the data, model and procedures of analyses.

Chapter Four presents and discusses the study's findings.

Chapter Five discusses the conclusions, policy implications and future research suggestions.

CHAPTER TWO: REVIEW OF SELECTED LITERATURE

This chapter presents an overview of selected studies, professional articles and reports that are relevant to the theoretical and conceptual framework for the model used in the study. The chapter contains three major sections, each with appropriate subsections. The sections focus on three major sources of influence in the math course selection process that can affect math course choice: 1) math achievement; 2) school policies and practices; and 3) parental influences.

Influence of Math Achievement

McKnight et al. (1987) found that although eighth grade students in advanced math (algebra) classes had higher arithmetic test scores than students in the other math classes suggesting stronger prior math achievement, there was still a great deal of overlap in prior achievement among different track or group placements. For example, the results of the study indicated that some students in Enriched math classes had higher scores than students in the Algebra classes and the lowest scoring students in Algebra had lower scores than almost all the students in the Typical math classes. The results of this study suggested that prior math achievement as well as other factors influenced math course placement.

Mason et al. (1992) found that 17% of average ability students in a pre-algebra class scored as high or higher than 47% of high ability students in algebra on a measure of pre-algebra mastery. The study concluded that middle schools unfairly and unnecessarily limited access to advanced math courses through their course assignment practices and policies.

Studies have found that average-ability students with highly educated, high SES parents are pushed up in the math tracking system, thus weakening the effect of academic performance on course choice. In an exploratory study that interviewed 41 mothers of eighth grade students, Baker and Stevenson (1986) suggested that highly educated mothers intervened in the course selection process in order to place their children in advanced courses. Interviewing 86 mothers of middle school students, Useem (1992b) concurred that highly educated mothers frequently intervened in the course selection process in the middle years to ensure their children's placement in advanced courses.

Basing a study on participant observation and interviews with school staff, Finley (1984) found that teachers stressed the importance of motivation over ability for enrollment in advanced classes. The study found that teachers recognized that many students with the ability to do advanced work were enrolled in less demanding classes because they were unwilling to do the work required of them in the advanced classes.

Reviewing the transcripts of 1,700 students entering the ninth grade, Garet and DeLany (1988) concluded that prior math achievement in terms of grades and test scores was a major determinant of course choice, but not the sole one. They found a great deal of variability along the lines of prior math achievement in the student composition of the advanced and regular math courses.

Influence of School Policies and Practices

Math Track Placement

The practice of using a within-school instructional stratification mechanism in the math program has been an integral aspect of public education, assuming a variety of formats and labels over the years. In spite of a high degree of variability among schools in policies and practices relating to math tracking (Hoffer, 1992; Useem, 1991b), there have been common patterns. The math curriculum has been frequently differentiated to reflect students' post-secondary plans. In addition, curriculum and instructional methodology has been shaped to meet special learning needs associated with specific groups of students identified through special education legislation, such as the learning disabled and gifted and talented. Another practice has evolved with the development and implementation of the regular and advanced math tracks for college bound students.

The policy and practice of within-school stratification or instructional grouping has both its critics and proponents. Social theorists who study the causes and consequences of a socially stratified society have criticized tracking because of its contribution to academic, social and economic inequities (Gamoran, 1986; Oakes, 1985; Rosenbaum, 1976). Barr and Dreeben (1983) argued that sorting and tracking of students is responsible for a greater inequality of learning opportunities occurring within schools than that which exists between schools. In spite of its drawbacks, many practitioners have defended tracking as being a necessary practice because of its effectiveness in educating a widely diverse group of students with different learning needs (Slavin, 1990) and motivation levels (Finley, 1984).

The impetus for much of the survey research on tracking over the past two decades was in response to Equality of Educational Opportunity, a national study commonly known as the Coleman report, (Coleman et al., 1966) which concluded that achievement varied more within schools than between them. In reaction to the report, researchers set out to identify the variables that contributed to the within-school variability in achievement (Gamoran & Berends, 1987). Controlling for general ability but not prior achievement in specific areas, Alexander and McDill (1976) found that college preparatory programs were associated with higher achievement. Gamoran (1987), using data from the High School and Beyond study and controlling for prior achievement, found that track placement resulted in significant achievement advantages, particularly in math. Using British survey data and controlling for prior achievement, Kerckhoff (1986) found substantial differences in math achievement that he attributed to differences in instructional grouping and track placement. Applying multiple regression techniques to High School and Beyond data, Vanfossen et al. (1987) found a moderate effect of track placement on the types of courses taken in math. Gamoran and Berends (1987) in their synthesis of survey and ethnographic research on tracking and grouping practices concluded that all forms of within-school instructional stratification were associated with differential course taking which, in turn, were associated with achievement differences in math.

Finley (1984) suggested an association between track placement and staff attitudes toward students. Through the use of participant observation and interviews with school staff, Finley investigated the use of tracking and documented how its practice evolved over a 13 year period in a specific suburban public high school. Finley found that staff described students in the advanced tracks as highly motivated, willing and eager to do whatever was assigned. Finley concluded that staff viewed students in the higher groups or tracks more favorably, thus providing them more encouragement and expecting more from them. In a study of British schools comparing grouped and non-grouped instruction, Kerckhoff (1986) suggested that membership in curricular tracks or groups conveyed a symbolic meaning to school staff, parents and students themselves that went beyond actual performance or potential.

Alexander and Cook (1982) found high school course taking patterns to be influenced by track placement which in turn was largely determined by the course selection patterns and academic performance established in the middle and elementary school years. They analyzed data from the 1960's collected by Educational Testing Service with a structural equations model of the school attainment process. The study concluded that track assignments were based mainly on criteria of academic performance originating from the elementary and middle school years and found little indication of socio-economic, racial or gender effects in the curriculum sorting process.

Tracking in math officially begins at the middle school level in grade eight when some students take algebra, the first high school math course, while others take regular math, usually arithmetic or pre-algebra. Becker (1990), conducting a multivariate statistical analysis of national survey data collected by the John Hopkins University Center for Research on Elementary and Middle Schools, concluded that although many students in the eighth grade quickly mastered the mathematics that was taught because it was a repetition of earlier instruction, they did not take algebra. Becker found that algebra was selectively offered to students, resulting in only one-sixth of students taking the course. Using the same national survey, Braddock (1990) found that schools increasingly assigned students to ability-grouped classes in math as they moved to higher grades (from 57% in grade 5 to 94% in grade 9). Using

LISREL VII to analyze data collected from 1987 to 1989 by the Longitudinal Study of American Youth (LSAY), Hoffer (1992) reached several significant conclusions regarding tracking. Hoffer concluded that the practice of ability grouping in math in the middle school constituted tracking. Secondly, he concluded that students assigned to the low and middle groups were put at a major disadvantage with respect to math achievement because of the differentiated curriculum. Students in the low and middle groups took a course primarily consisting of arithmetic whereas students in the high groups took algebra. Controlling for initial differences among the students in the different groups, Hoffer concluded that high grouped students experienced differential benefits primarily due to exposure to a differentiated curriculum. An earlier study reviewing the textbooks used in the middle school math curriculum criticized non-algebra courses as being arithmetic-driven and largely repetitious of elementary school math (Flanders, 1987). Flanders estimated that 90% of the content in algebra was new in contrast to only 30% of the content in regular math.

Kulik and Kulik (1987) performed a meta-analytic study involving 90 studies focusing on grouping or tracking of students by classes. The major finding was that students in the advanced classes, groups or tracks experienced the greatest gains in academic achievement.

Prior research has indicated that track placement influences students' access to a school's resources, including counseling. Using a path analysis to analyze the data collected by Coleman's Equality of Opportunity survey, Heyns (1974) found the variable, track placement, was the single largest predictor of the number of times a student saw a counselor. Heyns concluded that track placement influenced the differential allocation of a school's counseling services that provided guidance and encouragement in the course selection process.

School Guidance

There have been numerous studies that have examined the role of school guidance in the course selection process, with some studies concentrating exclusively on math course choice. Some of the studies have focused exclusively on the role of the counselor, while others have examined the importance of teachers in an advisory and guidance role.

The Commission on Precollege Guidance and Counseling (1986) asserted that students who do not receive educational guidance for course selection at home are the ones who need to receive assistance from the school. Using data from the High School and Beyond survey, the Commission's study found the influence of counselors and teachers on students post-high school educational plans increased as the socioeconomic and parental education levels of the students decreased. Unfortunately, the study found that too often students who did not receive educational guidance at home were the same ones who did not receive it at school.

Analyzing data from the High School and Beyond Surveys with path analysis, Lee and Ekstrom (1987) conducted a study that examined the impact of school counseling on math course choice in high school. The study had a dual focus. First, it examined the factors that affected access to a school's counseling services for math course selection. Secondly, it examined the effect of a school's counseling services on math course selection. The study concluded that students in public schools from lower socioeconomic homes often did not receive advice from either home or school regarding math course choice, so often were forced to make choices on their own. By contrast, students from higher socioeconomic homes were influenced in their math course selection by both parents and school. The study also concluded that background characteristics and track placement directly affected student access to school counseling services regarding math course selection.

Miller (1992) found that teachers' encouragement or "teacher math push" had a positive effect on a student's attitude and persistence in math throughout a student's school career. Analyzing data from the Longitudinal Study of American Youth (LSAY) within the framework of a structural equations model, Miller was primarily interested in examining the factors that influenced a student's decision to take advanced math courses in high school. Miller concluded that math course choice at the middle school level was a significant predictor of advanced math course taking in high school. The study made a recommendation for future studies to examine the impact of early math tracking decisions.

After analyzing face-to-face interactions and interviews between counselors and students in high schools and junior colleges, Erickson and Shultz (1982) concluded that counselors frequently acted as gatekeepers by not making information available to students on course options and consequences of course selections. Prior achievement was not the best predictor of course selection advice from a counselor for students in the middle of the grade range but, on the other hand, was the best predictor for students at the extremes of the grading scale. The results of the study indicated that social identity factors, including socioeconomic status and race and ethnicity, influenced the course selection advice. Consequently, counselors closed the door to educational and career opportunities for many students, frequently unintentionally.

Several studies have suggested that student course enrollment patterns were strongly related to the frequency of student contact with school counselors (Heyns 1974; Hauser, Sewell & Alwin, 1976; Commission on Precollege Guidance and Counseling, 1986). In an overview of studies on secondary school counseling programs, Borders and Drury (1992) concluded that counseling services were not equitably distributed to all students, particularly to those from lower socioeconomic families, suggesting that such students were less likely to be guided into rigorous academic classes.

Investigating the difference in the social distribution of mathematics achievement in public and Catholic high schools, Lee and Bryk (1988) found that neither public school staff nor parents provided the course selection guidance to students to the same degree as that which occurred in Catholic schools. Analyzing High School and Beyond survey data with various interrelated statistical methods, including path analysis, Lee and Byrk concluded that schools and parents can exert a forceful influence on math course choice, as evidenced in the Catholic school sector.

Influence of Parents

Parents' Education Level

Numerous studies in status attainment research have found a strong association between family SES and student course enrollment patterns in public schools. For example, Vanfossen et al. (1987) found that SES had a strong independent effect on track placement and course selection, independent of ability and performance.

In a qualitative study involving a series of interviews with parents, Oakes (1985) found that highly educated parents took an active role in shaping a child's school experiences, including actively influencing course choices early on in a child's schooling. Oakes concluded that parental involvement in course selection explained why advanced courses in high school were predominantly filled with higher SES students.

Gamoran (1992) conducted a study using both qualitative and quantitative techniques to examine factors that influenced a student's placement in advanced English courses during the transition from middle school to high school. Collecting data through a multi-site case study approach and then analyzing the data with logistic regression techniques, Gamoran arrived at several findings. One of the more interesting findings was an SES effect that differed by achievement level. For students of average achievement, being one standard deviation above the mean on SES increased the likelihood of advanced course selection by nearly six percentage points. The advantage for students whose parents were extremely high SES and highly educated was even greater. Students who were two standard deviations above the mean in SES gained over 14 percentage points in the chances for placement in an advanced course. The analysis indicated that test scores mattered more for less-advantaged students than those of highly educated, high SES parents. Interviews with school staff suggested the reason behind the SES effect. High SES parents sometimes intervened in the course selection process. These parents sometimes pushed to get their children in advanced courses. Likewise, counselors frequently pushed such students into the advanced courses, assuming that they would have the family support to do what was necessary to academically succeed. Gamoran concluded that high SES, thus highly educated, parents were more likely to be influential in the course selection process.

In a qualitative study based on parent interviews, Lareau (1989) found that in elementary school, highly educated parents viewed their children's schooling as an extension of home life in much the same way as they viewed their jobs. Well-educated mothers, in particular, became involved in their children's schooling, shaping and choosing programs and services to meet the needs of their children. They contacted the school staff frequently to acquire information.

In another qualitative study that involved interviews with a random sample of 86 mothers in two suburban communities, Useem (1992b) found a high correlation, .57, between parents' education levels and students' math course choices at the middle school level. The high correlation was partially explained by the finding that highly educated mothers were more knowledgeable about the math tracking system than their less educated peers. Conversely, mothers with less formal education were not aware of the long-term implications of a student's math course choice in the middle years. Furthermore, Useem found that mothers with less formal education placed greater trust in the teachers and counselors with respect to appropriate math course placement, believing that such decisions should be made by school personnel. Moreover, the interview data indicated that mothers without college degrees used a less authoritative approach in advising their children, assuming that their children should have a major role in selecting their math courses. Consequently, these students usually chose less demanding courses. In addition, Useem found a high zero-order correlation, .63, between parental education level and track placement. Useem hypothesized that parents' education level influenced a student's track placement through parental involvement in the assignment process.

Taylor (1990) explained that parents' education levels influence math course choice because highly educated parents expect their children to take algebra as well as higher level math courses. Furthermore, these parents are willing to provide them with support services whenever necessary.

Parents' Educational Expectations

Numerous studies have concluded that parents' educational expectations for a child are influenced by a student's history of academic achievement and, in turn, influences a student's choice of courses. Ekstrom et al. (1988) found that parents' educational aspirations for their children was a major determinant for math course selection. One path analytic study found that parents' expectations, influenced by prior achievement, is one of the factors that mediates the effects of student background on academic achievement (Walberg & Marjoribanks, 1976). Using a structural model to explain the middle school learning process, Reynolds (1991) further demonstrated that parents' expectations influenced student expectations. Seginer's (1983) literature review of studies on the causes and effects of parents' educational expectations for their children arrived at the same conclusion.

