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Attitudes and experiences of Mexican-American females in mathematics

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ATTITUDES AND EXPERIENCES OF MEXICAN-AMERICAN
FEMALES IN MATHEMATICS

A Thesis

Presented to

The Faculty of the Department of Mathematics and Computer Science
San José State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

by

Gretchen Ann Ehlers

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ABSTRACT

ATTITUDES AND EXPERIENCES OF MEXICAN-AMERICAN FEMALES IN MATHEMATICS

by Gretchen Ann Ehlers

This study examined the mathematical attitudes and experiences of a group of Mexican-American female high school sophomores. Initially, the Fennema-Sherman Mathematics Attitude Scales were administered to a heterogeneous group of 10th-grade students. Eleven Mexican-American females with differing attitudes towards mathematics were selected from the initial surveyed group. These students were interviewed about their attitudes and experiences in mathematics.

The interview responses indicated that this group of Mexican-American females enjoyed mathematics and felt it would be useful to them in their futures. All of them planned to take four years of mathematics in high school and continue with it in college. The young women felt that their parents valued a good education for their daughters, even though some mentioned that their family situation inhibited them from reaching their full potential in school.

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CHAPTER 1

PERSONAL MOTIVATION FOR THE RESEARCH

When I began this research, I was teaching in a program for mathematically motivated high school students. The students in this program participated in an integrated mathematics class for two hours each day, and as a result, received two years of college preparatory mathematics credit for each year they were in the program. As part of my duties in this program, I was also responsible for recruiting eighth grade students into the class. Due to the politics of the program's funding, it was important that I recruit female minority students into the class. In the farming community I was working in, "minority" meant Mexican-American.

I had little previous experience working with this group, so my first-hand impressions of the Mexican-American student population formed as I got to know the individual students in this farming community. Due to stereotypes I had developed, I expected it to be extremely difficult to interest many Mexican-American students, particularly females, in this program. To my pleasant surprise, this was not the case. If anything, the Mexican-American females appeared to be more interested in this advanced mathematics program than any other group. As I got to know the students in my class and at the high school, I also found that most Mexican-American females appeared to take their education extremely seriously, including their education in mathematics. This came as somewhat of a surprise to me based on the little second-hand knowledge I had of this group.

It seemed to me that I probably was not the only one whose stereotypical views and personal experiences with Mexican-American females did not match. As I began to look for literature concerning Mexican-American females in mathematics, I found surprisingly little. There is an extraordinary amount of work dealing with gender issues in mathematics and

quite a bit on the educational attainments and attitudes of Hispanic students. But, little focused on gender groups within ethnicities. Based on the experiences I had with Mexican-American females in the mathematics classroom, it appeared to me that they quite possibly had characteristics entirely different from those documented in the heterogeneous female population or in the overall Hispanic population. Personally, it was important for me to learn about the characteristics of Mexican-American females in mathematics because they comprised a large percentage of the group of students with which I was working. I also felt that this knowledge was useful for the educational community because Mexican-Americans are one of the fastest growing ethnic groups in many states.

Note on Terminology

Throughout this paper, I will use the term "Mexican-American" to refer to the young women I interviewed. "Hispanic" or "Latina/o," terms referring to all Spanish-speaking groups, are used by researchers when more specific data were not collected. To avoid confusion, when referring to the research of others, I will use the identifying term or terms they used in their study.

CHAPTER 2

REVIEW OF THE LITERATURE

Mexican-American females are at the intersection of two groups that are traditionally underrepresented in mathematically related fields in the United States. However, it may be that this group possesses a set of characteristics unique from both the heterogeneous female and Mexican-American populations. There is clear evidence that males have traditionally outnumbered females in mathematics-related fields, although the gap is slowly shrinking. For example, in 1971, men were close to three times more likely than women to pursue a master's degree in mathematics, but this difference narrowed significantly by 1993. Similarly, in 1971, only 8 in 100 doctoral degrees in mathematics were awarded to women, but by 1993, almost one in four were awarded to women (Kopka and Korb, 1996). There is also evidence that the Mexican-American population is not succeeding in the United States school system. According to Carter and Wilson (1993), Hispanics are the least likely ethnic group to graduate from high school, to enroll in college, and to receive a college degree. And, of all the Hispanic subgroups, Mexican-Americans had the lowest level of educational attainment according to a report by the National Council of La Raza (De La Rosa and Maw, 1990). Due to findings such as these, it seems quite likely that Mexican-American females would be more disadvantaged in the pursuit of technical careers than both Anglo females and Mexican-American males.

This literature review summarizes research in the United States on gender and Mexican-American issues pertaining to mathematics. The purpose of this review is to set the stage for a study dealing specifically with Mexican-American female high school students and their experiences in mathematics in the United States. Hopefully, this study will shed a bit more light on the unique characteristics of Mexican-American females, their

experiences in mathematics in this country, and the obstacles preventing them from entering mathematics and science-related careers at a higher rate.

The Gender Issue

There have been many studies examining gender differences in performance and attitudes towards mathematics. These studies all identify reasons women are underrepresented in mathematics and science-related careers. There are those who argue this phenomenon is due to biological differences between the sexes. Other researchers have investigated attitudinal and societal factors. Many have found that males have greater confidence in their mathematical abilities and see mathematics as more useful to their futures. Researchers have shown that society conveys implicit and explicit messages that mathematics is a male endeavor, and females should not be pushed to excel in this area. All of the evidence supporting these arguments helps build an understanding of the reasons mathematics and science careers have been dominated by males. These studies also help educators devise strategies to improve the participation of women in mathematics and science-related fields.

However, there are very few studies concerning specifically Mexican-American women in mathematics-related fields. The data that do exist indicate that Mexican-American women have fairly low educational achievement and enter careers in mathematics and science at a lower rate than their male counterparts. California data show that Latinas are drawn to careers in humanities and psychology while Latinos are better represented in mathematics, science and engineering careers (California Postsecondary Education Commission [CPEC], 1993). According to De La Rosa and Maw (1990), Mexican-American women fare worse than Mexican-American males in terms of overall educational achievement, and they are among the least well educated of all groups in the United States. But, Hispanic women are making amazing strides. In 1989, 53% of the Hispanics in the

entering class of the University of California were female, and they remained 53% of the senior class in 1993 (CPEC, 1990). Educators need to support this group of women in their academic endeavors. However, because it is not clear that Mexican-American females have the same characteristics as the heterogeneous female population, effective support for this group may not take the same form as it does for the overall female population.

Nature Versus Nurture

Early researchers attempted to show that differences in mathematical achievement between males and females were due to biological factors. Benbow and Stanley (1980; see also Benbow, 1988) found a substantial gender difference for intellectually talented preadolescents in mathematical reasoning ability on the Scholastic Aptitude Test [SAT] in favor of boys. They believed that their findings were caused by a combination of biological and environmental factors. Berry, Hughes and Jackson (1980) concluded from their studies that females were not as good as males in spatial reasoning due to the differing hemispheric structures in the brain. Whether findings such as this are true or not, it remains unclear as to how much spatial reasoning actually affects mathematical performance.

Fennema and Tarte (1985) studied the mathematics performance of male and female students who were "discrepant" in their spatial visualization and verbal skills. In other words, each of their subjects had high spatial and low verbal skills or the reverse. They found that being low in spatial visualization skills did not appear to inhibit the males in their mathematics performance. However, low spatial visualization skills did appear to negatively affect the females' mathematics performance. They concluded that spatial visualization did appear to be a predictor of mathematical success for females. In another study, Connor and Serbin (1985) measured visual-spatial skills and mathematics achievement of male and female adolescents. They concluded that visual-spatial skill had no value as a predictor of mathematical success. Although there are still some researchers

investigating the relationship of biological differences in the brain to disparities in spatial skills and mathematical achievement, a majority of the recent research focuses on females' experiences in mathematics and attitudes toward the subject as clues to the observed performance and participation differences.

One trend which dispels the notion that mathematical aptitude has a strong biological basis from birth is that, in most recent studies, performance differences are not seen until high school. In a meta-analysis of mathematical performance studies, Hyde, Fennema and Lamon (1990) found that there were no gender differences in problem solving in elementary school and middle school. However, they found small differences favoring males in high school, and even greater differences at the college level. Halpern (1986) came to a similar conclusion when she found that males began to outperform females in tests of quantitative mathematical ability between ages 13 and 16. A recent National Assessment of Educational Progress [NAEP] documented few gender-related differences in mathematics ability in grades 4 and 8 other than higher proficiency in measurement and estimation for boys. However, by grade 12, males showed a small advantage in every mathematics content area except algebra (Mullis, Dossey, Owen, and Phillips, 1991).

Participation in Mathematics

A factor which appears to be positively correlated with mathematical performance in the teenage years is the number of mathematics courses taken. Armstrong (1985) found that 13-year old males and females intended to take the same amount of mathematics in high school. However, Meece, Parsons, Kaczala, Goff and Futterman (1982) found that over all four years, females actually selected fewer mathematics courses than males. In countries in which mathematics is required for all, and students do more homework, gender differences are reduced (American Association of University Women [AAUW], 1992).

Hence, researchers acknowledge that the disparity between the sexes in mathematics performance in high school may be due in part to the fact that males tend to take more mathematics courses.

Perceived Usefulness of Mathematics

A factor that appears to affect the differing levels of participation in mathematics is students' perceptions of the usefulness of mathematics in their futures. According to Fennema and Sherman (1976b), males perceive mathematics to be more useful in their adult lives, and, as expected, Leder (1990) documented that students who find mathematics more useful are more likely to pursue it. Leder (1990) also found that females who planned to get married and have children were less likely to take accelerated mathematics classes than females who did not. The decision to marry and raise a family did not seem to affect males in the same way. Leder (1995) found that the messages conveyed in the popular press are consistent with the small, but consistent differences in the ways females and males perceive and value mathematics and related careers as appropriate for themselves. Hence, because males tend to feel that they will need mathematics in their future, they take more courses and enter the field at a higher rate. But, females do not tend to see as much need for mathematics in their adult lives.

Societal Expectations

It may also be that young women tend not to excel in mathematics as much as they could because of the implicit and explicit messages they receive from society. Becker (1981) found that high school mathematics teachers had higher expectations for their male students than for their female students. As a consequence, they gave males more attention and reinforcement than females. Becker found that the female students responded to teacher expectations and treatment by becoming more passive in mathematics classes. Similarly,

Fennema (1990) found that mathematics teachers responded more frequently to requests for help from males than from females. However, teachers tended to criticize females more than males for the quality of their work. Stallings (1985) found that mathematics teachers initiated more contacts with male than female students, but there was no difference in the number of student-initiated contacts with teachers. Males received more individual instruction, social interaction, praise, encouragement and corrective feedback. She found that even though females volunteered answers as often as males, males were called upon more often. Similarly, Sullivan (1994) found that males were asked questions more frequently and the questions were more complex. Also, if boys' work was not good, teachers assumed lack of effort while effort was seldom mentioned to girls.