Seginer's summary of studies from the body of status attainment research also pointed out the influence of school feedback in terms of children's academic achievement on parents' educational expectations. Other antecedents of parents' expectations included parents' self-aspirations, reflected by years of schooling attained by parents, and parental knowledge, defined as access to a school's performance standards. Seginer argued the degree to which parents had fulfilled their own educational aspirations was a better explanation of parents' expectations than socioeconomic status. Mediating factors between parents' educational expectations and their children's academic achievement included parents' achievement supporting behaviors and differential reinforcement. An example of such a mediating factor in the model is the variable representing parental encouragement to take algebra.

From extensive interviews with parents and school staff, Oakes (1985) concluded that track placement affected parents' educational expectations. Oakes found that parents of students in the higher tracks had higher educational aspirations for their children, regardless of achievement. The students themselves held high educational goals, were surrounded by peers who intended to go to college and beyond, and were taught by teachers who expected them to go far in school.

Marjoribanks (1983) included parental aspirations as one of the three components of a hierarchical model that examined the relationship between family environment and academic achievement. One of the study's inventory items asked parents how much education they wanted their child to have. Using data from 900 Australian families, the hierarchical regression analysis found support for the theory that parents' educational expectations influenced children's academic achievement.

The Commission on Precollege Guidance and Counseling (1986) stressed the importance of providing college counseling to parents in the middle grades because if parents see college as a realistic option then students are more likely to choose rigorous courses and put forth maximum effort.

Parental Guidance

Studies have found that because public schools provide students with course options varying in level of difficulty, parental involvement in course selection can help guide students toward more academically rigorous courses (Ekstrom et al., 1988; Lee & Ekstrom, 1987; Oakes, 1985; Powell et al., 1985). Allowing for the diversity of definitions associated with the term parental involvement, Fehrmann, Keith, and Reimers (1987) acknowledged that general academic guidance and support was a form of parental involvement that influenced achievement.

Several studies have suggested that the influence of parental involvement in the course selection process is particularly important in the middle grades when course choice has long-term educational and career consequences (Baker & Stevenson, 1986; Useem, 1991b).

Interviewing parents, school administrators and middle school math teachers, as well as analyzing internal school documents, Useem (1991b) found that parental involvement in math course selection was conditioned by a school's practices and policies. In Useem's study, 26 school districts were selected as case studies for the purpose of analyzing the math course enrollment process. Useem found that some of the districts pumped students into advanced mathematics courses by encouraging students to take algebra at the middle school level, while other schools acted more like a filter, actively discouraging such enrollment. The districts who encouraged students to get on the advanced math track did not discourage parents from overriding a school's placement recommendation. Moreover, these districts actually encouraged students to enroll by remaining flexible regarding placement criteria and making course selection information readily available to parents. Useem found a strong link between school policy and the degree of parental influence in the course selection process during the middle school years.

Through interviews with 86 mothers of seventh grade students Useem (1992b) examined the degree to which they became involved in the assignment of their children to math courses to optimize their children's progress and achievement in a public school system. Although Useem agreed with the conclusion of Oakes' (1985) earlier study that school personnel largely determined math course choice in the middle grades, Useem found that parents frequently influenced math course choice through active intervention in the course selection process with school personnel and by exerting a direct influence over their child's math course preferences. Useem concurred with Lareau's (1989) finding that well-educated parents frequently customized their children's education through active involvement in the course selection process.

Baker and Stevenson (1986) conducted an exploratory study involving interviews with 41 mothers of eighth graders from one middle school to examine the strategies that parents took to manage their children's school careers. The researchers documented the kinds of strategies that parents used, assessed the effectiveness of the strategies and made a comparison across socioeconomic strata. The study found that mothers with more education were more likely to select the more demanding, college preparatory courses for their children than mothers of less education. These mothers directly influenced their child's high school course selections. In fact, the study found that educated mothers were more likely to override the school's recommendation and to increase the number of academically demanding courses, regardless of the student's academic performance. Dossey et al. (1988) and Hoffer (1992) both found that such parents encouraged students to take rigorous mathematics courses and then monitored and supported their efforts. As an extension of their earlier study Stevenson & Baker (1987) confirmed these findings when they analyzed a small data subset from a national survey with a series of multiple regression equations. Furthermore, they found that educated mothers had more frequent contacts with school personnel and suggested that parental intervention efforts decreased either with the child's age or once a child was on the right track. A national commission's study, the Carnegie Council on Adolescent Development (1989) found that all types of parental involvement declined progressively as the child became older and almost became non-existent for low-income students in the middle grades.

Other studies have concluded that parents' education levels impact on the degree parents become involved in the course selection process. They have found that parents with less formal education are not as confident about their involvement in course selection, particularly when they experience resistance from their children (Lareau, 1989) and school officials (Lareau, 1989; Useem, 1991b). They are frequently reluctant to challenge or question the teacher's expertise because they often do not understand the terminology commonly used in conferences (Lareau, 1989). They do not understand the intricacies of the math tracking system as well as their better educated counterparts (Useem,1991b). They also question their ability to help their children with school work, leading to a further erosion of confidence in course selection (Lareau, 1989).

Summary of Selected Literature

Studies coming from the broad area of status attainment research and the more narrow research area of math course selection comprised the core of the professional literature review. Selected studies, professional articles and commission reports from these two bodies of research focusing on three sources of influence in the middle school math course selection process were reviewed. The sources of influence included: 1) math achievement; 2) school policies and practices; and 3) parents.

Influence of Math Achievement

Studies in math achievement (McKnight et al., 1987; Mason et al., 1992) stressed that prior math grades and math test scores influenced math course choice but, at the same time, were not the sole determinants. They found a great deal of overlap in math test scores among students in the different eighth grade math courses, thus suggesting the possibility that middle schools unfairly restricted student access to algebra through their course selection policies and practices.

Studies focusing on parental influences in the course selection process (Baker & Stevenson, 1986; Useem, 1992b) suggested the effect of prior math achievement on math course choice is weakened because average-ability students with highly educated parents are pushed up in the math tracking system.

Basing a study on teacher interviews and participant observation techniques, Finley (1984) concluded that student motivation was more important than ability for enrollment in advanced courses.

Garet and DeLany (1988) found a great deal of variability in prior math achievement in the student composition of the advanced and regular math courses in the eighth grade, thus concluding that other factors were also influential in the math course selection process.

Influence of School Policies and Practices

Some studies concluded that schools' policies and practices relating to track placement, educational guidance and parental involvement in course selection largely determined a student's math course choice. Hoffer (1992) examined the middle school math course selection process and concluded that track placement exerted the greatest influence. An earlier study (Vanfossen et al., 1987) found a moderate effect of track placement on math course choice. In a meta-analysis on tracking and grouping practices, (Gamoran & Berends, 1987) concluded that track placement was associated with differential course-taking in math. Finley (1984) suggested that track placement influenced school staff's attitudes toward students and expectations of students, with students in the higher tracks receiving more encouragement. Heyns (1974) found that track placement influenced the differential allocation of a school's guidance services and concluded that students in the higher track received more advisement on course choice. Kerckhoff (1986) suggested that track placement carried a symbolic meaning to staff, parents and students themselves that went beyond actual performance or potential. Lee and Ekstrom (1987) concluded that students who did not receive guidance on math course choice from school were the same students who did not receive it from home. Useem (1991b) suggested that schools increased the number of students taking advanced math courses when they assumed a proactive approach to parental involvement in the course selection process. On the other hand, school staff restricted enrollment in advanced math courses when they acted as gatekeepers by restricting parental involvement (Useem, 1991b) and student access to information (Erickson and Shultz, 1982).

Influence of Parents

Some studies have claimed that parents have the greater influence as a result of their educational aspirations, intervention in the course selection process and direct advisory role with their children. Studies (Gamoran, 1992; Lareau, 1989; Oakes, 1985; Useem, 1992b) have attributed a strong parental influence in the course selection process to parents' high educational backgrounds. Dossey et al. (1988) and Hoffer (1992) concluded that highly educated parents encouraged students to take rigorous mathematics courses and then monitored and supported their efforts. Fehrmann et al. (1987)

acknowledged that academic guidance and support was a form of parental involvement that influenced achievement.

Marjoribanks (1983) found evidence that parents' educational expectations influenced student achievement. The factor, parents' educational expectations, was found to be a strong influence on math course choice (Ekstrom et al., 1988). The Commission on Precollege Guidance and Counseling (1986) stressed the need for parents to have high educational expectations in order for their children to pursue the more rigorous courses. Seginer's meta-analytic study found that antecedents to parents' educational expectations included parents' educational attainment and students' prior academic achievement. Oakes (1985) concluded that track placement also was an antecedent to parents' educational expectations.

Parent's direct involvement in the math course selection process in the middle school was found to be very important because of the long-term consequences of course choice (Baker & Stevenson, 1986; Useem, 1991b). Powell et al. (1985) concluded that parental guidance was critical since public schools provided students with course options that varied significantly in difficulty.

CHAPTER THREE: METHOD

This chapter consists of three sections, each one containing appropriate subsections. The sections include: 1) data; 2) model and; 3) procedures of analyses.

Data

Data Source

This study used data from the student and parent files of the base year survey of the National Education Longitudinal Study of 1988 (NELS 88), a major longitudinal study sponsored by the U.S. Department of Education's National Center for Education Statistics (NCES). The base year of NELS 88 was the first stage of a longitudinal research endeavor that surveyed a nationally representative sample of a cross section of eighth grade students. This 1988 eighth grade cohort was followed and re-surveyed thereafter at two year intervals, 1990 and 1992, as students progressed through high school and into post-secondary education (NCES, 1990).

One of the chief purposes of the surveys was to collect data from students, parents, school administrators and teachers that could be used to develop and evaluate educational policies at all levels of government. In particular, questions in the NELS 88 base year survey focused on interrelated policy issues, including: identification of school characteristics linked to achievement; transition of various groups from eighth grade to high school; and the impact of ability grouping on future learning outcomes (NCES, 1990).

This study accessed the NELS 88 data in a CD ROM format provided by the National Center for Education Statistics (NCES), Office of Educational Research and Improvement in the U.S. Department of Education.

Sample

The NELS 88 base year study used a two-stage stratified probability design to select a nationally representative sample of schools and students. Prior to sampling, schools were stratified according to region, urbanicity, and minority percentage. The first stage included 815 public schools. The second stage resulted in the participation of 19,396 eighth grade students selected randomly from the participating public schools, resulting in approximately 24 students per school.

For this study, the national sample consisted of a group of 7,648 public school eighth grade students whose parents completed a survey and whose response to a survey question regarding math course choice corresponded to their parents' response. There were several reasons why this study's public school sample was smaller than the one in NELS. One reason was due to the missing data on the parent and student survey items pertaining to the outcome variable. Out of the 19,396 cases in the NELS 88 public school sample, 2,451 cases had missing information for the parent survey item and 1,095 cases had missing information for the student survey item. Furthermore, due to a discrepancy of the responses from parents and students as to a student's math course enrollment and in consideration of the strong desire to use only those cases where there was a concurrence between the responses of parents and students, the NELS sample was reduced further. For example, there was a lack of correspondence between parents and students in 7,064 cases (see Appendix E, p. 122). By selecting only those cases where there was no missing data for the outcome variable, as well as a correspondence between parent and student respondents on math course choice, there was greater confidence in the reliability of the outcome variable and consequently the study's results. Moreover, only those cases were selected where parents had completed a questionnaire. Non-availability of the parent questionnaire reduced the NELS sample size by another 1,239 cases.

Data Preparation

This study relied upon Fortune and McBee's (1984) guidelines that suggested specific steps and procedures for a study based on a secondary data analysis. All of the survey items in the NELS 88 student and parent surveys pertinent to this study were identified. An SPSS system file for the identified survey items was created so the data could be analyzed using SPSS for Windows 6.0. To verify the accuracy of the data, the responses for each selected item were checked against the frequency data contained in the NELS 88 code books provided by NCES.

After verifying the accuracy of the data, student and parent files were merged. Cases were matched on the basis of student number. After the files were merged the study's target population of 7,648 cases was selected from the 19,396 cases contained in the NELS 88 national public school sample.

After the sample representing the target population was selected, the variables were prepared for analysis. First, all variables were examined for missing data. All responses indicating a non-response, multiple response, or 'don't know' were coded as missing. After the recoding, frequency distributions for the variables were run to verify that all missing data had been properly recoded. Secondly, the variables were recoded so that values would reflect a low to high quantification. The next step involved the creation of composite variables and their respective scales. Composite variables were created during a multi-stage process that utilized exploratory factor analysis. The composite variables represented different, but pertinent facets of school and parental influences in the math course selection process. The composite variables were labeled School-Parent Course Guidance Contacts and School-Parent Algebra Push. After creating the composite variables, the data were once again verified by running the appropriate frequency distributions. A description of the variables in the model is presented in Table 1. Details on variable construction are presented in Appendix A.

Table 1
Description of Variables, NELS 88 Items and Values Used in Model

Variables	NELS 88 Items	Values
Parents' Education Level [1] (PaEd)	BYPARED Parents' highest education level	1 = Did not finish HS 2 = HS grad or GED 3 = Grad HS & left 4yr 4 = College graduate 5 = MA or equivalent 6 = PhD, MD or other
Standardized Math Test [1] (MaTe)	BYTXMSTD Math test score	28.294 - 71.222
Math Grades [1] (MaGr)	BYS81B Math grades from grade 6 until now	1 = Mostly below D 2 = Mostly Ds 3 = Mostly Cs 4 = Mostly Bs 5 = Mostly As
Math Track Placement [1] (MaTr)	BYS60A R's ability group	1 = Low 2 = Middle 3 = High
School/Parent Course Guidance Contacts [3] (SPG)	BYP57B Parents contacted about academic program BYP57C Parents contacted about HS course selection BYP57D Parents contacted about placement decision regarding HS program	1 = None 2 = Once or twice 3 = Three or four times 4 = More than four times

(table continues)

Variables	NELS 88 Items	Values
Parents' Educational Expectations [1] (PaEx)	BYP76 How far in school parents think child will go	1 = Less than HS 2 = GED 3 = HS graduate 4 = Less than 1 year voc/tec 5 = 1 or 2 yrs voc/tec 6 = 2 yrs or more voc/tec 7 = Less than 2 yrs college 8 = 2 or more yrs college 9 = Finish a 2 year program 10 = Finish a 4 or 5 yr prog 11 = Master's degree/equiv 12 = PhD, MD or other advanced degree
School/Parent Algebra Push [2] (AlPu)	BYS61 Student talked to teacher/counselor about taking algebra BYS62 Parents/guardians wanted student to take algebra	0 = Neither 1 = Either school or parents 2 = Both school and parents
Math Course Choice [2] (MaCh)	BYP53 Parents response as to whether or not student was enrolled in algebra BYS66D Students' response as to whether or not they were enrolled in advanced math	0 = No 1 = Yes

Note. Number of survey items from NELS 88 used to create variable is presented in brackets. Abbreviations for variables used in tables in Chapter Four are presented in parentheses.

Model

The model constructed and tested for this study was a simple recursive path model that hypothesized a weak causal ordering among variables in a unidirectional manner. The model illustrated an ordering of variables that was based upon previous research, theory, and temporal logic (see Figure 2, p. 10). There were three exogenous and five endogenous variables in the model. The causal relationship between the variables was illustrated by means of lines with arrows, indicating paths.

Race, a composite variable from NELS 88 that identified the four major race/ethnic groups - Asian or Pacific Islander, Black, Hispanic and White - was used to select four separate subgroups for data analysis. Because prior research indicated differences in enrollment patterns in advanced math courses as well as differences in math achievement among the four subgroups, the model was applied to each of the subgroups to avoid the possibility of an interaction of race and ethnicity with other variables in the model.

Exogenous Variables

Variables representing background and academic characteristics hypothesized to influence math course choice and the selection process comprised the three exogenous variables. Parents' education level (PaEd) was selected to represent the background characteristic. Variables selected to represent academic characteristics were: standardized math test scores (MaTe) and math grades (MaGr). This study does not attempt to identify the causes of these variables nor explain the correlated relationships among them. These variables were included for control purposes, as well as, to show how they influenced the math course choice process. They were postulated to directly and/or indirectly affect an eighth grade student's math course selection.

Parents' education level was a NELS 88 composite variable developed from responses to questions in the parent survey eliciting information as to the highest level of education that either respondent parent or spouse had completed. It was hypothesized that parents' education level influenced a student's math course choice both directly and indirectly through parental involvement in the course selection process.

The respondents of the student survey completed a standardized math test sometime from February to June in the eighth grade. This test score was used as a proxy variable to represent a standardized indicator of a student's math proficiency at the end of the seventh or the beginning of the eighth grade. Standardized math test scores were hypothesized to directly and indirectly affect math course choice. Students who demonstrated higher math proficiency on standardized tests were expected to enroll in algebra based on the assumption that higher performing students were encouraged to take the more demanding math courses.

Math grades, the third exogenous variable, was taken from the survey item that asked students to report their math grades from grade six until now. Grades were included along with standardized math scores for two reasons. One, prior research has revealed gender and race/ethnic differences in standardized test scores, with lower test scores for females and minorities. This situation can cause a greater reliance upon grades for selection into courses such as algebra. Two, schools have varied in their utilization of test scores and grades as selection criteria for the more demanding math courses. Some have emphasized test scores while others have emphasized grades. It was hypothesized that students who earned higher grades in math were encouraged to take algebra, the more demanding math course of the two options.

Endogenous Variables

There were five endogenous variables: 1) math track placement (MaTr); 2) school-parent course guidance contacts (SPG); 3) parents' educational expectations (PaEx); 4) school/parent algebra push (AlPu); and 5) math course choice (MaCh), the outcome variable. The endogenous variables were selected because they were manipulable variables with policy implications for math achievement.

Math track placement was a variable derived from a survey question that asked the student respondent to identify his/her ability group in mathematics. The ability groups included low, middle and high. Based on a review of the research literature on tracking in mathematics, it was hypothesized that students' math track placement was influenced by parents' educational level, standardized math test scores and prior math grades. Furthermore, it was hypothesized that a student's math track placement influenced all the endogenous variables in the model.

School-parent course guidance contacts was a composite variable created from the responses of three survey items that asked parents if they had been contacted by the school about course selection. As a result of a qualitative research study, Useem (1991b) concluded that schools increased the number of students in the advanced math course pipeline when school personnel informed parents of the long-term implications of math course choice.

Parents' educational expectations was a variable derived from the survey item that asked how far in school parents thought their children would go. It was hypothesized that parents' educational expectations influenced a student's math course choice both directly and indirectly. Parents who had higher educational expectations were more likely to encourage their children to take the more demanding, rigorous courses.

School/parent algebra push was a composite variable created from two survey items that asked students if they had talked to a teacher or counselor about taking algebra and if their parents had wanted them to take algebra. Numerous studies have concluded that students take advanced courses as a result of both school personnel and parents encouraging them to do so. The two survey items were used to create the composite variable because prior studies have suggested that students who receive educational guidance to enroll in the more demanding courses from parents are the same ones who receive it from school.

Math course choice was the dichotomous outcome variable in the model. There were two survey items that addressed math course choice. Parents were asked if their child was enrolled in algebra. Students were asked if they were enrolled in advanced, accelerated math. The outcome variable was formed from these two variables, using only those responses where there was a correspondence between the two sets of respondents and no missing data.

Ordering of Variables

Two criteria were used to designate the position of the variables in the model in this cross-sectional study (Davis, 1985). First, the unidirectional ordering of the variables was largely determined by the results of prior research studies. For example, prior research studies (Alexander et al., 1978; Heyns, 1974) found a strong causal relationship between prior achievement, educational motivation and math track placement. Seigner's meta-analysis (1983) concluded that test scores, grades, track placement and communication from the school were antecedents of parents' educational expectations.

Likewise, the Commission on Precollege Guidance and Counseling (1986) found that parents' educational expectations influenced a student's course choices. Secondly, the ordering of the variables resulted from the application of temporal logic and personal background knowledge of the course selection process. In spite of these fairly stringent criteria, it is still acknowledged that a path model using cross-sectional data presents a weaker argument for inferring causal relationships than one based on a longitudinal design.

Procedures of Analyses

Descriptive Statistics

Frequency data, means, standard deviations and crosstabulations were used to describe the full sample, the subgroups and the variables pertinent to the study. Descriptive statistics were used for several purposes: 1) to provide insight into the data during the exploratory stage; 2) to substantiate that the study's sample was an approximation of the nationally representative NELS 88 sample; 3) to provide a greater understanding of the students' demographic and academic characteristics pertinent to this study; and 4) to furnish a comparative framework for a descriptive analysis of subgroup differences. All of the descriptive statistics based on frequency data, including the crosstabulations, used all of the cases in the sample. The means and standard deviations were based on only those cases without any missing values.

Correlations

Correlational analysis was performed on all the model's variables using a listwise approach. A decision was made to use a listwise matrix instead of pairwise after considering the advantages and disadvantages of each type of each matrix (Norusis, 1993a). In listwise, a case is eliminated if it has a missing value for any variable in the analysis. The disadvantage of a listwise matrix is a smaller number of cases for data analysis. The alternative, a pairwise treatment, involves the calculation of a correlation coefficient between a pair of variables based on all cases with complete information for the two variables, regardless of whether the cases have missing data for any other variable. In spite of the fact there are more cases to analyze, there are two disadvantages to a pairwise matrix. One disadvantage is inconsistency because different cases are used to estimate the coefficients in the matrix. Another disadvantage is a fluctuating sample size since each coefficient is based on a different number of cases. Thus, significance levels have to be interpreted with caution.

Collinearity Diagnostics

Recognizing the reality that collinearity among variables presents a problem in non-experimental behavioral science research, a decision was made to use SPSS collinearity diagnostics. Collinearity refers to the situation where there is a high correlation among independent variables (Norusis, 1993a).

Collinear variables cause problems because they provide similar information, thus making it difficult to identify the separate effects of individual variables. To determine the extent that collinearity among the independent variables degraded the estimated parameters, SPSS diagnostics were run to test the tolerance levels and variance inflation factor (VIF) of the variables. A variable is essentially a linear combination of other independent variables in the model if its tolerance level is small. If a variable's VIF is unusually high in comparison to the other variables, there is an increase in the variance of its regression coefficient.

Factor Analysis

Following SPSS guidelines (Norusis, 1993b) factor analysis was used in the process of creating composite variables for the model. A correlation matrix of all the variables pertinent to the study's model revealed a high intercorrelation among several variables that intuitively appeared to measure the same phenomenon. To identify potential common factors that might explain the high correlations, a factor analysis was performed on these selected variables. After a factor extraction was done to identify the factors with a eigenvalue greater than 1, a varimax factor rotation was performed to make it easier to identify the meaningful factors in the matrix. The varimax method minimized the number of variables with high loadings on a factor and facilitated interpretation. The variables used to create the two composite variables for the model had factor loadings greater than .70.

Path Analysis

The primary procedure in this study was a structural equations or path analysis used to determine if the model fit the data. Using ordinary least squares regression, a path analysis was run five times. Each path analysis entailed the following five multiple regression routines:

1. The outcome variable, math course choice, was regressed on seven variables: school-parent algebra push, parents' educational expectations, school-parent course guidance contacts, math track placement, prior math grades, standardized math test score and parents' education level.

2. The variable, school-parent algebra push, was regressed upon six variables: parents' educational expectations, school-parent course guidance contacts, math track placement, prior math grades, standardized math test scores and parents' education level.

3. The variable, parents' educational expectations, was regressed upon five variables: school-parent course guidance contacts, math track placement, prior math grades, standardized math test scores and parents' education level.

4. The variable, school-parent course guidance contacts, was

regressed upon four variables: math track placement, prior math grades, standardized math test scores and parents' education level.

5. The variable, math track placement, was regressed upon the three exogenous variables: prior math grades, standardized math test scores and parents' education level.

Path analysis was used to examine and analyze the hypothesized relationships among the variables considered to be important in the math course selection process in the eighth grade. Pedhazur (1982) defined path analysis as "a method for studying the direct and indirect effects of variables hypothesized as causes of variables treated as effects" (p. 580). Path analysis relies upon the calculation of path coefficients, correlation coefficients among the variables in the model, to represent the effects of specific variables on others. A path analytical approach was selected to examine the data because of the technique's strength in providing insight into a process.

GEMINI

The mainframe computer program GEMINI was used to estimate the structural equations model in this study (Wolfle & Ethington, 1985). To define the equations in the model GEMINI required the input of a correlation matrix, means and standard deviations for all of the exogenous and endogenous variables in the path model, along with a specification of the order of the variables. The program ran five multiple regression routines and computed partial regression (beta) coefficients, significance levels and coefficients of multiple determination (R^2) for each equation. After running the five equations, GEMINI provided the standardized and unstandardized (metric) direct, indirect and total effects and standard errors for indirect effects. GEMINI was run with five different sets of data. The first run was for the full sample, which included the four major race/ethnic subgroups. The other four runs were for each of the race/ethnic subgroups.

Calculation of Direct, Indirect and Total Effects. One of the reasons for using GEMINI to test the study's model was the capacity of the program to efficiently calculate direct, indirect and total effects as well as standard errors for indirect effects. A direct effect, the effect of one variable on another not mediated by any other variable in the model, was estimated by the magnitude of a partial regression coefficient. Indirect effects were estimated by the magnitude of the sum of products of direct causal effects through intervening variables. The program utilized a special algorithm that raised the matrix of structural parameter estimates to successive powers to calculate indirect effects. Total effects represented the sum of direct and indirect effects.

Standardized and Unstandardized Coefficients

Standardized coefficients measure change in the dependent variable in terms of standard deviations units. Expressed in standard scores, standardized regression coefficients are scale free indices. Since standardized coefficients can be compared across different variables, they are used to interpret the relative importance of variables within an equation for a specific group. Since a standardized coefficient reflects not only the effect of the variable with which it is associated, but also the variances of the other variables in the model, standardized coefficients are not used for generalizations across subgroups. Instead, unstandardized coefficients are used for across-group comparisons. At the same time, unstandardized coefficients cannot be compared within a given equation in terms of the relative importance of the variables with which they are associated. Their magnitudes depend upon the units associated with the measurement of the given variables. In this study, both standardized and unstandardized (metric) coefficients are used when interpreting the findings.

CHAPTER FOUR: RESULTS and DISCUSSION

This chapter focuses on the results of the data analyses. It consists of four major sections, each with appropriate subsections: 1) description of sample; 2) descriptive information on variables; 3) structural equations analyses; and 4) summary of results.

Description of Sample

This study was based on a subset of cases constituting a national sample of 7,648 public school students in the eighth grade who participated in the base year survey of the NELS 88 longitudinal study. The sample consisted of students whose parents completed a questionnaire and whose responses to a survey question asking about their choice of math course corresponded with their parents responses. The demographic and academic characteristics of the 7,648 cases in this study's sample approximated the characteristics of the nationally representative sample of 19,396 public school student respondents of the NELS 88 surveys (see Tables 2 and 3). Particularly germane to one of the policy implications of this study is the finding that only 23% of the parents were college graduates or holders of advanced degrees (see Figure 3, p. 59).

Table 2
Demographic Characteristics of Full Sample and NELS 88 Sample

	Study		NELS 88	
Characteristic	F	%	F	%
Sex				
Male	3,658	47.8	9,631	49.7
Female	3,990	52.2	9,765	50.3
Total	7,648	100.0	19,396	100.0
Race/Ethnicity				
Asian/Pacific Islander	493	6.4	1,232	6.4
Hispanic	1,069	14.0	2,772	14.3
Black	942	12.3	2,565	13.2
White	4,994	65.3	12,343	63.6
American Indian	79	1.0	257	1.3
Missing cases	71	1.0	227	1.2
Total	7,648	100.0	19,396	100.0
Parents' Education Level				
Did not graduate from HS	947	12.4	2,493	12.9
High school graduate or GED	1,559	20.4	4,107	21.2
One year of college	3,392	44.4	8,105	41.8
College graduate	962	12.6	2,463	12.7
Masters Degree	547	7.2	1,417	7.3
PhD, MD or other adv degree	237	3.0	621	3.2
Missing cases	4	0.0	190	.9
Total	7,648	100.0	19,396	100.0
Urbanicity of School				
Urban	1,947	25.4	5,006	25.8
Suburban	3,218	42.1	8,005	41.3
Rural	2,483	32.5	6,385	32.9
Total	7,648	100.0	19,396	100.0

Table 3
Academic Characteristics of Full Sample and NELS 88 Sample

	Study		NELS 88	
Characteristic	F	%	F	%
Overall Math Proficiency				
Below Level 1	1,300	17.0	3,452	17.8
Level 1	2,922	38.2	7,074	36.5
Levels 1 and 2	1,553	20.3	3,649	18.8
All Three Levels	1,164	15.2	3,059	15.8
Missing Cases	709	9.3	2,162	11.1
Total	7,648	100.0	19,396	100.0
Math Grades: Gr 6 Until Now				
Mostly Below D	199	2.6	516	2.7
Mostly Ds	531	6.9	1,316	6.8
Mostly Cs	1,748	22.9	4,185	21.6
Mostly Bs	2,669	34.9	6,527	33.7
Mostly As	2,270	29.7	6,178	31.9
Missing Cases	231	3.0	674	3.3
Total	7,648	100.0	19,396	100.0
Math Track Placement				
Low	590	7.7	1,399	7.2
Middle	3,574	46.7	8,097	41.7
High	2,017	26.4	5,681	29.3
Not Grouped	982	12.8	2,495	12.9
Missing Cases	485	6.4	1,724	8.9
Total	7,648	100.0	19,396	100.0