In a study of mathematically gifted students, Casserly (1979) found that females tend not to be encouraged to challenge themselves as much as males. She found that many times, females were never forced to express an opinion, even if they wanted to. However, when females were forced to speak up in class, their perception of their abilities more nearly mirrored the teacher's. Hence, according to Casserly, the more young women are challenged to excel, the more confident they become. Casserly also found that a peer group is very important for females interested in mathematics and science because many working-class students have no one at home to offer encouragement or understanding of what is needed to succeed academically. She found that most schools which successfully encouraged their females to pursue mathematics and science included career counseling and college guidance within these departments. Stallings (1985) found that the most important factors influencing women's decisions to enroll in advanced mathematics classes included parents' encouragement and support, successful experiences in mathematics classes, and career plans. Clearly, societal expectations and attitudes do affect females' successful participation in mathematics classes and their entry into related fields.

Attitudinal Variables

Differences have also been found in attitudes males and females have towards mathematics. According to Meyer and Koehler (1990), males show greater confidence in their ability to learn mathematics from grade six on. Leder (1990) showed that equal mathematics achievement between the sexes did not necessarily result in an equal confidence level in their abilities (see also Fennema and Sherman, 1976b). Similarly, Leder (1990) found that while females tend to attribute their mathematical successes to effort, males attribute it to innate ability. This indicates that females tend to have less confidence in their own mathematical abilities. The above studies all support Fennema, Wolcott and Pedro's (1979) findings on attribution of mathematical success and failure. They theorized that attribution of success and failure can be categorized into the matrix shown in Table 1, with locus of control being one dimension and stability the other. They found that females attributed their successes in mathematics most to environmental factors, or things they had little control over, and least to ability. Males also contributed their successes primarily to environmental factors, but ability came in a close second. Leder (1990) also showed that females perceive mathematics as harder than males do. Other studies by Leder (1982) and Clarkson and Leder (1984) have shown that, for young women, success in mathematics provokes anxiety towards success in other areas of their lives. Based on studies such as these, it appears that females as a group have more negative attitudes towards mathematics and their own mathematics abilities than males. This clearly would deter them from entering mathematics-related careers.

Table 1

Categories of Attributions

		<u>Locus of Control</u>	
		Internal	External
<u>Stability</u>	Stable	Ability	Task
	Unstable	Effort	Environmental

Limitations of the Current Body of Research

Although it is very extensive, the research on gender differences within mathematics is still limited by the lack of gender-specific studies within ethnicities. In the United States in 1990, Hispanics comprised approximately 10% of the student population (De La Rosa and Maw, 1990). Yet, when these students are included in studies of gender and mathematics, they are typically grouped with all other ethnicities. Due to different cultural experiences, it is entirely possible that different trends will emerge between genders in different cultures. For example, Hyde, Fennema, and Lamon (1990) found that, excluding the SAT, there were essentially no gender differences in mathematics performance for African-Americans, Hispanics and Asian-Americans while studies of the heterogeneous United States population have shown gender differences in mathematics performance. Additional research needs to be done to both verify results of studies such as the one cited above and to expand the body of knowledge about gender differences within specific cultures.

Mexican-American Performance in Mathematics

There is quite a large body of research on the Mexican-American experience in schools in the United States. Although very little of it focuses specifically on mathematics

achievement, what does exist is not optimistic. Data from the National Center for Educational Statistics in 1978 indicated that Hispanic youth were significantly below the majority of students on mathematics knowledge, skills and understanding. And, this deficit grew as children got older (Cocking and Chipman, 1988). Mexican-Americans enrolled in fewer mathematics courses in high school than Anglo students (Rendón, 1983). Hispanic students were least likely of any group of eighth graders to take advanced mathematics and most likely to take remedial mathematics (De La Rosa and Maw, 1990). The 1980 High School and Beyond Survey reported that Hispanic high school seniors were the least likely to participate in honors mathematics courses of all ethnic groups (De La Rosa and Maw, 1990). According to 1987 data, only 30.2% of Hispanics had taken Algebra II compared with 51.9% of Anglos. Only 9.9% of Hispanics had taken Trigonometry compared to 20.9% of Anglos (De La Rosa and Maw, 1990). Even worse, of all the Hispanic subgroups, Mexican-Americans had the lowest level of educational attainment, while Cubans had the highest (De La Rosa and Maw, 1990). On a positive note, Hispanic students made greater gains in mathematics achievement than did Anglo students between the second and third national assessments done in 1978 and 1982 (Matthews, Carpenter, Lindquist, and Silver, 1984).

Mexican-American Attitudes Towards Education

The poor performance of Mexican-American students does not seem to be due to a lack of parental interest or understanding about the importance of education, but rather to factors such as family situation and language. Valverde (1984) found that parents of Hispanics value education as highly as Anglos. Espinoza, Fernández, and Dornbusch (1977) found that Hispanics link success in school with success in work. MacCorquodale (1984) found that Mexican-American parents were twice as likely as Anglo parents to stress the importance of education for success and more likely to praise or counsel their children

about their futures. Similarly, Anglo parents were four times as likely to believe that their children did not need encouragement. Mexican-American parents were three times as likely to report that they encouraged studying and, on the average, expected their children to spend twice as much time studying as Anglo parents did.

Similar attitudes and aspirations have been found in Mexican-American students. In a study of high school students in the Southwest, Powers and Wagner (1983) found Hispanics were more likely than Anglos to believe that their successes were due to effort more than luck, indicating that they felt they had some control over their successes. According to a study by MacCorquodale (1988), Mexican-American students believed that a college education was more important to their parents than to Anglo parents. They also reported that learning mathematics was slightly more important to their mothers, fathers and friends than to Anglos. A National Science Foundation [NSF] (1990) report stated that first year college students of Hispanic background tended to aspire to higher levels of education than did all first year students. This NSF paper also reported that the same proportion of Hispanics as of all college-bound seniors intended to major in science or engineering fields. Fernández, Espinosa, and Dornbusch (1975) found that both Hispanic students and their families cared about their schooling and believed that there was a close link between schooling and the world of work. Because Hispanic performance in school did not fit the image of students who cared deeply about schooling, the researchers hypothesized that teachers and other school personnel allowed these students to believe that they were exerting an appropriate level of effort when, in actuality, they were not doing the kind of work required to achieve their future goals.

It does not appear that attitudes and aspirations can account for the comparatively low mathematical performance of Mexican-Americans. Other factors such as family situations and language barriers do seem to contribute. MacCorquodale (1984) found that family obligations appeared to influence higher education and career options since Mexican-

Americans are more likely to believe they will have to stop school due to family duties. MacCorquodale (1988) also found that even though Mexican-American parents appeared to give more general encouragement, they also appeared to offer less specific help. Among Anglos, 56% of the parents of males and 67% of the parents of females helped select courses. Among Mexican-Americans, the percentages are 29 and 44, respectively. Twenty-five percent of Latino parents did not feel they had enough knowledge to recommend possible occupations for their children who were interested in mathematics while only 10% of the Anglo parents did not feel they had this information. Much of this lack of knowledge is undoubtedly due to language barriers Mexican-American parents face. MacCorquodale (1988) suggested that a strategy for increasing Mexican-American participation in mathematics-related careers would be to provide parents with more information about requirements, course choice and career options.

The Need for Additional Research

These findings reveal the top of a huge iceberg yet to be completely explored. The research cited above helps us to understand why females and Mexican-Americans are not better represented in mathematics-related careers. However, few studies consider the interaction of both gender and ethnicity on students' performance in and attitudes towards mathematics. This gap in the research has been pointed out by other experts in the field. Take, for example, the testimony of Jane Butler Kahle, Professor of Science Education at Miami University, to a congressional subcommittee.

A review of science and mathematics education for girls, particularly girls of color, is severely restricted by the type and number of individual studies as well as by the nature of the analyses that are available on national data sets. Available data are seldom desegregated by race/ethnicity and sex or by economic level and sex. In fact, if my testimony leads to only one outcome, many of my colleagues and I hope that it will be a Congressional directive to the National Center for Educational Statistics to require that NAEP data be reported by sex within each racial/ethnic group. (*Testimony of Jane Butler Kahle, 1994, p.42*)

Consider the large Mexican-American population being educated in the United States. Do the same performance and participation differences occur between the sexes in this group that occur between sexes in studies of heterogeneously grouped students? Do Mexican-American females exhibit the same lack of confidence that has been shown to exist in the overall female population? Do Mexican-American females view mathematics as useful to their futures? Are they affected by the same external factors at home and at school with respect to their attitudes towards mathematics? These and other similar questions have yet to be studied in depth.

Clearly, research about Mexican-American females in mathematics is lacking, but why is this research important? From a humanitarian point of view, it is important to help these females reach their full potential. From a societal point of view, the United States will need their participation in the scientific work force. Currently, 8% of the labor force is composed of scientists and engineers. These are mostly Anglo male (American Association of University Women [AAUW], 1992). The fraction of new jobs requiring a full four years of high school mathematics is expected to be 60% higher in the late 1990s than in the 1970s (Steen, 1990). By the end of the century, only 15% of the net new entrants into the labor force will be Anglo male. Hence, the United States will need female minorities trained in pure and applied mathematics (AAUW, 1992). And, because Hispanics are projected to become the largest minority group in the United States around the year 2010 (United States Bureau of the Census, 1986), it is important that we know as much about the characteristics of Hispanic subgroups as possible.

Research on Mexican-American Females and Mathematics

Recent studies of mathematics achievement have involved gender comparisons or race and ethnic contrasts; however, few inquiries examine gender and ethnicity simultaneously to determine whether minority women are double disadvantaged. (MacCorquodale, 1988, pp.137-138)

Based on the research focusing on gender and mathematics and the research on Mexican-American performance in the United States education system, one could easily conclude that Mexican-American women are “double disadvantaged.” Although there is little research on this topic, there is evidence to the contrary. Moore and Smith (1985) found that, while Anglo males demonstrated greater mathematics knowledge than Anglo females, there was no difference among Hispanic males and females. Although Anglo male community college students had taken more high school mathematics courses than Anglo females, among Hispanics, there was no difference (Rendón, 1983). Powers and Wagner (1983) found that Hispanic females attributed their achievement less to unstable factors such as effort and luck than did Hispanic males. This is different from the findings of Fennema et al. (1979) on attribution for success in mathematics. In the AAUW Report, *Shortchanging Girls, Shortchanging America* (1991), researchers found that Latinas reported the highest levels of self-esteem among girls in elementary school, but then experienced the greatest drop in self-esteem of all groups, although not to levels as low as those experienced by Anglo girls.

In 1990, Hispanics represented one in ten elementary and secondary students in the United States (De La Rosa and Maw, 1990). Yet, there are very few studies dealing specifically with the traits and experiences of the females in this group. Many would expect to see the same trends and behaviors that research attributes to females and Mexican-Americans in general. However, what little research does exist indicates that this may not be an accurate characterization of this group. The goal of the current study is to examine the mathematical attitudes and experiences of a small group of Mexican-American female high school students. Hopefully, with increased knowledge about Mexican-American females, society will be better able to serve their needs and more effectively encourage them to enter the scientific work force.

CHAPTER 3

METHODOLOGY

This study had two components. The first was a survey which gathered preliminary data on Mexican-American female tenth graders' attitudes towards mathematics compared to the attitudes of other tenth graders. This survey also allowed the researcher to identify Mexican-American female students with relatively positive and relatively negative attitudes towards mathematics. The second component was a set of in-depth interviews with a subgroup of Mexican-American tenth grade females from the original group of surveyed students. The purpose of the interviews was to examine interviewees' attitudes and experiences surrounding mathematics in the United States. The subjects who participated in the survey were recruited from the tenth grade student population at a high school in a farming community in California.

This school had an 82% Hispanic population at the time of the study and was chosen because of the large percentage of Mexican-American students. High school students were chosen because gender-related differences in mathematics frequently appear at this age (Hyde et al., 1990; Halpern, 1986; Mullis et al., 1991). Tenth graders were specifically chosen to lessen variability in student responses due to age. In addition, by tenth grade, most students were still taking mathematics. The survey and interviews were conducted by the researcher who was also teaching part-time at the high school.

The students were recruited for the survey through the mathematics classes at the school. Initially, the researcher discussed the entire study with the teachers at a mathematics department meeting. After the teachers explained the purpose of the study to their students, the subjects volunteered to participate in the survey component. It is important to note that all but one of the teachers who recruited students for this survey were female, and most of the mathematics teachers at the high school were also female. Each of the subjects and one

of their parents or guardians signed a consent form before participating in this research. Both the survey and the consent form were available to the students in English and Spanish.

The researcher administered the survey during a lunch period so that none of the students would miss any part of a class. First, the subjects were asked to complete personal identification information and then to respond to the survey on a scantron answer sheet. The survey itself consisted of questions from the Fennema-Sherman Mathematics Attitude Scales [MAS] (see Appendix A for complete instructions and survey) (Fennema and Sherman, 1976a). A couple of days after the students completed the survey, they were given a pizza lunch.

The MAS was used because it is an instrument which is highly regarded in the mathematics education community. According to Forgasz, Leder and Gardner (1996), "The contributions made by the Fennema-Sherman 'Mathematics Attitude Scales' to research on gender differences in mathematics learning outcomes cannot be underestimated" (p. 2-361). According to Walberg & Haertel (1992), Fennema and Sherman's (1977) first study which reported findings using the Mathematics Attitude Scales is among the most cited articles in journals of educational psychology.

There are seven separate scales in the Fennema-Sherman instrument. The following are the definitions Fennema and Sherman (1976a) gave for each of the scales.

The Attitude toward Success in Mathematics Scale is designed to measure the degree to which students anticipate positive or negative consequences as a result of success in mathematics. They evidence this fear by anticipating negative consequences of success as well as by lack of acceptance or responsibility for the success, e.g., "It was just luck."

The Mathematics as a Male Domain Scale is intended to measure the degree to which students see mathematics as a male, neutral, or female domain in the following ways: a) the relative ability of the sexes to perform in mathematics; b) the masculinity/femininity of those who achieve well in mathematics; and c) the appropriateness of this line of study for the two sexes.

The Mother [Father] Scale is designed to measure students' perceptions of their mother's / father's interest, encouragement and confidence in the student's ability. It also includes the student's perception of their mother's / father's example as an individual interested, confident, and aware of the importance of mathematics.

The Teacher Scale is designed to measure students' perceptions of their teachers' attitudes toward them as learners of mathematics. It includes the teachers' interest, encouragement and confidence in the student's ability.

The Confidence in Learning Mathematics Scale is intended to measure confidence in one's ability to learn and to perform well on mathematical tasks. The dimension ranges from distinct lack of confidence to definite confidence. The scale is not intended to measure anxiety and/or mental confusion, interest, enjoyment or zest in problem solving.

The Mathematics Anxiety Scale is intended to measure feelings of anxiety, dread, nervousness and associated bodily symptoms related to doing mathematics. The dimension ranges from feeling at ease to those of distinct anxiety. The scale is not intended to measure confidence in or enjoyment of mathematics.

The Effectance Motivation Scale in Mathematics is intended to measure effectance as applied to mathematics. The dimension ranges from lack of involvement in mathematics to active enjoyment and seeking of challenge....

The Mathematics Usefulness Scale is designed to measure students' beliefs about the usefulness of mathematics currently and in relationship to their future education, vocation, or other activities. (pp. 2 - 5)

Eight males and 23 females took the initial survey. Twenty of the females were Mexican-American, 2 were Anglo and 1 was Filipino. Five of the males were Mexican-American, 2 were Anglo and 1 was Asian. The subjects were identified with the data through their student identification numbers at the high school so the investigator could identify the students for future interviews. These identification numbers were then translated to pseudonyms for the students who were interviewed.

Each student was given a score on each of the attitude scales described above. This score reflected the students' mean response to the questions within each of the scales. The scores ranged from 1 to 5, with 5 indicating the most positive attitude towards mathematics. For example, an average score of 5 on the Teacher scale would indicate that the subject perceived his or her teacher to have a very positive attitude towards her or him as a mathematics student. The only exception to this is the Mathematics as a Male Domain

scale. On this scale, an average score of 1 indicates that the student did not consider mathematics solely a male domain while a score of 5 indicates that the student did feel that mathematics was primarily a male domain.

The researcher interviewed a subset of the Mexican-American females who took the survey. The interview subjects were chosen based on their responses to the Anxiety and Confidence subscales of the MAS in order to get a subgroup which was somewhat heterogeneous in their attitudes towards mathematics. The researcher chose four females who had relatively low confidence levels and high anxiety levels towards mathematics, one who had fairly average confidence and anxiety levels, two who had high confidence levels and medium anxiety levels, two who had medium confidence levels and high anxiety levels, and two who had high confidence and low anxiety levels (see Appendix B for interviewed subjects' scores on the MAS).

Each of the young women was asked essentially the same questions in the interview. The goal of the interview was to get an overall sense of the students' experiences in mathematics and their attitudes towards mathematics. The questions were drawn primarily from four sources. Brush (1980) performed an extensive research project designed to help understand why so few women went on to study advanced mathematics. As part of her study, she interviewed high school females whose attitudes toward the field or plans to enroll in mathematics courses had changed in either a positive or negative way. Questions for the interview in this research were adapted from her Tenth Grade Questionnaire. Gwizdala and Steinback (1989) compared mathematics attitudes of students at an all-female high school and all-male high school in a written survey. The concepts of many of their questions were incorporated into the present interview. Content ideas for other questions were taken from Baxter Magolda's (1992) study on gender-related patterns in students' intellectual development. Two questions as well as the interview structure were adapted from the work by Tims and Parker (1995) who interviewed both male and female

students about mathematics assessment types and contexts. In all cases, the questions were rephrased or reorganized for the purposes of this study in this particular environment.

Additional questions were asked if they seemed appropriate in the context of the conversation. The researcher used the following script for the interview:

- 1) Describe a typical day in your current mathematics class.
Prompts: What does the teacher do? What do the students do? How much time is spent with the teacher lecturing? How much time is spent with students doing activities?
- 2) What do you like about this mathematics class? What would you like to change?
- 3) What types of things do you like to be graded on? Tests, homework, portfolios, weekly challenges, projects?
- 4) What types of things that you're graded on do you feel like you do best on?
- 5) Describe yourself as a student.
Prompts: Do you sit quietly and listen? Do you ask lots of questions? Do you like to work with others? Do you always need to be doing something active?
- 6) What type of teaching helps you learn mathematics best?
Prompts: Do you prefer to listen to the teacher explain things or do you like to try to learn it on your own? Do you like working with your peers?
- 7) Do you enjoy mathematics? Why or why not? When did you start enjoying / not enjoying mathematics?
- 8) Is there someone in your life that has affected the way you feel about mathematics?
- 9) Do you like to do your mathematics work alone or with others? Why?
- 10) What types of mathematics problems do you like best? Do you like the long ones that are kind of hard to figure out or do you like the shorter ones that don't take a lot of time?
- 11) Would you rather do problems that use algebra or geometry?
- 12) How much mathematics do you plan to take after this year? In high school? In college?
- 13) Do you feel like you are good at mathematics? How do you know?
- 14) What types of jobs do you think use mathematics? How?
- 15) Do you plan on having a career that uses mathematics in any way?

16) How do you think you are going to use mathematics outside your job when you're an adult?

17) Are there people in your life who really encourage you to study more mathematics? Who?

18) Does it seem like some people don't care whether or not you take more mathematics? Who?

19) Do you think your father would treat you differently if you were male? How?

20) Do you think your mother would treat you differently if you were male? How?

21) Tell me something you remember doing in a mathematics class. Why do you think you remembered doing this?

22) How would you feel if you got the highest grade on a mathematics test? Who would you tell? Why?

23) Have you noticed differences between males and females in your mathematics classes?

Prompt: What are they? When did you start to see these differences?

24) Think about your mathematics class and your friends. Are there any people you know that will probably become someone who uses a lot of mathematics, like an engineer or a physicist? Who?

25) What would you do if you were given a mathematics problem which you didn't know how to do?

26) There are many studies showing that there are more male scientists and engineers than female scientists and engineers. Why do you think this is true? Do you think this will change?

27) Do you notice any differences, not only in terms of mathematics, between the Mexican-American culture and the Anglo culture?

28) Is there anything else you would like to add to this interview?

The interviews were each recorded on audio cassette tapes labeled with the student's school identification number. After the eleven interviews were completed, they were transcribed. The researcher then summarized each of the interviews by recording pertinent attitudes and experiences each student conveyed.