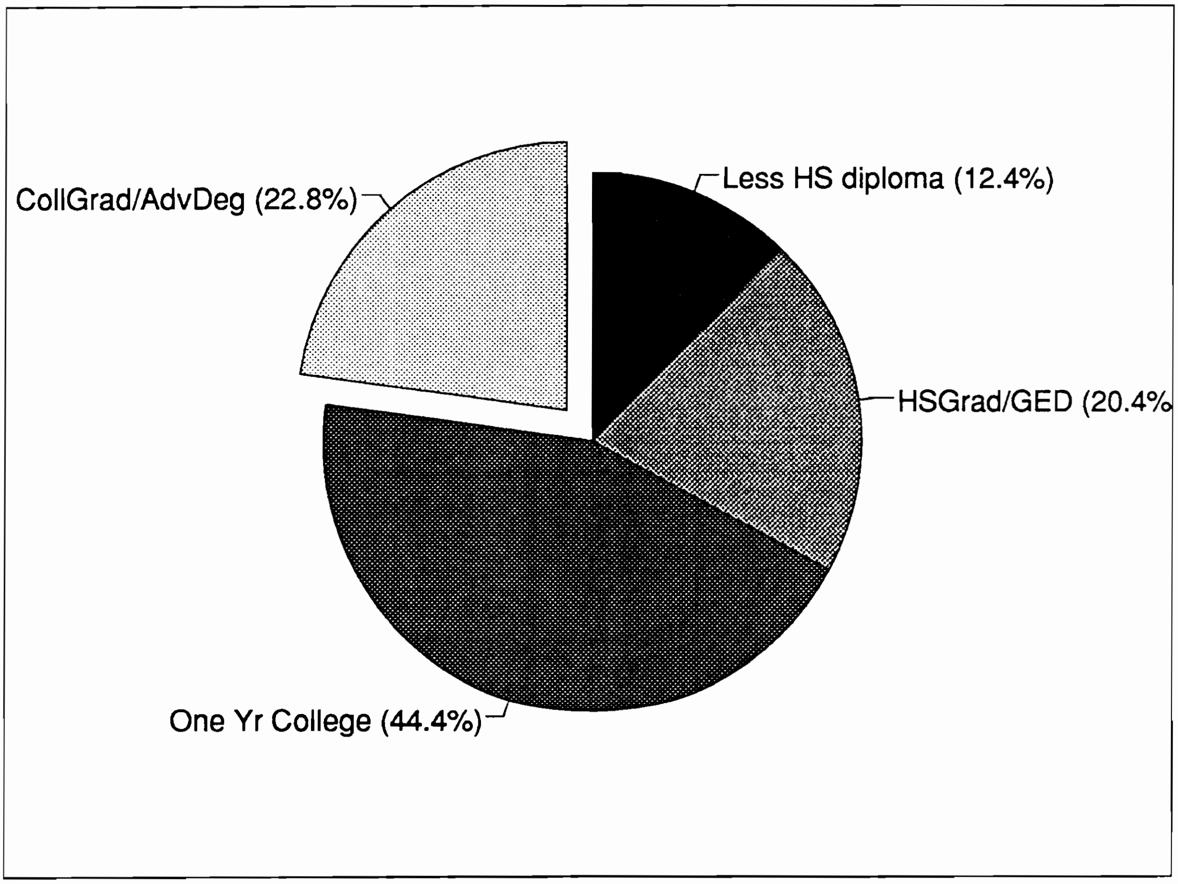


Figure 3. Education attainment levels of parents in full sample.

Description of Subgroups

Subgroups were selected out of the full sample according to the students' responses to a question requesting their race/ethnic identification. The subgroups consisted of the following number of respondents: Asian or Pacific Islander, 493; Hispanic, 1,069; Black, 942; White, 4,994.

When the demographic and academic characteristics of the subgroups were compared, descriptive differences and similarities among the groups surfaced that were pertinent to this study (see Tables 4 and 5). There was a large difference in the levels of parents' education attainment among the subgroups. For the Asian subgroup, 43% of the parents were college graduates or graduates with advanced degrees. The proportions of the other subgroups were much lower, ranging from approximately 10% of the Hispanic and Black subgroups to 26% of the White subgroup. There was also a sharp contrast in the percentages of the subgroups making mostly A's in prior math courses. Within the Asian subgroup, almost one-half of the students made mostly A's in comparison to about one-fourth of the Hispanic and Black subgroups and one-third of the White subgroup. In contrast to these differences, the overall math proficiency levels of the subgroups were similar, a finding with policy implications.

Table 4

Demographic Characteristics of Subgroups

Characteristic	Asian F	Asian %	Hispanic F	Hispanic %	Black F	Black %	White F	White %
Sex								
Male	247	50.1	497	46.5	429	45.5	2,415	48.4
Female	246	49.9	572	53.5	513	54.5	2,579	51.6
Total	493	100.0	1,069	100.0	942	100.0	4,994	100.0
Parents' Education Level								
Did not graduate from HS	60	12.2	350	32.7	157	16.7	356	7.1
HS graduate or GED	55	11.2	172	16.1	228	24.2	1,080	21.6
One year of college	166	33.7	443	41.4	450	47.8	2,252	45.1
College graduate	117	23.7	54	5.1	61	6.5	715	14.3
Masters degree	56	11.4	37	3.5	38	4.0	412	8.3
PhD, MD or other.	38	7.7	13	1.2	7	0.7	178	3.6
Missing Cases	1	0.1	0	0.0	1	0.1	1	0.0
Total	493	100.0	1,069	100.0	942	100.0	4,994	100.0
Urbanicity of School								
Urban	171	34.7	489	45.7	484	51.4	757	15.2
Suburban	264	53.5	380	35.5	228	24.2	2,302	46.1
Rural	58	11.8	200	18.8	230	24.4	1,935	38.7
Total	493	100.0	1,069	100.0	942	100.0	4,994	100.0

Table 5
Academic Characteristics of Subgroups

	Asian		Hispanic		Black		White	
Characteristic	F	%	F	%	F	%	F	%
Overall Math Proficiency								
Below Level 1	92	18.7	196	18.3	172	18.3	820	16.4
Level 1	191	38.7	432	40.4	329	34.9	1,910	38.2
Level 1 and 2	99	20.1	202	18.9	204	21.7	1,011	20.2
All Three Levels	76	15.4	151	14.1	144	15.3	773	15.5
Missing Cases	35	7.1	88	8.2	93	9.9	480	9.6
Total	493	100.0	1,069	100.0	942	100.0	4,994	100.0
Math Grades: Gr 6 Until Now								
Mostly Below D	5	1.0	36	3.4	31	3.3	124	2.5
Mostly Ds	14	2.8	97	9.1	77	8.2	331	6.6
Mostly Cs	77	15.6	251	23.4	253	26.9	1,128	22.6
Mostly Bs	153	31.0	361	33.8	302	32.0	1,802	36.1
Mostly As	225	45.7	277	25.9	232	24.6	1,500	30.0
Missing Cases	19	3.9	47	4.4	47	5.0	109	2.2
Total	493	100.0	1,069	100.0	942	100.0	4,994	100.0
Math Track Placement								
Low	18	3.7	108	10.1	70	7.4	370	7.4
Middle	223	45.2	523	48.9	421	44.7	2,342	46.9
High	204	41.4	197	18.4	209	22.2	1,379	27.6
Not Grouped	29	5.9	158	14.8	188	20.0	589	11.8
Missing Cases	19	3.8	83	7.8	54	5.7	314	6.3
Total	493	100.0	1,069	100.0	942	100.0	4,994	100.0

Descriptive Information on Variables

Outcome Variable: Math Course Choice

The frequency data revealed that approximately one-third of eighth grade students in public schools were enrolled in algebra, with approximately an equal number of female and male students. Considering that enrollment patterns might be different in urban, suburban and rural schools due to a variety of factors including potential differences in course availability, crosstabulations were done to determine if the proportion of students enrolled in algebra varied according to urbanicity. The results indicated that course availability and course enrollment were approximately the same, regardless of urbanicity (see Figure 4). Although no differences were found relating to gender or urbanicity, differences among the subgroups were evident (see Figure 5). Over half of the students in the Asian subgroup were enrolled in algebra, in contrast to approximately a third of each of the other subgroups.

Means and Standard Deviations

The means and standard deviations for the full sample and the subgroups were based on cases that did not have any missing data for any of the variables (see Table 6). As expected, based upon the results of the frequency data, an examination of the means revealed descriptive differences among the subgroups. The Asian subgroup had the highest means for all variables.

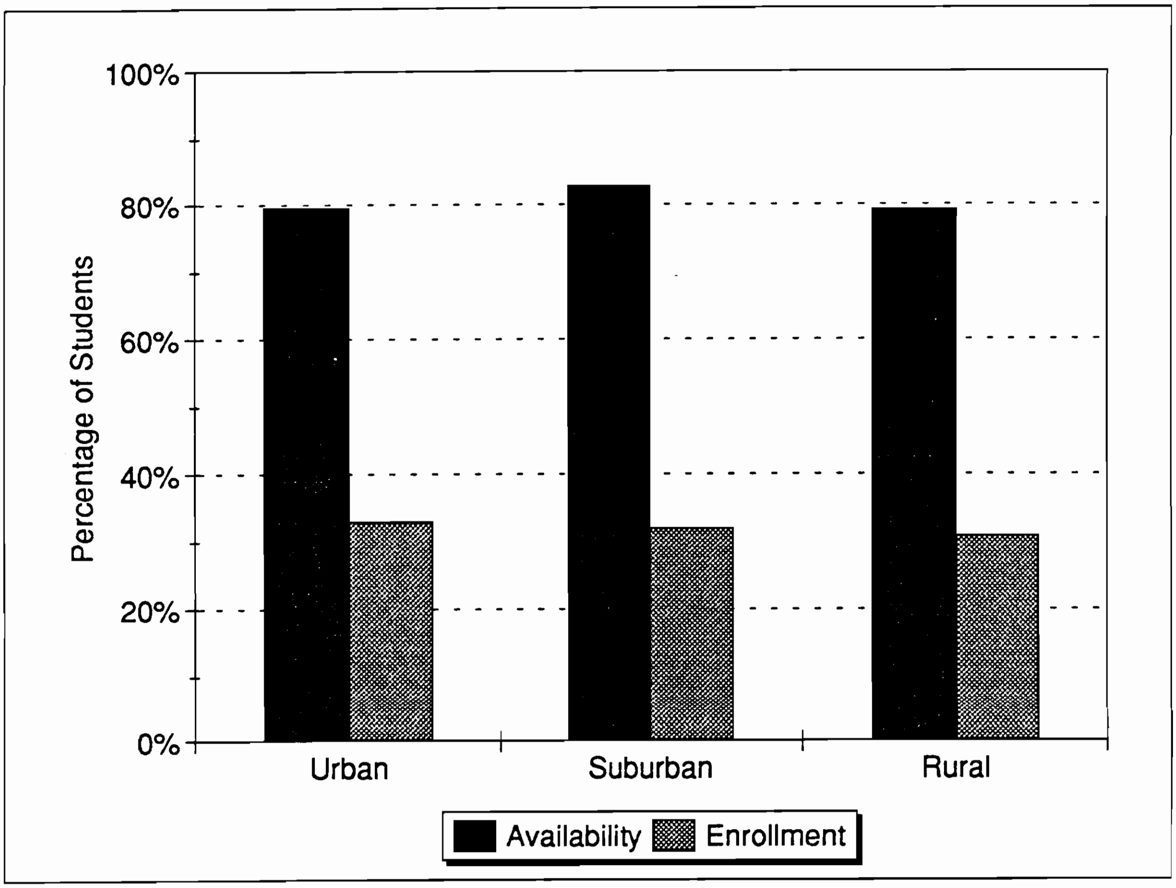


Figure 4. Percentage of students in urban, suburban and rural public schools who have access to algebra compared to the percentage of students who are enrolled.

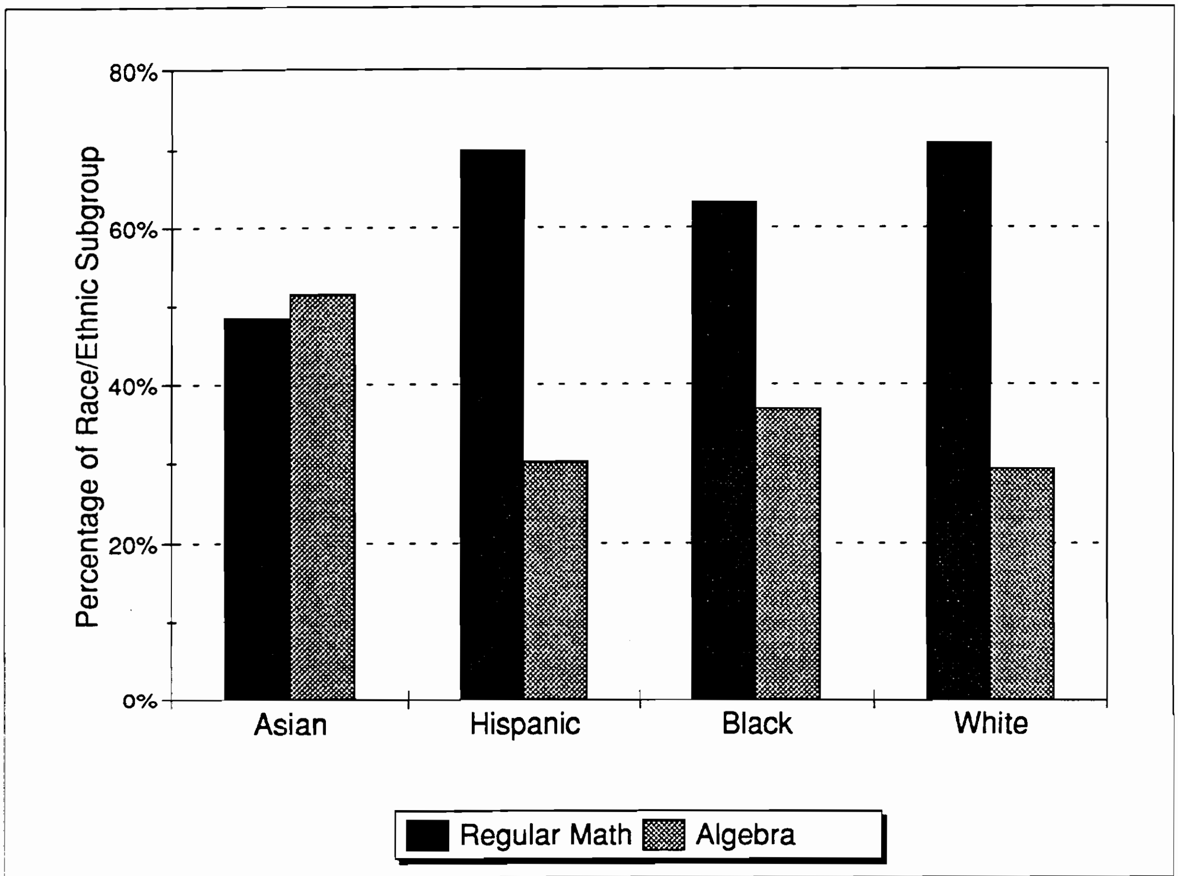


Figure 5. Percentage of race/ethnic subgroups enrolled in algebra and regular math in the eighth grade.