The data from the interviews were analyzed by first listing the categories which a majority of the subjects responded to in some meaningful way. Within each of these

categories, the students' responses were summarized and further categorized based on whether the student had relatively positive, negative or neutral views towards mathematics from the MAS. By categorizing the responses this way, the researcher was able to see trends that occurred among all the students interviewed as well as trends which appeared based on the students' survey responses.

CHAPTER 4

RESULTS

Survey

The first segment of this study was the administration of the MAS to a heterogeneous group of tenth graders. The results of this survey are given in Table 2.

In general, the findings of the survey alone were not that interesting due to the small number of subjects in each subgroup. As expected, all groups considered mathematics primarily a male domain. However, there are also a couple of surprising trends. Females saw mathematics as more useful than males. This is contrary to past research indicating that males tend to find mathematics more useful (Fennema and Sherman, 1976b). The females also felt that their teachers were more supportive of them than the males did. This may be due to the fact that a majority of the mathematics teachers at the school at the time of this study were female. Again, these findings are interesting and somewhat surprising, but there would have had to be many more subjects in each of the subgroups for the findings to be conclusive.

Table 2

Means and Standard Deviations For Subgroups on the Fennema-Sherman Mathematics Attitude Scales

Fennema-Sherman scale	Mexican-American females (n = 20)	Mexican-American males (n = 5)	All females (n = 23)	All males (n = 8)
Male Domain				
<u>M</u>	4.50	4.46	4.48	4.31
<u>SD</u>	0.58	0.60	0.54	0.60
Father				
<u>M</u>	3.80	3.75	3.85	3.96
<u>SD</u>	0.61	0.60	0.62	0.64
Mother				
<u>M</u>	3.93	3.89	3.95	4.16
<u>SD</u>	0.66	0.46	0.62	0.53
Success				
<u>M</u>	4.25	4.28	4.24	4.07
<u>SD</u>	0.49	0.37	0.48	0.47
Usefulness				
<u>M</u>	4.09	3.52	4.10	3.86
<u>SD</u>	0.69	0.50	0.71	0.69
Teacher				
<u>M</u>	3.94	3.43	3.97	3.49
<u>SD</u>	0.67	0.68	0.65	0.53
Anxiety				
<u>M</u>	3.36	3.66	3.41	3.93
<u>SD</u>	0.69	0.50	0.73	0.59
Effectance Motivation				
<u>M</u>	3.41	3.67	3.48	3.71
<u>SD</u>	0.57	0.34	0.56	0.53
Confidence				
<u>M</u>	3.71	3.82	3.77	4.01
<u>SD</u>	0.69	0.87	0.66	0.74

Interviews

The second part of this study involved interviewing a subset of 11 of the Mexican-American females who were previously surveyed. Tables 3 through 13 indicate the individual's scores on the Fennema-Sherman Attitude Scales. Following the corresponding table is a summary of the interview of each student.

Teresa

Table 3

Mean Responses on the Fennema-Sherman Mathematics Attitude Scales

Scale	MD	F	M	S	U	T	An	EM	C
Teresa	4.50	4.33	5.00	4.50	4.00	4.25	3.00	2.67	2.50

Note. MD = Mathematics as a male domain scale; F = Father's attitude toward subject as a learner of mathematics scale; M = Mother's attitude toward subject as a learner of mathematics scale; S = Attitude toward success in mathematics scale; U = Usefulness of mathematics scale; T = Teacher's attitude toward subject as a learner of mathematics scale; An = Anxiety towards mathematics scale; EM = Effectance motivation in mathematics scale; C = Confidence in learning mathematics scale.

Compared to the group of Mexican-American females surveyed, Teresa's score on the Anxiety scale was fairly average and on the Confidence scale was relatively low (see Tables 2 and 3). Her effectance motivation towards mathematics is also fairly low. Teresa believes that mathematics is primarily a male domain. However, based on her scores on the MAS, in all other areas, she feels fairly positive towards mathematics (see Table 3).

Teresa is in the second year of a non-traditional, integrated mathematics program. She enjoys this class because it helps her understand what mathematics is used for. This

helps explain her mean score of 4 on the Usefulness scale (see Table 3). Teresa plans to take all four years of mathematics in high school and would like to take mathematics every year when she goes to college because it is “really good.”

If Teresa continues with her plans to go into business, she probably will be taking some mathematics in college. She is encouraged to take a lot of mathematics by her older brother, who was not that academically successful, and her sister, who currently works in a factory, but had a job in business and told her that knowing a lot of mathematics helped her get a job. Teresa thinks that every job uses some kind of mathematics and seems to have a good sense of which jobs use which different types of mathematics.

Until eighth grade, Teresa did not think of herself as a very good student because she “really didn’t care.” But, in eighth grade, she started realizing how important both school and mathematics were. Teresa’s best friend was a positive role model for her in this transition, and her brother also encouraged her to do well in school because he had not and, as a consequence, did not graduate from high school. However, Teresa still does not feel like she is very good at mathematics because she needs someone to help her do it.

Teresa is the youngest in her family. Her mother encourages her to do well in school, but allows her to make her own choices. Her mother told Teresa how important it was to have an education because she has had a hard time due to her own limited education. Teresa explained her mother’s situation.

She had a hard time getting a good job.... Back then, it was very hard to get an education. You had to deal with family. Especially because she was one of the oldest. And it was very hard to go to school and take care of a lot of brothers and sisters. She knows it’s very important to get an education.

Her mother was the oldest child in her family and had to take care of her brothers and sisters. In the conversation, it came out that Teresa has been raised as an only child by her mother while her grandmother raised all of Teresa’s siblings.

Teresa feels that the only thing that would change in the way her family treats her if she were male would be that she would be able to play soccer. As it is, they are afraid that she will get hurt, even though they let her nephews play soccer.

Teresa said that the difference she notices between the boys and the girls in her mathematics classes is that the boys do not pay attention as much and generally, “just don’t want to deal with it.” She said that she thinks this is due to the peer pressure of high school. She also felt that this behavior might change if they were in a private school. Teresa participates in the Mathematics, Engineering and Science Achievement [MESA] organization at her school and said that most of the students she knows who want to be engineers are male. Her score of 4.5 on the Male Domain scale reinforces that she does see mathematics as primarily a male discipline (see Table 3). When pushed, she said that she felt this was because she knows that to be an engineer, you have to dedicate a lot of your time to this career, and the females “don’t really want to deal with it all. They want to do other things. Get married”

Teresa enjoys helping others and presenting what she has done to her mathematics class. She wants to have a mixture of teacher explanation and student interaction during class time. She likes to work with other people on her mathematics work because she can get help if she does not understand a problem. Teresa said that she likes mathematics problems that do not take a lot of time,

...because sometimes, when you have the big ones, you start thinking and thinking and you get confused because you have a lot of information. You just don’t know how to organize it. And, then, once you get confused, you don’t get it and then you hate it, and you just don’t get it.

If Teresa had a mathematics problem she did not know how to do, she would first ask her teacher, and if she were not available, she and her friend would “work it out together.” This response combined with the fact that she had a score of 2.5 on the Confidence scale

indicates that she probably does not have a lot of confidence in her mathematical abilities (see Table 3).

In terms of attitudes towards schooling, Teresa feels that the Mexican-American culture is split, and the parents pass on their attitudes to their children. On one side, some parents “really encourage their sons and daughters to go to school and get a good education that they didn’t have a good opportunity to do.” But, others say, “No, you have to start working because that’s how it’s been in the family. Don’t waste time over there in school.” Teresa feels that in the Anglo culture, most parents encourage their children to go to school.

Marisol

Table 4

Mean Responses on the Fennema-Sherman Mathematics Attitude Scales

Scale	MD	F	M	S	U	T	An	EM	C
Marisol	4.17	3.17	3.58	4.50	4.58	4.45	3.09	4.33	3.92

Marisol’s scores on the Anxiety and Confidence scales were relatively average compared to the other Mexican-American females surveyed (see Tables 2 and 4). Her score on the Father scale is due to the fact that she does not have a father living at home, and a score of 3 indicates that the question is not applicable. She has fairly high effectance motivation towards mathematics and feels that success in mathematics is a very positive thing (see Table 4).

Marisol is in the second year of an accelerated, integrated mathematics program. This accelerated class meets two hours five days per week. Marisol plans to take mathematics courses through Calculus in high school, but does not know how much mathematics she will take in college. She does know that she wants to go to college.

Marisol likes mathematics because it is something she feels she will use in her life quite a bit. Her score of 4.58 on the Usefulness scale as shown in Table 4 reinforces that she believes mathematics will be useful to her outside of school. She also said that mathematics is a challenge for her, and she did have a bad experience with it in Mexico when she changed her mathematics teachers six times in one year. Marisol feels she started enjoying mathematics in sixth grade. She sees it being different from other subjects because one has to concentrate, and there are many difficult problems to solve. Her teacher and university mentor, a Mexican-American female mathematics major, are the people that have recently influenced her opinions about mathematics the most. Her score of 4.45 on the Teacher scale reinforces that she feels supported by her mathematics teacher (see Table 4). In particular, Marisol identifies with her mentor because she told Marisol that she had not liked mathematics when younger either, but now really enjoys it. Her friends think it is neat that Marisol is in the accelerated mathematics class, but it is somewhat of a problem for Marisol because none of them are in the same program. The only person she works with outside of class is her mentor. Marisol does not feel that she is good at mathematics because, "it's the class where I have the lowest grade." If it were not for grades she would say she was about in the middle in mathematics ability.

Marisol believes that mathematics is used in every career and specifically cited engineering and computer graphic design. She would possibly like to become a computer programmer and is planning to take a computer class next year.

Marisol feels that the main difference between males and females is that females concentrate more in class than males. "Sometimes, the boys can get really noisy, so they don't pay attention." She thinks the reason that there are more male engineers and scientists than females is because the women tend to get married and do not continue their careers. Based on these comments and her score of 4.17 on the Male Domain scale, she does seem to feel that mathematics is a male field (see Table 4). Marisol plans to start her career and

then possibly get married. She said, "I plan to first start my career, and after that, I can get married and do whatever. But, if I have to do something, I'm going to choose my career."

Marisol believes that, "In Mexico, it's [the mathematics education] more advanced, and it's more strict there." She also feels that in Mexico, boys are encouraged to study mathematics more than girls.

Marisol feels that the people who have encouraged her most to take mathematics are her mathematics teacher and her brother. Her brother praises her for participating in the accelerated mathematics program. Marisol is still learning English, and is somewhat nervous about presenting in front of the class. However, she thinks that she is getting less and less nervous. This fear of speaking in front of her mathematics class may create some anxiety towards mathematics as her score of 3.09 on the Mathematics Anxiety scale indicates (see Table 4).

Marisol likes to be graded on portfolios and projects because she has as much time as she needs to work on them. She does not like tests because she "always gets a low grade," and said she is not good at them. She said the reason for this is that she does not study very much. Marisol's favorite part of mathematics class is the groupwork. But, sometimes, she also likes to listen and concentrate on what the teacher is saying. If she were given a mathematics problem which she did not understand, she would first try to understand it on her own through examples.

Rosa

Table 5

Mean Responses on the Fennema-Sherman Mathematics Attitude Scales

Scale	MD	F	M	S	U	T	An	EM	C
Rosa	5.00	2.67	4.00	3.50	3.58	3.00	2.33	3.00	3.25

Rosa's scores on the MAS are fairly representative of the Mexican-American females surveyed with the exception of her score on the Anxiety scale, which was quite low, indicating a high level of anxiety towards mathematics (see Tables 2 and 5).

Rosa is in the second year of a non-traditional, integrated mathematics program. Rosa said that mathematics is all right, but she is not very fond of it. This is because, "It's hard to understand sometimes. It gets me like, you know when you can't get something, you're all stressed out and everything." This explains her low score on the Anxiety scale (see Table 5). She used to like mathematics when it was "just like little numbers and stuff." Her favorite subjects are English and biology. She likes English because she likes to read, and she likes biology because she likes to do all the labs. She feels that she is not that good at mathematics, but "still manages to get through it." When pressed, she said that just about every career requires mathematics, and gave as examples cashiers, teachers and accountants. However, her score of 3.67 on the Usefulness scale indicates that she probably does not believe she will use mathematics that much (see Table 5). Rosa is thinking about becoming a lawyer and said that she would not use a lot of mathematics in this career.

Rosa plans to take all four years of mathematics in high school because she will gain a better understanding of all different types of mathematics, and it will also be good for college. She plans to take only two years of mathematics in college.

Rosa sees differences between Anglo and Mexican-American culture. She thinks that Anglos do more homework, and as a consequence, get better grades. She feels that because Anglos tend to have smaller families, students do not have to be as worried about helping around the house, and their houses are quieter because they do not have "all those kids running around and being all noisy and stuff." Rosa also mentioned that Mexican-American males tend to be aggressive when they want their own way. However, if a female were to be aggressive in asking for her own way, the males would say, "What do you think you're doing?"

Rosa said that if she were male, her dad would let her go out more and let her do social things that she cannot currently do. She indicated that her father does not encourage her that much in school, but does tell her to do better when she gets a poor grade on her report card. Based on Rosa's score on the Father scale, she does not feel that he is very supportive (see Table 5). However, she said that her mom is very interested in how she is doing in school, and always asks about her progress. She said her mother wants her to do well in school so that she can be successful later on. On the Mother scale, Rosa also indicated that she felt that her mother was supportive of her as a mathematics student (see Table 5). She does not feel that her mom would treat her differently if she were male.

When asked about the differences between the females and males in her mathematics class, she indicated that the "boys are like goofing off sometimes, but the girls are like putting on their make-up, and they're not being loud." She thinks that the boys in her class understand the mathematics a little bit better because the girls always ask the questions, and they are the ones that say, "Oh, I don't understand this." This is indicative that she does believe that mathematics is a male domain, and her score on the Male Domain scale supports this (see Table 5). Rosa also said that this may be because the boys are shy and do not ask the questions. She believes that females get higher grades in mathematics

based on the grades that she has seen. When asked who she knew that she thought might become engineers or scientists, Rosa first mentioned two females and then two males.

When asked why she thought there were more male scientists and engineers than female scientists and engineers, Rosa said that she thought this was because women do not get as much of a chance to succeed in these fields as men. Rosa said the people who make hiring decisions, who she envisions to probably be male, do not think that the women will continue in the career because they do not have such high self-esteem.

Rosa likes the fact that, in her current mathematics class, they work in groups and everyone is supposed to participate. Rosa likes doing her mathematics with other people because they can help each other out. However, when she is trying something for the first time, she wants to do it by herself. Rosa and a group of male and female friends get together after school to work on their mathematics homework. She said the guys typically just look at others' work and criticize their methods, but do not work anything out by themselves.

The frustrating thing for Rosa in this class is that people who are tardy take time away from the class when they could be reviewing homework. In terms of class structure, she likes it best when the mathematics teacher explains a little bit, and she has a chance to try a problem.

Rosa enjoys doing longer, more complex problems as opposed to the shorter, straightforward problems. She said, "I like looking at all the numbers you write down, and then knowing that the answer's like this little number. I think that's cool." When asked what she would do if there was a problem which she did not know how to do, she indicated that she would do her best and explain her work, but also explain what she thought she did wrong. This indicates a relatively high level of confidence in her own abilities and is somewhat surprising given that Rosa's Confidence scale score was actually fairly low (see Table 5).

Marbella

Table 6

Mean Responses on the Fennema-Sherman Mathematics Attitude Scales

Scale	MD	F	M	S	U	T	An	EM	C
Marbella	4.67	4.55	4.75	4.45	3.64	4.33	4.45	3.42	4.70

As seen in Table 6, Marbella has relatively high scores in almost all areas of the Attitude Scales. Her only score which is not high is on the Usefulness scale.

Marbella is currently enrolled in a traditional geometry class. She said she has always “kind of” liked mathematics and likes it most when it is challenging. When asked why she thought she was “kind of” good at mathematics, she said, “I like to have good grades, and I do my best, but I don’t have 100%.” Her concentration on doing well in mathematics in school may be part of the reason she does not see that it is extremely useful outside of academics (see Table 6). Marbella wants to take four years of mathematics in high school. She plans to go directly to a two-year college or university after high school graduation and said that the amount of mathematics she takes in college will depend on the career she chooses. When asked which careers use mathematics, she mentioned architect, biologist and teacher. She would like to become an architect, and realizes she will have to take quite a bit of mathematics for this career.

Outside of school, she uses mathematics to help her younger sister and brothers. Her older brother, who attended the University of Guadalajara, helps her. Marbella said that her teachers have encouraged her to study mathematics, English and computers if she wants to have a good job in the future. However, her friends joke about her taking mathematics because they say it is so boring. Marbella’s parents and brother have all encouraged her to succeed academically in order to get a good job. Her responses to the

Father, Mother and Teacher scales reinforce that she does have support from these people in her life (see Table 6). Her mother completed third grade and her father seventh grade, both in Mexico. They both work in a cannery.

Marbella feels that both her mother and father would treat her differently if she were male. They would let her out of the house more. However, her parents also feel that it is more important for her to start a successful career than to get married. She said that when her parents were growing up, it was more important for them to get married than to have a good job.

Marbella went to school in Mexico through eighth grade. When she came here, she felt that the level of mathematics was lower than what she was learning in Mexico. She mentioned that in the United States, there are students who do not want to be in school.

The difference Marbella sees between the females and males in her mathematics class is that the boys act up more, and the girls are more shy. She believes there are more male scientists and engineers than female scientists and engineers because the females probably only see the numbers. This comment helps explain why she saw mathematics as primarily a male domain in the Attitude Scales (see Table 6).

Marbella said that she likes her geometry class because it gives her the opportunity to learn about things she does not already know about. This supports her high score on the Effectance Motivation scale (see Table 6). However, she wishes the teacher would spend more time explaining the problems. Marbella said that if she can understand an entire problem, rather than just seeing a bunch of numbers, she does not feel it is boring. She likes taking the tests even though she does not study for them. She does well on them because she tries to follow the teacher when he is teaching. Marbella prefers to listen to the teacher and work alone, "Because sometimes when the friends disagree on answers, I have to explain why I get things, and I don't like." She said that language may be a problem in this case. However, she feels that most people like to work together, even though she does

not. Marbella said that she will only ask the teacher questions when she does not understand the explanation in the book. This indicates a relatively high level of confidence to be able to solve a problem on her own. This is supported by her score on the Confidence scale (see Table 6).

Luisa

Table 7

Mean Responses on the Fennema-Sherman Mathematics Attitude Scales

Scale	MD	F	M	S	U	T	An	EM	C
Luisa	5.00	4.58	4.75	5.00	4.58	4.67	3.33	4.42	4.17

According to the Fennema-Sherman scale results (see Table 7), Luisa is fairly motivated to study mathematics and does see its usefulness outside of school. She feels supported by her mother, father and mathematics teacher and is relatively confident in her own abilities. However, she experiences some anxiety towards the subject.

Luisa is enrolled in the second year of a non-traditional, integrated mathematics program. She was born in the United States, and has always liked mathematics. She feels that her dad has been instrumental in helping her do well and enjoy school. He completed tenth grade and is a farm worker. Her mother is very active in Luisa's mathematics schooling, goes to every parent informational meeting and keeps updated on Luisa's progress in mathematics. She completed twelfth grade and is a homemaker. Both of Luisa's parents were born in Mexico. These interview results are strongly supported by Luisa's positive responses to the Mother and Father scales of the MAS (see Table 7).

Luisa plans to take four years of mathematics in high school and plans to take more mathematics in college, but does not know how much. Mathematics is her favorite subject

because she can see how she will use the problems in real life. This attitude explains her high score on the Usefulness scale (see Table 7). Luisa feels she is good at mathematics because it is easier for her than other subjects and she gets good grades in the subject. She also feels that mathematics is easier for her than for other students in the class. This indicates a very high level of confidence, possibly even higher than her Confidence score would indicate (see Table 7).

When asked which jobs use mathematics, Luisa cited accounting, business and engineering and seems to have a pretty good sense of how much mathematics each of these careers requires. She does not know what career she is interested in, but would like a career that uses mathematics, even though she also likes other things. She mentioned that one possibility for her would be interior design.

Luisa said that her dad expects a lot more from her and her sisters than from her brothers. She thinks that he expects the girls in her family to get higher paying careers than the boys. She also said that, if she were male, she probably would not be as close to her mother as she is now. She does not think her mom would ask her as much about her schoolwork if she were male.

Her mom is the first person Luisa usually tells about her accomplishments at school because she is the one who is home when she gets there. She also shows her brothers and sisters when she gets good grades because she wants to encourage them to do well in school, too. Luisa helps her little brothers and sisters at home. She does not get frustrated with her brothers and sisters like she does with her peers because she realizes that her siblings are young. Regarding her peers, she said, "It seems like they don't want to learn, and I just keep explaining to them and I get so frustrated." She hears this attitude more from males than from females. When I asked her why, she said, "I don't know if this is a stereotype, but girls pay more attention when it comes to schoolwork and men, it seems like they're always thinking about what they're going to do right after this class and they're

not paying attention.” Luisa also feels that girls ask more questions than boys, and boys do not say anything if they do not understand. When asked why she thought there were more male engineers and scientists than females, she said that historically there have not been many women engineers, and there is also the stereotype that boys do better in mathematics than girls. Based on her score on the Male Domain scale, she also seems to believe this stereotype (see Table 7). However, she feels that this is going to change because more women are now speaking up for their wants and needs.