Table 6

Means and Standard Deviations for Variables in Model for Full Sample and Subgroups

	Groups				
Variable	Full sample	Asian	Hispanic	Black	White
PaEd	3.0212 (1.1802)	3.3487 (1.3882)	2.4676 (1.1886)	2.6816 (1.0135)	3.1549 (1.1377)
MaTe	50.5438 (9.8959)	54.5437 (10.0154)	46.7754 (8.8353)	44.4440 (8.6325)	52.0040 (9.6047)
MaGr	3.9294 (0.9805)	4.2680 (0.8535)	3.7804 (1.0288)	3.7318 (1.0325	3.9567 (0.9638)
MaTr	2.2485 (0.6039)	2.4380 (0.5572)	2.1464 (0.5932)	2.2011 (0.6020)	2.2602 (0.6052)
SPG	1.4274 (0.4457)	1.4897 (0.4329)	1.4451 (0.4563)	1.3845 (0.4332)	1.4225 (0.4441)
PaEx	8.7355 (2.9101)	9.1009 (2.7859)	8.8636 (2.8068)	8.6946 (2.9282)	8.6734 (2.9405)
AlPu	0.8049 (0.8247)	1.0115 (0.8152)	0.7188 (0.7890)	0.7989 (0.8356)	0.8047 (0.8286)
MaCh	0.3725 (0.4835)	0.5533 (0.4979)	0.3611 (0.4807)	0.4320 (0.4958)	0.3433 (0.4749)

Note. Standard deviations are presented in parentheses.
Full Sample N = 4,757; Asian N = 347; Hispanic N = 601; Black N = 537;
White N = 3,190.
Explanation of abbreviations for variables: PaEd=Parents' Education Level; MaTe=Standardized Math Test Score; MaGr=Prior Math Grades, Grades 6-8; MaTr=Math Track Placement; SPG=School-Parent Course Guidance Contacts; PaEx=Parents' Educational Expectations; AlPu=School-Parent Algebra Push; MaCh=Math Course Choice.

Correlations

Appendix B - 1 through B - 5 contain listwise correlation matrices for the variables in the model for the full sample and the subgroups. For the full sample a listwise analysis indicated there was a positive correlation between all of the predictor variables and the outcome variable, math course choice. After examining the tolerance levels and variance inflation factors for the variables, it was concluded that collinearity among the variables did not threaten the parameter estimates. The tolerance levels for the variables ranged from .63261 to .95956. The variance inflation factors ranged from 1.042 to 1.581.

Listwise correlation matrices were run for all of the subgroups, resulting in a positive correlation between all of the predictor variables and the outcome variable, with one exception. For the Asian subgroup, there was a small negative correlation between parents' education level and math course choice.

Structural Equations Analyses

The primary reason for using a structural equations analytical approach to examine the data was to construct and test a model that would provide insight into the math course selection process for policy makers.

Estimation of Model for Full Sample

When math course choice was regressed on all seven predictor variables, the coefficient of determination, R^2, was .3090. This R^2 suggests the model fits the data reasonably well, with approximately 31% of the variation in math course choice explained by the variables in the model (see Figure 2, p. 10 for model). Table 7 presents the regression coefficients, the significance levels and the R^2s for the equations in the structural model. Table 8 presents the decomposition of the effects into direct, indirect and total effects, providing a complete picture of the influence of the factors in the math course selection process. Appendix C - 1 presents the standard errors for the indirect effects.

Influence of the Variables. Contrary to the findings and suggestions in the studies reviewed for this study, the results of this path analysis did not find evidence to support the theory that parents' education level was an influential factor in the math course selection process. The factor's influence on math course choice was small and negative (-.0370). Its influence on school-parent algebra push was small and positive, but statistically significant (.0408). The factor did not have any meaningful indirect effects on the dependent variables in the equations in the model, using the guideline that indirect effects should be at least twice the size of their standard errors. One possible explanation for the discrepancy between the research literature and the findings is that many of the studies reviewed for this research suggesting a strong relationship between parents' education levels and math course choice were qualitative, primarily relying on interviews with small samples of White parents. Another reason might be found in the subgroup analyses which revealed a negative effect (-.1090) of this factor for the Asian subgroup.

Table 7

Structural Parameter Estimates for Math Course Selection Process Model for Full Sample

DV	Independent Variables							R^2
	PaEd	MaTe	MaGr	MaTr	SPG	PaEx	AlPu	
MaTr	-.0014	.3769**	.2698**					.2947
	(-.0007)	(.0230)	(.1662)					
SPG	-.0149	.0413*	.0119	.0292				.0041
	(-.0056)	(.0019)	(.0054)	(.0215)				
PaEx	.0045	.0171	.0308	.0762**	.0886**			.0199
	(.0112)	(.0050)	(.0915)	(.3670)	(.5788)			
AlPu	.0408**	.1214**	.0582**	.2440**	-.0007	.0497**		.1397
	(.0285)	(.0101)	(.0489)	(.3332)	(-.0013)	(.0141)		
MaCh	.0370**	.0672**	.0045	.3870**	.0587**	.2005**	.1491**	.3090
	(-.0152)	(.0033)	(-.0022)	(.3098)	(.0637)	(.0333)	(.0874)	

Note. N = 4,757.
Metric coefficients are presented in parentheses.
*$p < .05$. **$p < .01$.
Explanation of abbreviations for variables: PaEd=Parents' Education Level; MaTe=Standardized Math Test Score; MaGr=Prior Math Grades, Grades 6-8; MaTr=Math Track Placement; SPG=School-Parent Course Guidance Contacts; PaEx=Parents' Educational Expectations; AlPu=School-Parent Algebra Push; MaCh=Math Course Choice.

Table 8

Direct, Indirect and Total Effects for Structural Model of Math Course Selection Process for Full Sample

IV	Math Track Placement			Sch-Pa Guidance			Parent Expectations			Sch-Pa Algebra Push			Math Course Choice		
	D	I	T	D	I	T	D	I	T	D	I	T	D	I	T
PaEd	-.0014 [-.0007]	-	-.0014 [-.0007]	-.0149 [-.0056]	.0000 [.0000]	-.0149 [-.0056]	.0045 [.0112]	-.0014 [-.0035]	.0031 [.0076]	.0408 [.0285]	-.0002 [-.0001]	.0406 [.0284]	-.0370 [-.0152]	.0053 [.0022]	-.0318 [-.0130]
MaTe	.3769 [.0230]	-	.3769 [.0230]	.0413 [.0019]	.0110 [.0005]	.0523 [.0024]	.0171 [.0050]	.0333 [.0098]	.0505 [.0148]	.1214 [.0101]	.0944 [.0079]	.2158 [.0180]	.0672 [.0033]	.1912 [.0093]	.2584 [.0126]
MaGr	.2698 [.1662]	-	.2698 [.1662]	.0119 [.0054]	.0079 [.0036]	.0197 [.0090]	.0308 [.0915]	.0223 [.0662]	.0531 [.1577]	.0582 [.0489]	.0685 [.0576]	.1266 [.1065]	-.0045 [-.0022]	.1351 [.0666]	.1306 [.0644]
MaTr				.0292 [.0215]	-	.0292 [.0215]	.0762 [.3670]	.0026 [.0125]	.0788 [.3795]	.2440 [.3332]	.0039 [.0053]	.2479 [.3385]	.3870 [.3098]	.0545 [.0436]	.4414 [.3534]
SPG							.0886 [.5788]	-	.0886 [.5788]	-.0007 [-.0013]	.0044 [.0082]	.0037 [.0069]	.0587 [.0637]	.0183 [.0199]	.0770 [.0835]
PaEx										.0497 [.0141]	-	.0497 [.0141]	.2005 [.0333]	.0074 [.0012]	.2079 [.0345]
AlPu													.1491 [.0874]	-	.1491 [.0874]

Note. N = 4,757.

Standardized effects are presented first; unstandardized (metric) effects are in brackets.

Explanation of abbreviations for variables: PaEd=Parents' Education Level; MaTe=Standardized Math Test Score; MaGr=Prior Math Grades, Grades 6-8; MaTr=Math Track Placement; SPG=School-Parent Course Guidance Contacts; PaEx=Parents' Educational Expectations; AlPu=School-Parent Algebra Push; MaCh=Math Course Choice.

Standardized math test scores was an influential factor throughout the math course selection process. Its strongest influence was on math track placement, (.3769). The variable had substantial total effects on school-parent algebra push (.2158) and math course choice (.2584). These findings suggest that a student's standardized math test score is a factor that influences the course selection process as well as the student's math course choice.

Prior math grades was an influential factor in the process primarily because of its effect on math track placement (.2698). The factor had a total effect (.1266) on school-parent algebra push. As a consequence of its indirect effect (.1351), it had a total effect (.1306) on math course choice. These results suggest that between the two achievement indicators, the factor, prior math grades, has less of an influence on math course choice than standardized math test scores.

A highly alterable school policy variable, math track placement, had the largest direct effect, (.3870), on math course choice. The variable's indirect effect (.0545) was statistically significant because it was more than twice its standard error. Of all the school and parental influences, math track placement had the greatest total effect (.4414) on the outcome variable. Its direct effect on other variables in the model was also noteworthy. It had a direct effect (.2440) on school-parent algebra push and direct effect (.0762) on parents' educational expectations. This finding suggests that math track placement, as expected, strongly influences a student's access to algebra in the eighth grade.

Although school-parent course guidance contacts had a weaker influence on math course choice than the other school and parental influences, its direct and total effects were noteworthy. The variable had a direct effect (.0587) with a total effect (.0770) on math course choice. Examining the factor's influence on the other variables in the model revealed that it had a direct effect (.0886) on parents' educational expectations. Although its effect is small when compared to the other factors, it is an influence in the course selection process.

Parents' educational expectations had the second largest direct effect, (.2005), next to math track placement on the outcome variable. The variable had a direct and total effect (.0497) on school-parent algebra push, a small, but statistically significant influence in the course selection process. This finding suggests that the variable, parents' educational expectations, influences the course selection process and a student's math course choice.

School-parent algebra push, a variable constructed to represent the encouragement students receive from parents and school to take algebra, had a (.149) effect on math course choice. This finding suggests that guidance from counselors, teachers and parents can influence a student's selection of a math course.

<u>Estimation of Model for Subgroups</u>

When math course choice was regressed on all seven predictor variables for each separate subgroup, the R^2 for each subgroup was different. This suggests the model does not explain the process of math course choice equally well for the subgroups. The model appears to be more effective in explaining the process for the Asian and White subgroups than for Hispanic and Black subgroups. The R^2s for the individual subgroups were as follows: Asian (.3725), White (.3497), Hispanic (.2421) and Black (.2167). Although the most influential factors were the same across the subgroups, there were some interesting differences as to how the various variables operated within the math course selection process.

Asian Subgroup. Table 9 presents the regression coefficients, the significance levels and the R^2s for the equations in the structural model. Table 10 presents a decomposition of the effects into direct, indirect and total effects. The most influential variable in the model for Asian students was math track placement, with a direct effect (.5322) on math course choice. Likewise, the variable had a direct effect (.1857) on school-parent algebra push. Direct effects on math track placement from the two exogenous variables, standardized math test scores (.4218) and prior math grades (.2665), set up indirect effects from test scores and grades on math course choice. Parents' educational expectations also had a substantial direct effect (.1849) and school-parent algebra push had a smaller effect (.0979) on the outcome variable. Parents' education level had a negative direct effect (-.1090) on math course choice, suggesting the opposite of what has been suggested in much of the research literature. At the same time, parents' education level had a direct effect (.1387) on school-parent algebra push. Another noteworthy finding was the effect (.1410) that school-parent guidance contacts had on parents' educational expectations. Also, grades had a total effect (.0559) on school-parent course guidance contacts.

Table 9

Structural Parameter Estimates for Math Course Selection Process Model for Asian Subgroup

	Independent Variables							
DV	PaEd	MaTe	MaGr	MaTr	SPG	PaEx	AlPu	R^2
MaTr	-.0080 (-.0032)	.4218** (.0235)	.2665** (.1740)					.3622
SPG	-.0347 (-.0108)	-.0132 (-.0006)	.0275 (.0140)	.1064 (.0826)				.0134
PaEx	-.0461 (-.0926)	.1072 (.0298)	.0927 (.3026)	.0380 (.1901)	.1410** (.9072)			.0584
AlPu	.1387** (.0815)	.0842 (.0069)	.1019 (.0973)	.1857** (.2716)	-.0112 (-.0210)	.0511 (.0150)		.1308
MaCh	-.1090* (-.0391)	-.0492 (-.0024)	.0367 (.0214)	.5322** (.4756)	-.0196 (-.0226)	.1849** (.0330)	.0979* (.0598)	.3725

Note. N = 347

Metric coefficients are presented in parentheses.

*$p < .05$.   **$p < .01$.

Explanation of abbreviations for variables: PaEd=Parents' Education Level; MaTe=Standardized Math Test Score; MaGr=Prior Math Grades, Grades 6-8; MaTr=Math Track Placement; SPG=School-Parent Course Guidance Contacts; PaEx=Parents' Educational Expectations; AlPu=School-Parent Algebra Push; MaCh=Math Course Choice.

Table 10

<u>Direct, Indirect and Total Effects for Structural Model of Math Course Selection Process for Asian Subgroup</u>

IV	MathTrack Placement			Schl-Pa Guidance			Parent Expectations			Sch-Pa Algebra Push			Math Course Choice		
	D	I	T	D	I	T	D	I	T	D	I	T	D	I	T
PaEd	-.0080 [-.0032]	-	-.0080 [-.0032]	-.0347 [-.0108]	-.0009 [-.0003]	-.0356 [-.0111]	-.0461 [-.0926]	-.0053 [.0107]	-.0515 [-.1033]	.1387 [.0815]	-.0037 [-.0022]	.1350 [.0793]	-.1090 [-.0391]	.0001 [.0001]	-.1089 [-.0391]
MaTe	.4218 [.0235]	-	.4218 [.0235]	-.0132 [-.0006]	.0449 [.0019]	.0316 [.0014]	.1072 [.0298]	.0205 [.0057]	.1277 [.0355]	.0842 [.0069]	.0845 [.0069]	.1687 [.0137]	-.0492 [-.0024]	.2640 [.0131]	.2147 [.0107]
MaGr	.2665 [.1740]	-	.2665 [.1740]	.0275 [.0140]	.0283 [.0144]	.0559 [.0283]	.0927 [.3026]	.0180 [.0588]	.1107 [.3614]	.1019 [.0973]	.0545 [.0521	.1564 [.1494]	.0367 [.0214]	.1765 [.1030]	.2133 [.1244]
MaTr				.1064 [.0826]	-	.1064 [.0826]	.0380 [.1901]	.0150 [.0750]	.0530 [.2651]	.1857 [.2716]	.0015 [.0022]	.1872 [.2739]	.5322 [.4756]	.0260 [.0233]	.5583 [.4988]
SPG							.1410 [.9072]	-	.1410 [.9072]	-.0112 [-.0210]	.0072 [.0136]	-.0040 [-.0074]	-.0196 [-.0226]	.0257 [.0295]	.0060 [.0069]
PaEx									-	.0511 [.0150]	-	.0511 [.0150]	.1849 [.0330]	.0050 [.0009]	.1899 [.0339]
AlPu													.0979 [.0598]	-	.0979 [.0598]

Dependent Variables

<u>Note</u>. N = 347

Standardized effects are presented first; unstandardized (metric) effects are in brackets

Explanation of abbreviations for variables: PaEd=Parents' Education Level; MaTe=Standardized Math Test Score; MaGr=Prior Math Grades, Grades 6-8; MaTr=Math Track Placement; SPG=School-Parent Course Guidance Contacts; PaEx=Parents' Educational Expectations; AlPu=School-Parent Algebra Push; MaCh=Math Course Choice.

Hispanic Subgroup. Table 11 presents the regression coefficients, the significance levels and the R^2s for the equations in the structural model. Table 12 presents a decomposition of the effects into direct, indirect and total effects. As stated earlier, the model does not appear to explain the process of math course choice as well for Hispanic students as it does for the Asian and White subgroups. As with all the subgroups, math track placement had the strongest influence with a direct (.3166) and total effect (.3546) on the outcome variable. It had a total effect (.2630) on school-parent algebra push. As expected, math test scores (.3581) and math grades (.2918) influenced track placement. Parents' educational expectations had a direct effect (.2106) on math course choice. School-parent algebra push had a smaller effect (.0711) on math course choice. The unstandardized coefficients for this variable for all of the subgroups indicated that this variable was weaker for the Hispanic subgroup than the White and Black subgroups. As for the influence of math achievement in the model, standardized math test scores had a substantial total effect (.2472) on the outcome variable, partially due to its indirect effect (.1358). The influence of prior math grades in the model was noteworthy. As expected, grades had a substantial effect (.2918) on track placement, but it had a small, negative effect (-.0814) on school-parent course guidance contacts.

Table 11

Structural Parameter Estimates for Math Course Selection Process Model for Hispanic Subgroup

	Independent Variables							
DV	PaEd	MaTe	MaGr	MaTr	SPG	PaEx	AlPu	R^2
MaTr	.0092 (.0046)	.3581** (.0240)	.2918** (.1683)					.2795
SPG	.0373 (.0143)	.0627 (.0032)	-.0779 (-.0346)	-.0118 (-.0090)				.0094
PaEx	-.0122 (-.0289)	-.0029 (-.0009)	.0588 (.1605)	.0963* (.4558)	.0369 (.2268)			.0178
AlPu	.0069 (.0046)	.0577 (.0052)	.0725 (.0556)	.2595** (.3451)	-.0104 (-.0180)	.0358 (.0101)		.1121
MaCh	.0032 (.0013)	.1114** (.0061)	.0068 (.0032)	.3166** (.2565)	.0778* (.0819)	.2106** (.0361)	.0711 (.0433)	.2421

Note. N = 601

Metric coefficients are presented in parentheses.

*$p < .05$. **$p < .01$.

Explanation of abbreviations for variables: PaEd=Parents' Education Level; MaTe=Standardized Math Test Score; MaGr=Prior Math Grades, Grades 6-8; MaTr=Math Track Placement; SPG=School-Parent Course Guidance Contacts; PaEx=Parents' Educational Expectations; AlPu=School-Parent Algebra Push; MaCh=Math Course Choice.

Table 12

Direct, Indirect and Total Effects for Structural Model of Math Course Selection Process for Hispanic Subgroup

IV	MathTrack Placement			Sch-Pa Guidance			Parent Expectations			Sch-Pa Algebra Push			Math Course Choice		
	D	I	T	D	I	T	D	I	T	D	I	T	D	I	T
PaEd	.0092 [.0046]	-	.0092 [.0046]	.0373 [.0143]	-.0001 [.0000]	.0372 [.0143]	-.0122 [-.0289]	.0023 [.0053]	-.0100 [-.0236]	.0069 [.0046]	.0016 [.0011]	.0086 [.0057]	.0032 [.0013]	.0043 [.0017]	.0075 [.0030]
MaTe	.3581 [.0240]	-	.3581 [.0240]	.0627 [.0032]	-.0042 [-.0002]	.0585 [.0030]	-.0029 [-.0009]	.0367 [.0116]	.0338 [.0107]	.0577 [.0052]	.0935 [.0084]	.1512 [.0135]	.1114 [.0061]	.1358 [.0074]	.2472 [.0135]
MaGr	.2918 [.1683]	-	.2918 [.1683]	-.0779 [-.0346]	-.0034 [-.0015]	-.0814 [-.0361]	.0588 [.1605]	.0251 [.0685]	.0840 [.2290]	.0725 [.0556]	.0796 [.0610]	.1521 [.1166]	.0068 [.0032]	.1146 [.0535]	.1213 [.0567]
MaTr				-.0118 [-.0090]	-	-.0118 [-.0090]	.0963 [.4558]	-.0004 [-.0021]	.0959 [.4537]	.2595 [.3451]	.0036 [.0047]	.2630 [.3498]	.3166 [.2565]	.0380 [.0308]	.3546 [.2873]
SPG							.0369 [.2268]	-	.0369 [.2268]	-.0104 [-.0180]	.0013 [.0023]	-.0091 [-.0157]	.0778 [.0819]	.0071 [.0075]	.0849 [.0894]
PaEx										.0358 [.0101]	-	.0358 [.0101]	.2106 [.0361]	.0025 [.0004]	.2132 [.0365]
AlPu													.0711 [.0433]	-	.0711 [.0433]

The "Dependent Variables" heading spans the five dependent-variable column groups.

Note. N = 601

Standardized effects are presented first; unstandardized (metric) effects are in brackets

Explanation of abbreviations for variables: PaEd=Parents' Education Level; MaTe=Standardized Math Test Score; MaGr=Prior Math Grades, Grades 6-8; MaTr=Math Track Placement; SPG=School-Parent Course Guidance Contacts; PaEx=Parents' Educational Expectations; AlPu=School-Parent Algebra Push; MaCh=Math Course Choice.

Black Subgroup. Table 13 presents the regression coefficients, the significance levels and the R^2s for the equations in the structural model. Table 14 presents a decomposition of the effects into direct, indirect and total effects. Math track placement (.2771) and parents' educational expectations (.2744) had the strongest direct effects on math course choice. A comparison of the unstandardized effects of math track placement among the subgroups revealed this factor had a weaker effect on the outcome variable for the Black subgroup in comparison to the other subgroups. Furthermore, standardized math test scores had a weaker effect on math track placement for this subgroup than was evident with the other subgroups. Test scores had a stronger total effect (.1027) on school-parent course guidance contacts than was evident in the other subgroups. Parents' educational expectations had a stronger direct effect on the outcome variable for this subgroup in comparison to the other groups. School-parent algebra push had a total effect (.1213) on math course choice. As stated earlier, the model does not appear to explain the math course selection process as well for this subgroup as the other subgroups. This is partially due to the weaker total effects of both test scores and track placement on math course choice.

Table 13
Structural Parameter Estimates for Math Course Selection Process Model for Black Subgroup

	Independent Variables							
DV	PaEd	MaTe	MaGr	MaTr	SPG	PaEx	AlPu	R^2
MaTr	.0112 (.0067)	.2670** (.0186)	.3484** (.2031)					.2509
SPG	-.0228 (-.0098)	.1026* (.0051)	.0347 (.0145)	.0004 (.0003)				.0128
PaEx	-.0422 (-.1220)	.0376 (.0128)	.1488** (.4221)	-.0704 (-.3422)	.0544 (.3677)			.0255
AlPu	.0455 (.0375)	.0744 (.0072)	.0336 (.0272)	.2172** (.3014)	.0161 (.0310)	.0513 (.0146)		.0850
MaCh	-.0082 (-.0040)	.0357 (.0021)	-.0196 (-.0094)	.2771** (.2282)	.1190** (.1362)	.2744** (.0465)	.1213** (.0720)	.2167

Note. N = 537
Metric coefficients are presented in parentheses.
*$p < .05$. **$p < .01$.
Explanation of abbreviations for variables: PaEd=Parents' Education Level; MaTe=Standardized Math Test Score; MaGr=Prior Math Grades, Grades 6-8; MaTr=Math Track Placement; SPG=School-Parent Course Guidance Contacts; PaEx=Parents' Educational Expectations; AlPu=School-Parent Algebra Push; MaCh=Math Course Choice.

Table 14

Direct, Indirect and Total Effects for Structural Model of Math Course Selection Process for Black Subgroup

	Dependent Variables														
IV	MathTrack Placement			Sch-Pa Guidance			Parent Expectations			Sch-Pa Algebra Push			Math Course Choice		
	D	I	T	D	I	T	D	I	T	D	I	T	D	I	T
PaEd	.0112 [.0067]	-	.0112 [.0067]	-.0228 [-.0098]	.0000 [.0000]	-.0228 [-.0098]	-.0422 [-.1220]	-.0020 [-.0059]	-.0443 [-.1279]	.0455 [.0375]	-.0002 [-.0002]	.0453 [.0374]	-.0082 [-.0040]	-.0063 [-.0031]	-.0144 [-.0071]
MaTe	.2670 [.0186]	-	.2670 [.0186]	.1026 [.0051]	.0001 [.0000]	.1027 [.0051]	.0376 [.0128]	-.0132 [-.0045]	.0244 [.0083]	.0744 [.0072]	.0609 [.0059]	.1352 [.0131]	.0357 [.0021]	.1093 [.0063]	.1451 [.0083]
MaGr	.3484 [.2031]	-	.3484 [.2031]	.0347 [.0145]	.0002 [.0001]	.0348 [.0146]	.1488 [.4221]	-.0226 [-.0641]	.1262 [.3580]	.0336 [.0272]	.0827 [.0669]	.1163 [.0941]	-.0196 [-.0094]	.1494 [.0718]	.1298 [.0623]
MaTr				.0004 [.0003]	-	.0004 [.0003]	-.0704 [-.3422]	.0000 [.0001]	-.0703 [-.3421]	.2172 [.3014]	-.0036 [-.0050]	.2136 [.2964]	.2771 [.2282]	.0067 [.0055]	.2838 [.2337]
SPG							.0544 [.3677]	-	.0544 [.3677]	.0161 [.0310]	.0028 [.0054]	.0189 [.0364]	.1190 [.1362]	.0172 [.0197]	.1363 [.1560]
PaEx										.0513 [.0146]	-	.0513 [.0146]	.2744 [.0465]	.0062 [.0011]	.2807 [.0475]
AlPu													.1213 [.0720]	-	.1213 [.0720]

Note. N = 537

Standardized effects are presented first; unstandardized (metric) effects are in brackets

Explanation of abbreviations for variables: PaEd=Parents' Education Level; MaTe=Standardized Math Test Score; MaGr=Prior Math Grades, Grades 6-8; MaTr=Math Track Placement; SPG=School-Parent Course Guidance Contacts; PaEx=Parents' Educational Expectations; AlPu=School-Parent Algebra Push; MaCh=Math Course Choice.

White Subgroup. Table 15 presents the regression coefficients, the significance levels and the R^2s for the equations in the structural model. Table 16 presents a decomposition of the effects into direct, indirect and total effects. The model fits the data fairly well for this subgroup. As with the other subgroups, math track placement (.3949) and parents' educational expectations (.1805) had the strongest direct effects on math course choice. When indirect effects were considered, math track placement had a total effect (.4571) on the outcome variable. As with the Asian subgroup, standardized math test scores had a strong effect (.4058) on math track placement. One particularly interesting finding was the direct effect (.1701) of school-parent algebra push on math course choice for this group. An examination of the unstandardized effects for this variable across subgroups indicated this factor had the strongest effect for the White subgroup. These findings suggest that all the factors in the model influenced math course choice except parents' education level. The stronger influence of school-parent algebra push for this subgroup suggests the possibility that White students might receive more encouragement from the home and school to take algebra than the other subgroups.

Table 15
Structural Parameter Estimates for Math Course Selection Process Model for White Subgroup

	Independent Variables							
DV	PaEd	MaTe	MaGr	MaTr	SPG	PaEx	AlPu	R^2
MaTr	-.0025 (-.0013)	.4058** (.0256)	.2407** (.1511)					.3027
SPG	-.0213 (-.0083)	.0272 (.0013)	.0225 (.0104)	.0310 (.0228)				.0038
PaEx	.0271 (.0701)	.0160 (.0049)	-.0086 (-.0262)	.1013** (.4923)	.1014** (.6717)			.0248
AlPu	.0306 (.0223)	.1585** (.0137)	.0520** (.0447)	.2405** (.3293)	-.0007 (-.0014)	.0516** (.0145)		.1561
MaCh	-.0271 (-.0113)	.1115** (.0055)	-.0193 (-.0095)	.3949** (.3099)	.0481** (.0514)	.1805** (.0291)	.1701** (.0975)	.3497

Note. N = 3,190
Metric coefficients are presented in parentheses.
*$p < .05$. **$p < .01$.
Explanation of abbreviations for variables: PaEd=Parents' Education Level; MaTe=Standardized Math Test Score; MaGr=Prior Math Grades, Grades 6-8; MaTr=Math Track Placement; SPG=School-Parent Course Guidance Contacts; PaEx=Parents' Educational Expectations; AlPu=School-Parent Algebra Push; MaCh=Math Course Choice.