Luisa feels that one of the differences between the Anglo and Mexican-American cultures is that in the Mexican-American culture, one is always expected to do well, but in the Anglo culture, if you do not do well, you can “do better next time.”

In her mathematics class, Luisa likes working in groups, but sometimes feels that she is the only person in her group doing the work. She likes to do her homework alone, but for more complex problems, she likes to work with another female friend taking the same mathematics class. She feels that she is most successful when the teacher explains a little bit about the mathematics and then lets the students try it on their own. The thing she likes most about her mathematics class is that it has taught her to speak in front of people and to explain her thought processes well. Luisa really enjoys the Problems of the Week because they are fun and interesting and they help her learn new things. She also likes them because she has a whole week to explore each problem. Luisa likes the fact that she has to show how she solved the problem and that there are many different ways of solving the same problem. She said she likes the longer problems because, “They take more thought. And there’s more process to those longer problems, and you need to explain why did you get that answer and you get to show it. There’s different ways you can show how to solve that problem.”

Lucia

Table 8

Mean Responses on the Fennema-Sherman Mathematics Attitude Scales

Scale	MD	F	M	S	U	T	An	EM	C
Lucia	4.67	3.92	3.50	4.00	4.17	4.17	2.58	3.42	3.00

All of Lucia's scores are fairly representative of the entire Mexican-American female group which was surveyed (see Tables 2 and 8).

Lucia is also enrolled in the second year of a non-traditional, integrated mathematics program. It is very important for Lucia to understand mathematics and do well in it. She said, "Mathematics is very important in our lives. Not only right now, but later." She particularly enjoys seeing how mathematics is related to real life. Lucia plans to take mathematics through her senior year in high school, and take some in college as well. She is planning to go to a local four-year university. Lucia feels she is good at mathematics, partly because she gets good grades and partly because she really enjoys it. This indicates a fairly high level of confidence, which does not support her relatively average score on the Confidence scale (see Table 8). She plans to be an elementary teacher and knows how important it is for her to be able to teach her students to solve problems well.

Lucia feels that all jobs use some level of mathematics, and mentioned engineering as a career that uses upper level mathematics and strawberry picking as an example of a job that uses lower level mathematics. When asked if she enjoyed solving challenging mathematics problems, Lucia responded:

Yeah. I like them. It's just that sometimes, I get piled up with some other homework, and I wait until the last minute, and I don't do it right. But, when I really get into that problem, I really like it. And, I feel very happy when I get to solve a problem, and I have the correct answer. I get really happy.

Lucia feels that she started enjoying mathematics in about seventh grade because of a male mathematics teacher who explained mathematics really well and made mathematics fun for her.

Lucia said that her father encourages her to take as many college preparatory classes as she can, and her mom does not really understand the different levels of classes in the United States school system as well as her father does. This is reflected in her scores on the Mother and Father scales (see Table 8). Both of her parents were educated through third grade. Her mother is a strawberry picker and her father is a material handler. Lucia thinks that her father would treat her differently if she were male because she has seen her uncles push their boys harder because they think they will “slack off and do something else and get a job.” She feels that, ultimately, both her father and her uncles want their children to be happy and successful in their careers. She said, “None of them want us to go back and like them, work on the fields. Like my dad, he just carries boxes and they just don’t want us to do anything like that.” She thinks that her mom would treat her differently if she were male because she would not have to do as much housework. “I wouldn’t have to do as much. Since I have more sisters, they would probably do everything and let me go play sports.”

Lucia had an interesting reaction to a question about the difference between the females and males in her mathematics class.

Interviewer: Have you noticed differences between boys and girls in your mathematics classes?

Lucia: Well, like in my mathematics class right now, there’s just like five boys.

Interviewer: Really? In the whole class?

Lucia: No, that really pay attention. The other ones, there’s a couple that are smart, but just don’t tend to want to do what we are doing.

Interviewer: Are there girls in your class that do the same thing?

Lucia: There’s three that just don’t want to do anything.

When Lucia was asked if she believed that males were better than females at mathematics, she said that this was not true and cited the fact that most of the top students in the sophomore class were female. However, when she was asked who she thought would become engineers in her mathematics classes, she talked about three boys, one white and two Mexican-American. Lucia also said that if she decided to become an engineer, she would probably get quite a bit of resistance because females typically did not go into engineering. This attitude is supported by her score on the Male Domain scale (see Table 8). However, she feels that this trend will change.

Lucia envisions herself both having children and a career. However, she stressed that it was very important that the caregivers for her children are family or people she knows well rather than strangers in a daycare center. She said that even though, traditionally, the woman takes care of the home and family and the man earns the money in Mexican society, this is changing and both partners are beginning to take responsibilities in both areas.

Lucia sees the major difference between the Mexican-American and Anglo cultures in the United States is that Mexican-Americans have more fun at their parties and dance a lot. She also said that she thinks that parents in the Anglo culture are more permissive about dating at a younger age. She does not have a boyfriend and does not feel any pressure from her family to have one, even though they will allow her to have a boyfriend.

Of the different types of activities in her mathematics class, Lucia enjoys the portfolios the most because she gets to revisit everything she learned in the unit. This helps her understand the material even better. She also likes the teacher to explain the mathematics and then give her the chance to do it on her own. In Lucia's words, "I like that she [the teacher] talks and then we talk."

There are many student presentations in this class. At first, Lucia was very uncomfortable presenting because she did not know anybody in the class. But, now, she

really enjoys presenting because that is the way she understands the problems the best. The teacher forces her to go through each problem step-by-step when she presents, and that way she knows how to do every part of each problem she presents. However, based on her Anxiety score, she still does have some fear of mathematics in some areas of her life (see Table 8). Lucia also likes to work with other people on problems and feels that working in groups in class and having the other students' phone numbers has helped her get together with other students so they can share their ideas. Lucia likes working with others, but not in all cases. She prefers working by herself when she has to explain her thoughts, and she prefers working with others when they are just starting a problem. Lucia is in MESA, and uses her MESA study group as time to start a problem. She also works on problems with her cousins and friends.

Zulema

Table 9

Mean Responses on the Fennema-Sherman Mathematics Attitude Scales

Scale	MD	F	M	S	U	T	An	EM	C
Zulema	3.42	3.00	3.08	3.25	2.83	2.58	2.08	2.67	2.83

Zulema's scores in all areas were about one point lower than the average for the Mexican-American females surveyed (see Tables 2 and 9).

Zulema is in the second year of a non-traditional, integrated mathematics program. She plans to take either three or four years of mathematics in high school, and then more traditional mathematics coursework in college. When asked what careers use a lot of mathematics, she came up with architecture. She also said that teachers in subjects other than mathematics would use a little bit of mathematics. She likes mathematics because she

knows she is going to need it in the future. However, her score on the Usefulness scale does not support this claim (see Table 9). She said her favorite subject is biology because she likes doing the labs and the reports. Zulema would like to be a marine biologist or archaeologist when she gets older. She is already thinking about going to a four-year university in her area which she believes will help her with her career goals. When asked how she became interested in archaeology, she responded:

Well, when I started seeing the movies, Indiana Jones, and all the things that he did, he looks for stuff, and I thought it was really interesting. Two years ago, I read this article in the newspaper about some people who had gone to Israel because they had found a lost city or something, and I wanted to go. I couldn't go because I was under age.

Zulema said that her mom encourages her to be good in mathematics, although her score on the Mother scale was average (see Table 9). However, her friends are not as positive about the subject. "Well, some of my friends, they're always complaining about it, that it's really boring and they don't want to take it. Like, they don't even know why we have it." But, she feels this is because her friends are in General Mathematics and she thinks these attitudes would change if her friends were in the same mathematics program she is in. She also believes that they could be in a more challenging mathematics program if someone helped them learn how to work harder.

Zulema said that her mom treats her very differently from her brothers. She sometimes does not let her go out with her friends, and when she does, she has to know who she is with and what time she will be back. However, she does not do this with Zulema's brothers because her mother believes that boys can take care of themselves better than girls. She also believes that her mother has higher expectations for her than for her brothers. She has one brother who did very well in school in Mexico and two others who were not very successful in school in the United States. Her mother is very proud of Zulema's successes. Zulema's mother is also currently going to school in the United States.

Zulema said that the major difference she sees between males and females in her mathematics class is that the males in her class generally seem like they do not care. She did mention that once she was the only girl in her group and the teacher praised her because she actually got the boys in her group to do an uncharacteristically good job on their assignment.

Zulema feels that teachers in Mexico are much stricter and expect more work from students than teachers in the United States. However, she was able to help her cousin on his work when she went to Mexico on a visit, and that made her feel very good. She feels that the school system in Mexico is better than in the United States because people have to pay to go to school in Mexico, and in the United States, it is free, so people do not care about it.

Zulema wants to get married and have children, but her first priority is her career. She said that this is so probably because having a family is such a strong tradition in Mexican culture, and she does not want to just follow tradition. She also feels that her mother would support her in this priority.

The big difference that Zulema has noticed between the Anglo and Mexican-American cultures is in the treatment of the elderly. She said that Mexican-Americans take care of their elders when they are unable to care for themselves while Anglos typically put their older relatives in homes.

In her mathematics class, Zulema prefers working in groups to working on her own because if she has questions, there is someone there to help her. In the past, she did not like the word problems she had in her mathematics classes, but she likes the word problems she gets in this class because they make her think. The only thing she would like to change about her mathematics class is to have more of a mixture of “number” and “word problems.” By this, she seems to mean that she would like to have a few more basic

problems. Zulema does worry that she will not get enough of the traditional mathematics that she will need to use in a job if she remains in this non-traditional program.

Zulema feels she learns best if the teacher does some explaining before she starts a problem on her own. She said, "I like to listen to what she [the teacher] has to say because, if she just puts us to do the work, then I don't know how to do it. But, I need her to explain stuff so I could understand it." Zulema prefers to do the shorter mathematics problems because she feels that, "the long ones are usually too difficult for me. I don't like spending lots of time thinking about it because I get frustrated when I can't get it, when I don't get the answer."