Table 16
Direct, Indirect and Total Effects for Structural Model of Math Course Selection Process for White Subgroup

IV	MathTrack Placement			Sch-Pa Guidance			Parent Expectations			Sch-Pa Algebra Push			Math Course Choice		
	D	I	T	D	I	T	D	I	T	D	I	T	D	I	T
PaEd	-.0025 [-.0013]	-	-.0025 [-.0013]	-.0213 [-.0083]	-.0001 [.0000]	-.0213 [-.0083]	.0271 [.0701]	-.0024 [-.0062]	.0247 [.0638]	.0306 [.0223]	.0007 [.0005]	.0313 [.0228]	-.0271 [-.0113]	.0078 [.0032]	-.0193 [-.0081]
MaTe	.4058 [.0256]	-	.4058 [.0256]	.0272 [.0013]	.0126 [.0006]	.0398 [.0018]	.0160 [.0049]	.0452 [.0138]	.0612 [.0187]	.1585 [.0137]	.1007 [.0087]	.2592 [.0224]	.1115 [.0055]	.2173 [.0107]	.3288 [.0163]
MaGr	.2407 [.1511]	-	.2407 [.1511]	.0225 [.0104]	.0075 [.0034]	.0300 [.0138]	-.0086 [-.0262]	.0274 [.0837]	.0188 [.0575]	.0520 [.0447]	.0588 [.0506]	.1108 [.0953]	-.0193 [-.0095]	.1187 [.0585]	.0994 [.0490]
MaTr				.0310 [.0228]	-	.0310 [.0228]	.1013 [.4923]	.0031 [.0153]	.1045 [.5076]	.2405 [.3293]	.0054 [.0073]	.2459 [.3367]	.3949 [.3099]	.0622 [.0488]	.4571 [.3587]
SPG							.1014 [.6717]	-	.1014 [.6717]	-.0007 [-.0014]	.0052 [.0098]	.0045 [.0084]	.0481 [.0514]	.0191 [.0204]	.0672 [.0718]
PaEx										.0516 [.0145]	-	.0516 [.0145]	.1805 [.0291]	.0088 [.0014]	.1892 [.0306]
AlPu													.1701 [.0975]	-	.1701 [.0975]

Note. N = 3,190
Standardized effects are presented first; unstandardized (metric) effects are in brackets
Explanation of abbreviations for variables: PaEd=Parents' Education Level; MaTe=Standardized Math Test Score; MaGr=Prior Math Grades, Grades 6-8; MaTr=Math Track Placement; SPG=School-Parent Course Guidance Contacts; PaEx=Parents' Educational Expectations; AlPu=School-Parent Algebra Push; MaCh=Math Course Choice.

Summary of Results

The descriptive statistics indicate that approximately 32% of the full sample are enrolled in algebra. The analysis confirms prior research findings of differential patterns in course enrollment among the race/ethnic subgroups. Approximately one-half of the Asian students are enrolled in algebra in comparison to approximately one-third of the other subgroups. The Asian subgroup has the highest means for the variables in the model. One of the most obvious descriptive differences among the subgroups is related to prior math grades. Approximately 46% of the Asian subgroup indicate they have received mostly A's in math in comparison to much smaller percentages of the other subgroups. In spite of the differences, the subgroups are similar regarding levels of math proficiency.

The structural equations model explains the math course selection process fairly well for the full sample with a R^2 of .3090 . An examination of the R^2s for the subgroups suggests the model explains the process most effectively for Asian and White students, with R^2s of .3725 and .3497 respectively, but less well for Hispanic and Black students.

For the full sample and the subgroups, the results suggest that school and parental factors in the model influence an eighth grade student's math course choice when parents' education level, standardized math test scores and prior math grades are controlled. The variable that appears to have the greatest influence on math course choice for the full sample and each of the subgroups is a highly alterable school policy variable, math track placement. Next to math track placement, the variable, parents' educational expectations, appears to have the strongest influence on math course choice. The variable, school-parent algebra push, also appears to be an important influence for the full sample and subgroups, but most important for the White subgroup.

CHAPTER FIVE: CONCLUSIONS, POLICY IMPLICATIONS and RECOMMENDATIONS FOR FUTURE RESEARCH

This chapter consists of two sections: 1) conclusions and policy implications; and 2) recommendations for future research.

Conclusions and Policy Implications

The study's conclusions have meaningful policy implications for educators and policy makers concerned about the overall low enrollment and race/ethnic enrollment differences in advanced math courses. Although numerous studies have found a high positive association between advanced course taking and mathematics achievement (Ekstrom et al., 1988; Horn & Walberg, 1984; Reynolds & Walberg, 1992), only about one-third of middle school students in public schools enroll in algebra, gaining access to the advantages of advanced math track enrollment. Furthermore, there are substantial differences in enrollment patterns among the four race/ethnic subgroups, resulting in approximately half of the Asian subgroup enrolled in algebra in comparison to approximately a third of the other subgroups. The math course selection process in the eighth grade in public schools represents a two-dimensional policy issue, with implications for both educational productivity and equity.

Dunn's (1981) approach to policy analysis with a focus on the formulation of policy problems, identification and prioritization of stakeholders and development of policy alternatives provides a constructive framework to discuss this study's policy implications. This study heeds Murnane's (1983) caution against proposing sweeping policy recommendations based on the findings of a non-experimental study. Instead of proposing policy changes for local, state and federal jurisdictions, this study suggests alternatives for policy makers to consider.

One conclusion is that track placement plays an important role in the math course selection process in the eighth grade. The findings of this study support conclusions of prior studies that math track placement is largely determined by prior math achievement and educational motivation and, in turn, is a determinant of course taking patterns (Alexander et al., 1978; Heyns, 1974; Hoffer, 1992). In order to increase the enrollment in advanced math courses, policy makers must examine the current policies associated with math tracking and structure the problem accordingly. The policy problem can be viewed as to how to find ways to expand the number of students in the top track without impacting negatively on instructional quality. Another way of approaching the problem is to find ways to de-couple the practices of track placement and curriculum exposure. A third approach is to view the problem as a need to eliminate or modify the hierarchical nature of tracking.

Results of prior studies comparing math achievement between Catholic and public schools (Camarena, 1990; Lee, 1985) suggest possible alternative policies and practices for public school policy makers. Math course choice was less dependent on track placement in Catholic schools than in public schools. There was less reliance on student and parent choice and prior math achievement for both track placement and course selection. Moreover, the curriculum was more uniform across tracks and there was more student mobility between tracks in Catholic schools. NCTM (1988) recommended similar policy initiatives when it urged public schools to adopt a core curriculum, uniform standards for all students and more flexibility in tracking practices. Going further, NCTM has proposed modifying the vertically structured math curriculum, by infusing algebra in the elementary school curriculum. This latter approach might diminish the gatekeeping role of the eighth grade math course selection process that has restricted student access to advanced math course taking. Of course, changes in policies and practices regarding tracking always impact immediately on local officials and practitioners. Changes in tracking are always controversial because of a lack of consensus among policy makers, practitioners and clients as to the formulation of the problem and potential solutions.

A second conclusion of the study is that parents' educational expectations is an important influence in the math course selection process. Recognizing the importance of this factor in their efforts to increase enrollment in advanced math courses, policy makers and educators should consider at least three alternatives. One, they can initiate programs that encourage parents to become more involved in the course selection process and to acquire higher educational expectations for their children. This alternative is suggested by the Commission on Precollege Guidance and Counseling (1986). In consideration of the finding that only 23% of parents have graduated from college or hold advanced degrees (see Figure 3, p. 59), a majority of parents probably do not know the impact of advanced math course taking on a student's future. By initiating pro-active programs and services, educators would be ensuring greater equity in access to information. Programs to educate parents on the importance of advanced math course taking to a student's future educational and career prospects might be a highly productive policy initiative. A second alternative is to make the course selection process less dependent on parental involvement and expectations by having educators become more directive in course placement. Support for the second alternative comes from studies (Cusick, 1983; Lee & Ekstrom, 1987) that suggest disadvantaged students are placed at a greater disadvantage because they are asked to make curricular choices without the benefit of course guidance from either home or school. A third alternative is to eliminate curricular options altogether, or at least to narrow the difference among the choices.

A third conclusion of the study is that school-parent algebra push is moderately important in the course selection process, but not equally so for all subgroups. Policy makers should examine, in particular, the weaker influence of this factor for the Hispanic subgroup.

A fourth conclusion of the study is there are meaningful differences relating to prior math grades and test scores among the race/ethnic subgroups that establish pre-existing achievement differences. The Asian subgroup has the highest math grades and test scores coming into the eighth grade. Partially due to the causal link between prior achievement and track placement in public schools, this results in a greater proportion of the Asian subgroup enrolling in algebra in the eighth grade. This conclusion suggests that policy initiatives to alter the disparity in enrollment patterns among the subgroups should be targeted at increasing student achievement in the elementary years. At the same time, policy makers should study the implications of the finding that math proficiency levels of the subgroups are quite similar, in spite of a difference in the means of prior math grades and test scores.

Recommendations for Future Research

This study used selected data from the NELS 88 base year survey to construct and test a model of the math course selection process in the eighth grade, a critical transitional period in a student's secondary school career. This study can be expanded and modified in numerous ways. The present study can be expanded by incorporating selected data from the 1990 and 1992 surveys that followed up on the eighth grade student cohort in the students' sophomore and senior years. Moving away from strictly a cross-sectional analysis and assuming a longitudinal framework, a model should be constructed and tested to determine the effects of the eighth grade math course selection process on high school math course taking patterns and math achievement. In addition, future analyses could test the model after deleting the variable, math track placement. There is a concern that the strength of the relationship between the variables, math track placement and math course choice, indicates a lack of distinctiveness between the two variables. If this is the case, then the two variables might not represent completely different phenomena (Pedhazur and Schmelkin, 1991). The results of the new analysis could be compared with those of the present study for the full sample and the subgroups. Another suggestion is that LISREL VII should be used to analyze this study's current, modified or expanded model.

This study focuses exclusively on the math course selection process in the eighth grade in public schools. Future research efforts should be expanded to examine the relationship between the math course selection process in the eighth grade and course taking and achievement patterns in related quantitative curricular areas, such as science and computer science in high school and college. Policy makers are concerned because of the gender (Ethington & Wolfe, 1988; Ware & Lee, 1988) and race/ethnic (Jacob, 1990; National

Research Council, 1989) differences in enrollment patterns in advanced quantitative courses.

Future research should also focus on analysis of math course taking and achievement patterns of magnet schools in the public sector as well as schools, other than Catholic schools, in the private sector. Much of the prior research on sector differences has been restricted to a comparison of achievement and course taking patterns between Catholic and public schools.

In addition, many public schools are presently initiating policy changes relating to the math program in elementary and middle schools with the objective of increasing student enrollment in advanced math courses at the high school level. There is a need for both qualitative and quantitative research to assess the effectiveness of these changes.

In conclusion, this study's focus was restricted to constructing and testing a model of the math course selection process in the eighth grade in public schools, a pivotal transitional point between elementary and high school. In view of the relationship between math course taking patterns and achievement and the probable continuation of policies and practices that foster curricular choices and options in American secondary education, there are numerous areas in need of research.

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Appendix A

Details on Construction of Variables and Values

Table A - 1
Details on Construction of Variables and Values

Race/Ethnicity Status Used RACE variable, coded 1=Asian, 2=Hispanic, 3=Black, 4=White to select cases for the separate analyses of the four major race/ethnic student population subgroups.

Parents' Education Level Used composite variable, BYPARED, as originally constructed. Values ranged from 1=Did not finish H.S. to 6=Ph.D or M.D. Recoded 7 through 9 as missing values.

Standardized Math Test Score Used variable, BYTXMSTD, as originally constructed. Scores ranged from 28.294 through 71.222. Recoded 99 as missing value.

Prior Math Grades Used variable, BYS81B, Math Grades from Grade 6 Until Now. Original coding: 1=Mostly As, 2=Mostly Bs, 3=Mostly Cs, 4=Mostly Ds, 5=Mostly below D, 6= Not graded. Recoded so values represented low to high numerical quantification. Revised codes: 1=Mostly below D, 2=Mostly Ds, 3=Mostly Cs, 4=Mostly Bs, 5=Mostly As. Values, 6 and 96 through 99 recoded as missing values.

Math Track Placement Used variable, BYS60A. Original coding: 1=High, 2=Middle, 3=Low, 4=Aren't Grouped. Recoded values: 1=Low, 3=High, 5 through 9 as system missing values. After value 4 was included for analysis, it was recoded as a missing value.

School/Parent Course Guidance Contacts Used three variables to create new composite variable. Variables used were: BYP57B, BYP57C and BYP57D. Original coding included 1=None, 2=Once or twice, 3=Three or four times, 4=More than four times. The mean of the variables' values was computed for all cases. Values 6 through 9 coded as missing values. Scale for composite variable was the same as original.

Parents' Educational Expectations Used variable, BYP76, How Far in School R Expects Child To Go, as originally constructed. Values range from 1=Less than H.S. diploma through 12=Ph.D, M.D. Values 96 through 99 were recoded as missing values.

School/Parent Algebra Push Used two variables, BYS61, Talk to Teacher/Counselor about Taking Algebra, and BYS62, Did Parents/Guardians Want Respondent to Take Algebra, to create new composite variable. Original variables were coded 1=Yes and 2=No. Coding revised to read 0=No and 1=Yes. Values were summed across variables. New scale was created to read: 0=Neither, 1=Either school or parents, 2=Both school and parents. For both variables, values, 3 through 9, were recoded as missing values.

Math Course Choice Used variables BYP53, Child Enrolled in Algebra This Year, and BYS66D, In Advanced, Enriched Accelerated Math, to select cases where there was a concurrence between parent and student respondents regarding algebra enrollment. Original coding for both variables read 1=Yes and 2=No. Values recoded to read 0=No and 1=Yes. Values 6 through 9 recoded as missing values. There was no need to create composite variable. Used BYP53 as outcome variable.

(table continues)

Urbanicity Used variable, G8URBAN, Urbanicity Composite, to identify schools according to setting. Original coding used in analysis: 1=Urban; 2=Suburban; 3=Rural.

Algebra Availability Used variable, BYS65, to identify students who did not have access to algebra because of non-availability of course. Value 6=Algebra not offered.

Math Proficiency Level Used variable, BYTXMPRO, to identify students who performed at specific proficiency levels in the eighth grade. Original coding used in analysis: 1=Below level 1; 2=Level 1; 3=Level 1 and 2; 4=All three levels.

Appendix B

Correlations, Means and Standard Deviations for Variables in Model for Full Sample and Subgroups

Table B - 1

Correlations, Means and Standard Deviations for Variables in Model for Full Sample

Variables	1	2	3	4	5	6	7	8
1. Parents' Education Level	1.0000							
2. Standardized Math Test Score	.3735	1.0000						
3. Prior Math Grades, 6-8	.1459	.3949	1.0000					
4. Math Track Placement	.1788	.4830	.4185	1.0000				
5. Sch-Pa Guidance	.0075	.0545	.0382	.0514	1.0000			
6. Parents' Educational Expectations	.0297	.0726	.0735	.1027	.0947	1.0000		
7. Sch-Pa Algebra Push	.1397	.2810	.2178	.3393	.0257	.0890	1.0000	
8. Math Course Choice	.0838	.2981	.2280	.4851	.1046	.2625	.3125	1.0000
M	3.0212	50.5438	3.9294	2.2485	1.4274	8.7355	.8049	.3725
SD	1.1802	9.8959	.9805	.6039	.4457	2.9101	.8247	.4835

Note. N = 4,757.