Gloria

Table 10

Mean Responses on the Fennema-Sherman Mathematics Attitude Scales

Scale	MD	F	M	S	U	T	An	EM	C
Gloria	4.67	3.00	4.83	5.00	4.92	4.67	4.55	4.10	4.75

Gloria's scores are comparatively high in all areas except on the Father scale (see Table 10). This is because she has no father at home.

Gloria is in the second year of an accelerated mathematics program. She indicated that she enjoys mathematics "because it's fun. I get to see the finished product. I usually enjoy the algebra because I see, I work the problem out, and then I know that I have a correct solution, and I can help because I can see that I can do something right." She said she does not particularly enjoy geometry because she believes that her mind does not work in shapes. Throughout the interview, Gloria frequently gave learning styles as reasons that students do what they do or think the way they think.

Gloria started enjoying mathematics in first grade because she had the highest grade in mathematics and was ahead of everyone. This attitude accounts for her score of 5 on the Success scale (see Table 10). She credited her middle school principal with stimulating her interest in upper level mathematics when he took her out of a regular mathematics class and put her into an accelerated class. She also credits her enjoyment of mathematics to having the same teacher for two years in a row both in middle school and in high school.

Gloria feels that, sometimes, she should work alone so that she pushes herself to get the answers. But, if she does not feel confident from the very beginning of a certain type of problem, she feels that she should work with others. Gloria typically works with two female friends (one Anglo and one Filipino) and a Mexican-American male friend on the particularly challenging problems. She also has a tutor (a Mexican-American female mathematics major from a local university) who she gets together with on a semi-regular basis.

Gloria plans to take mathematics courses through calculus in high school and then go on to college and take three years of mathematics. She plans to become a biomedical engineer. Gloria feels that every job uses mathematics, "everything from a cashier at a supermarket to a corporate executive." Gloria also has an extremely accurate picture of the types of mathematics different professions use. When asked if she could name a career that uses higher level mathematics, she mentioned an engineer. She said that in her proposed career as a biomedical engineer, she will use mathematics for things like calculating dosages. Outside her job, she sees herself using mathematics to work with taxes, savings accounts and shopping.

Gloria feels that both her current teacher and her mom encourage her to study more mathematics. This is evident in her scores on the Mother and Teacher scales (see Table 10). Her mom did not expect Gloria to like school and mathematics so much because her mom was not good at mathematics. However, now that Gloria is successful, she feels that her

mom is extremely supportive. Her mom even helps her find references and materials she needs for various projects. However, Gloria said that her younger sister is not supportive of her being enrolled in this accelerated mathematics program because she cannot tell her friends about it for fear they will say that Gloria is a “school girl.”

There are three females and no males living in Gloria’s household, and she does not believe that her mother would treat her or her sister any differently if they were male. Gloria’s mother completed high school and currently is employed as a “line worker.” Gloria mentioned that her best friend is a Mexican-American male who is in most of her classes. Even though he is her best friend, she does like to compete with him. She finds that the major difference between the males and females in her mathematics classes is that, “Girls are more quiet and more serious, and the males are usually more distracted and are usually fooling around most.” She gave an extremely interesting response to a question about the grades which girls and boys receive.

Well, girls usually get between a high B and an A, and boys, depends, I’ve seen the worst goof-offs get A’s, and I think that’s, it depends. Maybe, that’s how they learn. Maybe, goofing off and playing with cards or something, but yet, listening, makes them learn. Maybe they’re more of a touch learner than a visual or hearing learner.

This hints at why she scored fairly high on the Male Domain scale (see Table 10).

Gloria was also very verbal about her views on cultural differences. She said that Pacific Islanders are usually oriented towards mathematics because that is what their parents want. However, she said that the Mexican-American culture typically does not push females to be anything except housewives while males are encouraged to at least graduate from a junior college. She said this is changing though. She also said that no matter what gender or ethnicity, she feels that parental support is a huge factor in a student’s success.

Gloria takes two hours of mathematics every day. She said that in her class, “it’s 85% student and 15% teacher.” Because there is so much student interaction, Gloria feels it is easier to ask questions when she needs to. However, she also feels that sometimes the

class goes too fast for her and she does not feel comfortable asking questions. She did indicate some fear of being embarrassed by asking questions. However, this was not apparent in her score on the Confidence or Anxiety scales (see Table 10). She said that she is specifically afraid of being embarrassed in front of the boys in the class. Gloria differs from the other interviewed subjects because she said that if she did not know how to do a mathematics problem, she would go to the library to see if they had anything that would help. However, she does not feel like the city's public library is really that useful for mathematics.

Gloria really likes the projects they do in her mathematics class. When asked why, she responded:

Because, in the project, I actually get to see if something went wrong and go back. In a test, I have to go through what I know and write it down, and I don't get to see if I did something wrong, a little mistake of minus or plus.

Ester

Table 11

Mean Responses on the Fennema-Sherman Mathematics Attitude Scales

Scale	MD	F	M	S	U	T	An	EM	C
Ester	4.67	4.5	3.67	3.75	4.67	3.92	4.08	3.58	3.33

Ester had fairly high scores on both the Usefulness and Anxiety scales, and the rest of her scores were average compared to the Mexican-American female group (see Table 11).

Ester is enrolled in the second year of a non-traditional mathematics program. She has been in the United States for six years. She plans to take all four years of high school mathematics, but does not know how much mathematics she will take in college. She does

feel like she is good at mathematics because she sees that her grades are going up. However, her confidence is still not that high according to her score on the Confidence scale (see Table 11). After she graduates, she wants to go into computer technology, but does not know how much mathematics this will require. She does know, however, that this career will be in high demand in the future.

Both of Ester's parents want her to be successful in her schooling because it is an opportunity that they did not have. When asked why they encourage her in school, she said, "Because, that I have the chance to study, like I'm studying right now. My dad got to sixth grade, that's middle school, and my mom got to third grade, so they want me to progress." Her mother is a homemaker and her father is a maintenance worker. Her dad wants Ester to be even more successful than her older brothers who are now working. She does not feel that her dad would treat her any differently if she were male, but that her mom would expect her to go outside the house and work.

The big difference Ester sees between the Anglo culture and Mexican-American culture is that in the Mexican-American culture, parents are more strict and make the women work at home and the men work outside the home. Despite this cultural difference, Ester wants to go to school and have a career before she starts a family.

Ester enjoys the mathematics program she is currently in because they "have time to talk about problems and share...." She also likes to present in front of the class even though she was nervous about it at first. She said that if she were the teacher, she would be more strict with her students because the students seem to want to talk more than work. However, she also said that in Mexico they were too strict. "And they want everything right. I like that way too, but I do not know, the way they explain it is more confusing. But, you learn more." She said that everyone is expected to get the right answers, and if they do not, they need to do it again.

When asked if she enjoyed mathematics, Ester said, "I think it's fun, and I like to play with numbers a lot, and I like to use the [graphing] calculators." Ester said that, as a student, she likes to listen to the teacher. She said, "I like to listen to the teacher a lot. I don't like to talk to students because they don't want to hear anything." She feels that the other students do not like the way she works and explains things. She especially likes it when the teacher explains a problem step-by-step and then has them try a similar problem. However, later in the interview, Ester said that she would rather work with others than on her own so they can share their problems and explain things to each other. But, she said that she does not have the opportunity to do this outside of school because her parents do not let her go out.

Ana

Table 12

Mean Responses on the Fennema-Sherman Mathematics Attitude Scales

Scale	MD	F	M	S	U	T	An	EM	C
Ana	4.67	4.17	3.67	4.00	4.17	3.50	4.50	3.58	3.50

Ana has a fairly low level of anxiety towards mathematics. However, in every other area, Ana has fairly average scores on the MAS (see Table 12).

Ana is in a traditional geometry class. She is planning to take four years of the traditional college preparatory mathematics program at her school and also plans to take mathematics in college. Ana went to elementary school in Mexico and thought that, there, mathematics was boring. When she came to the United States in middle school, she began to think mathematics was fun. She feels that her current geometry teacher has really helped her with mathematics because he has helped her to understand it. However, she finds it

very difficult to explain problems to other people even when she understands them. This could be more of a language problem than a mathematics problem. Ana's mom has also really encouraged her to study mathematics because it was a subject that her mom really liked when she was in school. Ana's mother completed through sixth grade in Mexico. However, Ana's friends do not encourage her to succeed in mathematics because they do not like it.

Ana plans to become a doctor when she gets older. However, she does not seem to be very knowledgeable about what this career choice entails in terms of preparation. She believes that she will probably need about two years of mathematics in college for this career. Ana plans to have a job before she has a family, but if she had to make a choice between job and family, she would choose her family. She also plans to live with her parents for quite a long time, and may even continue to live with them after she gets married.

She said that the major difference she sees between the males and females in her mathematics classes is that the boys seems to get frustrated more easily than the girls. However, she also said that she felt that boys were better at mathematics because they pay attention more. She believes that there are fewer women in mathematics-related fields because, generally, the females just are not interested in these fields. This supports her high score on the Male Domain scale (see Table 12).

Ana likes her geometry class because she said it is easy. She does best on tests in this class because she really studies hard for them. She likes to do problems on her own and does not really like listening to the teacher explain the mathematics because he is too boring. However, she prefers to work with other people than to work on her own because they can help each other. She said that she has no reason to get together with students outside the mathematics classroom because they are given time to finish their homework in class.

Ana prefers to do shorter mathematics problems. She says, "When I have long word problems, I get all confused, and they're hard to do." Ana feels like she is fairly average at mathematics because she is currently getting a B. She would feel she was doing well if she had an A. However, she does think she could get an A if she did more homework. She said that she would tell her mom, her brothers and a Mexican-American female friend who is "really, really good at mathematics" if she got the highest grade on a mathematics test.

Lilia

Table 13

Mean Responses on the Fennema-Sherman Mathematics Attitude Scales

Scale	MD	F	M	S	U	T	An	EM	C
Lilia	5.00	3.92	4.33	4.58	5.00	4.50	3.25	3.00	4.92

Lilia is highly confident in her mathematical abilities, yet has a fairly average level of anxiety towards the subject. She also has a very positive attitude towards success in mathematics (see Table 13).

Lilia is in the second year of a non-traditional, integrated mathematics program. Lilia said that mathematics is her favorite subject with English coming a close second. She feels that this is so because it comes so easily for her. She feels that she must have been born with some of her talent for mathematics because her parents could not have helped her develop this ability as they did not even get out of elementary school. Lilia plans to take all four years of mathematics in high school and go on to college and possibly major in mathematics. She also said that she wanted to get her career started before she got married and had a family. Lilia believes that every job uses some type of mathematics, "even if it's

just like a waiter trying to figure out how much money they're getting or how many hours...." This supports her high score on the Usefulness scale (see Table 13).