Table B - 2

Correlations, Means and Standard Deviations for Variables in Model for Asian Subgroup

Variables	1	2	3	4	5	6	7	8
1. Parents' Education Level	1.0000							
2. Standardized Math Test Score	.2735	1.0000						
3. Prior Math Grades, 6-8	.0599	.3528	1.0000					
4. Math Track Placement	.1233	.5136	.4148	1.0000				
5. Sch-Pa Guidance	-.0236	.0416	.0649	.1067	1.0000			
6. Parents' Educational Expectations	-.0099	.1527	.1527	.1409	.1566	1.0000		
7. Sch-Pa Algebra Push	.1905	.2608	.2240	.2943	.0235	.1026	1.0000	
8. Math Course Choice	-.0374	.2602	.2825	.5615	.0713	.2660	.2477	1.0000
M	3.3487	54.5437	4.2680	2.4380	1.4897	9.1009	1.0115	.5533
SD	1.3882	10.0154	.8535	.5572	.4329	2.7859	.8152	.4979

Note. N = 347.

Table B - 3

Correlations, Means and Standard Deviations for Variables in Model for Hispanic Subgroup

Variables	1	2	3	4	5	6	7	8
1. Parents' Education Level	1.0000							
2. Standardized Math Test Score	.2232	1.0000						
3. Prior Math Grades, 6-8	.0255	.3081	1.0000					
4. Math Track Placement	.0966	.4501	.4024	1.0000				
5. Sch-Pa Guidance	.0482	.0417	-.0624	-.0113	1.0000			
6. Parents' Educational Expectations	-.0003	.0574	.0941	.1171	.0314	1.0000		
7. Sch-Pa Algebra Push	.0462	.2000	.1989	.3196	-.0140	.0760	1.0000	
8. Math Course Choice	.0658	.2863	.1977	.4163	.0842	.2626	.2110	1.0000
M	2.4676	46.7754	3.7804	2.1464	1.4451	8.8636	.7188	.3611
SD	1.1886	8.8353	1.0288	.5932	.4563	2.8068	.7890	.4807

Note. N = 601.

Table B - 4
Correlations, Means and Standard Deviations for Variables in Model for Black Subgroup

Variables	1	2	3	4	5	6	7	8
1. Parents' Education Level	1.0000							
2. Standardized Math Test Score	.3108	1.0000						
3. Prior Math Grades, 6-8	.0751	.2990	1.0000					
4. Math Track Placement	.1204	.3747	.4291	1.0000				
5. Sch-Pa Guidance	.0117	.1060	.0638	.0510	1.0000			
6. Parents' Educational Expectations	-.0272	.0484	.1302	.0053	.0638	1.0000		
7. Sch-Pa Algebra Push	.0961	.1841	.1601	.2660	.0410	.0602	1.0000	
8. Math Course Choice	.0404	.1794	.1721	.3209	.1581	.2902	.2191	1.0000
M	2.6816	44.4440	3.7318	2.2011	1.3845	8.6946	.7989	.4320
SD	1.0135	8.6325	1.0325	.6020	.4332	2.9282	.8356	.4958

Note. N = 537.

Table B - 5

Correlations, Means and Standard Deviations for Variables in Model for White Subgroup

Variables	1	2	3	4	5	6	7	8
1. Parents' Education Level	1.0000							
2. Standardized Math Test Score	.3656	1.0000						
3. Prior Math Grades, 6-8	.1666	.4145	1.0000					
4. Math Track Placement	.1860	.5047	.4085	1.0000				
5. Sch-Pa Guidance	-.0018	.0444	.0429	.0500	1.0000			
6. Parents' Educational Expectations	.0502	.0780	.0483	.1160	.1068	1.0000		
7. Sch-Pa Algebra Push	.1445	.3166	.2235	.3534	.0260	.0958	1.0000	
8. Math Course Choice	.1175	.3630	.2325	.5217	.0957	.2541	.3553	1.0000
M	3.1549	52.0040	3.9567	2.2602	1.4225	8.6734	.8047	.3433
SD	1.1377	9.6047	.9638	.6052	.4441	2.9405	.8286	.4749

Note. N = 3,190.

Appendix C

Standard Errors for Indirect Effects
for
Full Sample and Subgroups

Table C - 1

Standard Errors for Indirect Effects for Structural Model of Math Course Selection Process for Full Sample

	Dependent Variables			
IV	SPG	PaEx	AlPu	MaCh
PaEd	.0001	.0043	.0023	.0029
MaTe	.0003	.0020	.0006	.0005
MaGr	.0021	.0147	.0046	.0040
MaTr		.0076	.0019	.0045
SPG			.0026	.0041
PaEx				.0004

Note. Explanation of abbreviations for variables: PaEd=Parents' Education Level; MaTe=Standardized Math Test Score; MaGr=Prior Math Grades, Grades 6-8; MaTr=Math Track Placement; SPG=School-Parent Course Guidance Contacts; PaEx=Parents' Educational Expectations; AlPu=School-Parent Algebra Push; MaCh=Math Course Choice.

Table C - 2

Standard Errors for Indirect Effects for Structural Model of Math Course Selection Process for Asian Subgroup

	Dependent Variables			
IV	SPG	PaEx	AlPu	MaCh
PaEd	.0015	.0170	.0056	.0010
MaTe	.0012	.0079	.0023	.0148
MaGr	.0092	.0624	.0187	.0150
MaTr		.0540	.0097	.0192
SPG			.0047	.0019
PaEx				.0104

Note. Explanation of abbreviations for variables: PaEd=Parents' Education Level; MaTe=Standardized Math Test Score; MaGr=Prior Math Grades, Grades 6-8; MaTr=Math Track Placement; SPG=School-Parent Course Guidance Contacts; PaEx=Parents' Educational Expectations; AlPu=School-Parent Algebra Push; MaCh=Math Course Choice.

Table C - 3

Standard Errors for Indirect Effects for Structural Model of Math Course Selection Process for Hispanic Subgroup

	Dependent Variables			
IV	SPG	PaEx	AlPu	MaCh
PaEd	.0002	.0096	.0064	.0065
MaTe	.0009	.0056	.0017	.0012
MaGr	.0062	.0405	.0130	.0098
MaTr		.0087	.0056	.0126
SPG			.0035	.0097
PaEx				.0005

Note. Explanation of abbreviations for variables: PaEd=Parents' Education Level; MaTe=Standardized Math Test Score; MaGr=Prior Math Grades, Grades 6-8; MaTr=Math Track Placement; SPG=School-Parent Course Guidance Contacts; PaEx=Parents' Educational Expectations; AlPu=School-Parent Algebra Push; MaCh=Math Course Choice.

Table C - 4

Standard Errors for Indirect Effects for Structural Model of Math Course Selection Process for Black Subgroup

	Dependent Variables			
IV	SPG	PaEx	AlPu	MaCh
PaEd	.0002	.0112	.0074	.0093
MaTe	.0007	.0049	.0016	.0013
MaGr	.0073	.0502	.0161	.0120
MaTr		.0132	.0056	.0156
SPG			.0061	.0152
PaEx				.0009

Note. Explanation of abbreviations for variables: PaEd=Parents' Education Level; MaTe=Standardized Math Test Score; MaGr=Prior Math Grades, Grades 6-8; MaTr=Math Track Placement; SPG=School-Parent Course Guidance Contacts; PaEx=Parents' Educational Expectations; AlPu=School-Parent Algebra Push; MaCh=Math Course Choice.

Table C - 5

Standard Errors for Indirect Effects for Structural Model of Math Course Selection Process for White Subgroup

	Dependent Variables			
IV	SPG	PaEx	AlgPu	MaCh
PaEd	.0002	.0066	.0030	.0036
MaTe	.0004	.0027	.0008	.0006
MaGr	.0024	.0174	.0054	.0049
MaTr		.0108	.0028	.0053
SPG			.0035	.0049
PaEx				.0005

Note. Explanation of abbreviations for variables: PaEd=Parents' Education Level; MaTe=Standardized Math Test Score; MaGr=Prior Math Grades, Grades 6-8; MaTr=Math Track Placement; SPG=School-Parent Course Guidance Contacts; PaEx=Parents' Educational Expectations; AlPu=School-Parent Algebra Push; MaCh=Math Course Choice.

Appendix D

Frequency Distributions for Variables in Model for Full Sample

Frequency Distributions for Variables in Model for Full Sample

BYPARED PARENTS' EDUCATION LEVEL

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Did not finish HS	1	947	12.4	12.4	12.4
H.S. grad or GED	2	1559	20.4	20.4	32.8
Gt H.S. & Lt 4yr degree	3	3392	44.4	44.4	77.2
College graduate	4	962	12.6	12.6	89.7
M.A. or equivalent	5	547	7.2	7.2	96.9
Ph.D, M.D., other	6	237	3.1	3.1	100.0
Missing	.	4	.1	Missing	
	Total	7648	100.0	100.0	

Valid cases 7644 Missing cases 4

- -

BYTXMSTD MATHEMATICS STANDARDIZED TEST SCORE

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
28.294-71.222	1	7385	96.6	100.0	100.0
Missing		263	3.4	Missing	
	Total	7648	100.0	100.0	

Valid cases 7385 Missing cases 263

- -

BYS81B PRIOR MATH GRADES
MATH GRADES FROM GRADE 6 UNTIL NOW
Mark the statement that best describes your grades from grade six until now.

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Mostly below D (below 60)	1	199	2.6	2.7	2.7
Mostly Ds (60-69)	2	531	6.9	7.2	9.8
Mostly Cs (70-79)	3	1748	22.9	23.6	33.4
Mostly Bs (80-89)	4	2669	34.9	36.0	69.4
Mostly As (90-100)	5	2270	29.7	30.6	100.0
Missing	.	231	3.0	Missing	
	Total	7648	100.0	100.0	

Valid cases 7417 Missing cases 231

BYS60A MATH TRACK PLACEMENT
R's ABILITY GROUP FOR MATHEMATICS
What ability group are you in for math?

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Low	1	590	7.7	9.5	9.5
Middle	2	3574	46.7	57.8	67.4
High	3	2017	26.4	32.6	100.0
Missing	.	1467	19.2	Missing	
	Total	7648	100.0	100.0	

Valid cases 6181 Missing cases 1467

- -

SCHOOL/PARENT COURSE GUIDANCE CONTACTS
(Composite variable created from three NELS 88 variables, BYP57B, BYP57C, BYP57D)

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
None	1	6349	83.0	84.3	84.3
Once or twice	2	1100	14.4	14.7	99.0
Three or four times	3	74	.9	.9	99.9
More than four times	4	4	.1	.1	100.0
Missing	.	121	1.6	Missing	
	Total	7648	100.0	100.0	

Valid cases 7527 Missing cases 121

BYP76 PARENTS' EDUCATIONAL EXPECTATIONS
HOW FAR IN SCHOOL RESPONDENT EXPECTS CHILD TO GO
How far in school do you expect your eighth grader to go?

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Less than high school diploma	1	26	.3	.4	.4
GED	2	15	.2	.2	.6
High school graduation	3	905	11.8	13.1	13.7
Vocational, trade, or business school after high school					
Less than one year	4	103	1.3	1.5	15.2
One to two years	5	308	4.0	4.5	19.6
Two years or more	6	214	2.8	3.1	22.7
College Program					
Less than two years of college	7	424	5.5	6.1	28.9
Two or more years of college	8	707	9.2	9.3	35.5
Finish a two year program	9	383	5.0	5.5	34.4
Finish a four or five year program	10	2881	37.7	41.7	76.1
Masters degree or equivalent	11	833	10.9	12.1	88.2
Ph.D., M.D., or other adv deg	12	815	10.7	11.8	100.0
Missing	.	741	9.7	Missing	
	Total	7648	100.0	100.0	

Valid cases 6907 Missing cases 741

SCHOOL/PARENT ALGEBRA PUSH (Composite variable created from two NELS 88 variables, BYS61 and BYS62)

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Neither	0	3426	44.8	49.4	49.4
Either school or parents	1	1898	24.8	27.4	76.7
Both school and parents	2	1613	21.1	23.3	100.0
Missing	.	711	9.3	Missing	
	Total	7648	100.0	100.0	

Valid cases 6937 Missing cases 711

MATH COURSE CHOICE (Created from two NELS 88 variables, BYP53 and BYS66D)

Student enrolled in algebra

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
No	0	5206	68.1	68.1	68.1
Yes	1	2442	31.9	31.9	100.0
	Total	7648	100.0	100.0	

Valid cases 7648 Missing cases 0

Appendix E

Crosstabulation of Variables Used to Select Cases

BYP53 = CHILD ENROLLED IN ALGEBRA THIS YEAR
BYS66D = IN ADVANCED, ACCELERATED MATH?

BYP53 by BYS66D

BYP53	Count / Row Pct / Col Pct / Tot Pct	BYS66D 0	BYS66D 1	Row Total
0	Count	5206	3897	9103
	Row Pct	57.2	42.8	61.9
	Col Pct	62.2	61.5	
	Tot Pct	35.4	26.5	
1	Count	3167	2442	5609
	Row Pct	56.5	43.5	38.1
	Col Pct	37.8	38.5	
	Tot Pct	21.5	16.6	
Column Total		8373	6339	14712
		56.9	43.1	100.0

Page 1 of 1

Number of Missing Observations: 3445

Wynonia L. Dunn
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Manassas, Virginia 22111

Professional Background

1987-Present: EXCEL, INC.
Position: President and Co-Owner
EXCEL, INC., a corporation in Fairfax, Virginia, provides counseling and training services to children, adolescents and educators and research services to organizations and educational institutions.

1992: Contract with Prince William County Schools
Position: Evaluation Specialist
Prince William County Public Schools is a public school system in the Washington DC metropolitan area. Project included an evaluation of the Substance Abuse Prevention Program and the development, administration and analysis of a needs assessment of the Student Services Program.

1982-1987: American College Testing
Positions: National Manager of Special Markets
Career Planning Services, Eastern Region Director
Assistant Director, DISCOVER Services
American College Testing (ACT), a national nonprofit organization, specializes in testing and research activities.

1979-1982: National Occupational Information Coordinating Committee
Position: Project Director, Career Information Systems
NOICC is an inter-agency of Departments of Labor and Education concerned with the analysis and dissemination of labor market information.

1972-1979: Fairfax County Public Schools
Position: Administrator, Counselor, Teacher
FCPS is a large suburban public school system in the Washington DC metropolitan area.

Professional Education

Loyola College, Baltimore, Md.	MBA	Marketing	1986
Miami University, Oxford, Ohio	MEd	Counseling	1972
Miami University, Oxford, Ohio	BA	English	1968