Lilia said that her mother supports her and her siblings in anything they want to do. She said that her father does encourage them to do well in school, but he does not have much time because he works so much. This appears in the discrepancy between her scores in the Father and Mother scales (see Table 13). The person that has influenced Lilia's attitude toward mathematics most is her older brother who is currently going to a university and majoring in mathematics.

Lilia feels that if she were a boy, she would be treated much differently because, as it is now, she wants to go to the same university that her brother goes to. This would mean that she would have to move away from home, and her parents do not want her to leave home. She feels that boys seem to have more privileges than girls in her family. She has told her parents that she is planning to go to school at the place that is best for her, and she thinks that they will eventually understand her. Even if they still disagree with her decision to go away when it is time for her to make it, she said that she will go away anyway. Lilia said that even though her mother would be very hurt at first, she feels that she will eventually understand.

Lilia remains quiet about her successes in mathematics because she does not want people to think that she is showing off. When asked how she feels when she succeeds in mathematics, she responded, "Sometimes I feel that I'm really happy, but I can't show my happiness because other people would say, 'She's just showing off.' So, most of the time, I just keep it quiet." This may be where she experiences the anxiety towards mathematics indicated in Table 13. She does tell her family about her successes however. When asked who else she thought would enter a mathematics-related career, she only mentioned one female. She believes that there are currently more males than females in mathematics-related careers because traditionally, women have stayed at home and men have worked.

You know, girls are supposed to stay at home; wives, you know serve; you know, cook. And the boys or whatever, or the men, are supposed to go out and work and provide for the family. Basically, I think that's what started it all. Women being at home and men being at work.

But, she does think this is changing for the better. However, based on her score on the Male Domain scale, she still does see mathematics as a male-dominated field (see Table 13).

Lilia sees that a major difference between Anglo and Mexican-American culture is that Anglo students and parents tend to be more involved in the school system. She credits this to the fact that many Mexican-Americans spend so much time working in the fields for a living that they do not have as much time to spend with their kids. Lilia knows that Mexican-American parents are supportive of their children's education, but said they do not always have the knowledge to help their children because they had a limited education themselves.

Lilia just enrolled in MESA this school year, and really enjoys it. She feels that she learns quite a bit about preparing for college and a career from the speakers and students that come to talk to the group. She also said that she is more interested in adult conversation than in the conversation of kids her own age. She said she has always been mature and had her own opinions.

Lilia really enjoys the mathematics program she is in because she finds it easy to understand. She said that they review the same type of problem more than once. Of the activities she does in her class, she seems to enjoy the unit assessments the most because she knows everything already and she has had quite a bit of practice. For her, mathematics is the easiest subject she has. Lilia prefers to do her mathematics alone because she gets tired of explaining things over and over to other people. She said, "...it's really hard, but sometimes it's easier for me to do it alone because I'm able to understand my thoughts

better than everybody calling and I have to explain this to them.” However, she did say that she would like to work with other people on something like a big project.

Lilia said that as a mathematics student, she is always thinking. “Even though I don’t participate sometimes, I’m always thinking of what they’re doing. And a lot of times some people she’s calling on and she wants answers and nobody gets it and it’s really nice to participate a lot and I always have the answer.” Lilia likes the teacher to explain something once or twice, and then let her do the work. She feels that she usually does not need a lot of explanation for most problems.

CHAPTER 5

CONCLUSIONS

Trends Seen in the Interviews

Many trends appeared in the interviews. Some appeared in a majority of the subjects regardless of their attitudes towards mathematics. Others were related to subjects' scores on the MAS. Tables 14 through 23 summarize students' responses to pertinent topics discussed in the interviews. Due to the lapse in time between the interviews and the completion of this paper, the researcher was able to obtain transcripts for each of the subjects. Where pertinent, data from the transcripts are also included in the summaries below.

Table 14

Opinions Towards Mathematics and/or Current Mathematics Program

Subject	Summary of statements on topic
Gloria (HH)	She enjoys mathematics because it is fun and she gets to see the finished product. She has enjoyed it since first grade. She likes the "hands-on" learning in the class she is currently taking.
Marbella (HH)	She has always liked mathematics.
Ana (HM)	She has thought mathematics was fun since middle school when she came to the United States from Mexico.
Ester (HM)	She enjoys the mathematics program she is in because they have time to talk about the problems. She thinks mathematics is fun, and she likes to play with numbers.
Lilia (MH)	Mathematics is her favorite subject.
Luisa (MH)	Mathematics is her favorite subject because she can see how she will use it in real life.

Marisol (MM)	She enjoys mathematics because she feels she will use it in her life quite a bit. She also sees it as a challenge. She did not used to like mathematics in Mexico because she changed teachers so often.
Rosa (LL)	She is not very fond of mathematics. She gets stressed when she does not understand something. However, she used to like it when it was “just like little numbers and stuff.”
Lucia (LL)	It is important for her to do well in mathematics because it is important to her future. She enjoys seeing how mathematics is related to real life.
Teresa (LL)	The program she is currently in helps her understand what mathematics is used for.
Zulema (LL)	She likes mathematics because she knows she is going to need it in the future.

Note. HH = high Anxiety score and high Confidence score on the MAS; HM = high Anxiety score and medium Confidence score on the MAS; MH = medium Anxiety score and high Confidence score on the MAS; MM = medium Anxiety score and medium Confidence score on the MAS; LL = low Anxiety score and low Confidence score on the MAS.

As seen in Table 14, all of the students interviewed, with the exception of Rosa, enjoyed the mathematics program they were currently enrolled in. Even Rosa liked components of her mathematics class, such as groupwork. However, reasons for liking mathematics varied. Marbella and Gloria had high scores on both the Confidence and Anxiety scales, indicating that they both had a low level of anxiety towards mathematics and a high level of confidence in their own abilities. Marbella has always liked mathematics, and Gloria has enjoyed it since first grade. Gloria said she enjoys mathematics because it is fun and she gets to see the finished product. The other two subjects (Ester and Ana) who had low anxiety towards mathematics based on the Anxiety scale of the MAS indicated that they also thought mathematics was fun. Ester said she thinks mathematics is fun and she likes to play with numbers. Ana has thought mathematics

was fun since middle school when she came to the United States. Of the remaining seven that had mixed or comparatively negative attitudes towards mathematics on the MAS, five mentioned that they liked their mathematics class either because it helped them see how mathematics would be used in “real life” or they knew it would help them in their future.

Based on these responses, it appears that those who have the most positive attitudes towards mathematics also seem to enjoy mathematics for its own sake, while those who have more negative attitudes derive enjoyment from mathematics because they know it will be useful in their futures. Rosa is the one exception. Even though she knows that mathematics will help her reach her career goals, she is not very fond of it because it gets her “stressed out.” With this exception, it does not appear that a lack of enjoyment of mathematics at the high school level will prevent these young Mexican-American women from planning to enter mathematics-related fields. In fact, some realize that they will need to use mathematics in their future, and enjoy the subject simply because of this.

Table 15

Future Plans for Taking Mathematics and Possible Career Choices

Subject	Summary of statements on topic
Gloria (HH)	She plans to take mathematics through calculus in high school and three years in college. She actually only took mathematics through her junior year in high school. She plans to become a biomedical engineer.
Marbella (HH)	She plans to take four years in high school, but is not sure about college. This depends on which career she chooses. She possibly wants to become an architect. She did take four years of mathematics in high school.
Ana (HM)	She plans to take four years in high school and some in college. She did take four years in high school. She thinks she wants to be a doctor.

Ester (HM)	She plans to take four years in high school and does not know how many in college. She did take four years of mathematics in high school. She wants to go into computer technology.
Lilia (MH)	She plans to take four years in high school, and possibly go on to be a mathematics major. She did take four years of college preparatory mathematics. She did not indicate any possible career choices.
Luisa (MH)	She says she will take four years in high school and more in college. She took mathematics all four years in high school. She is thinking about a career in interior design.
Marisol (MM)	She wants to take mathematics courses through calculus in high school, and does not know how much in college. She ended up taking college preparatory mathematics through her junior year. She plans on a computer programming career.
Rosa (LL)	She plans to take four years in high school and two in college. She actually passed three years of college preparatory mathematics, but failed the first semester of her fourth year. She is thinking about being a lawyer and does not think she would use much mathematics in this career.
Lucia (LL)	She wants to take four years in high school and some in college. She did take four years of college preparatory mathematics. She plans to become an elementary school teacher.
Teresa (LL)	She plans to take all four years in high school and every year in college. She took four years of college preparatory mathematics in high school. She plans on a career in business.
Zulema (LL)	She will take three or four years in high school and more traditional mathematics courses in college. She actually took at least three years of mathematics in high school. Her senior transcript was unavailable. She wants to be a marine biologist or an archaeologist.

All of the young women interviewed took at least three years of college preparatory mathematics in high school and planned to take mathematics courses in college. A general trend was that the students with the most positive attitudes towards mathematics based on responses to the Anxiety and Confidence parts of the MAS were also planning careers which used mathematics or required an excellent background in the subject. Marbella mentioned becoming an architect and Gloria mentioned becoming a biomedical engineer.

Ester wanted to go into computer technology and Ana wanted to become a doctor. Careers that some of the students with lower scores on the MAS Anxiety and Confidence scales mentioned were business, law, elementary education, biology and archaeology. Some mentioned the relevance of mathematics courses to their career plans, while others made absolutely no mention of this connection. As expected, it appears that those with the most positive attitudes towards themselves as mathematics students were also considering careers involving mathematics.

Table 16

People who Have Influenced Their Feelings Towards Mathematics

Subject	Summary of statements on topic
Gloria (HH)	The first person who encouraged her in mathematics was her middle school principal who put her in a higher mathematics class. Then, she got to have the same middle school teacher for two years and the same high school teacher for two years.
Marbella (HH)	Her teachers have encouraged her to study mathematics in order to get a good job in the future. Her parents and brother have encouraged her for the same reason.
Ana (HM)	Her current geometry teacher has helped her to understand mathematics. Her mom has also encouraged her to study mathematics because it was a subject that her mom really liked. However, her friends do not encourage her to succeed in mathematics because they do not like it.
Lilia (MH)	The person who has encouraged her to study mathematics is her older brother who is majoring in mathematics.
Luisa (MH)	Her dad and mom both encourage her.
Marisol (MM)	Her mathematics teacher and brother both encourage her to study mathematics. Her university mentor, a Mexican-American female, serves as a role model because she did not used to like mathematics but now does.

Lucia (LL)	A male mathematics teacher helped her to enjoy mathematics because he made it really fun for her and explained mathematics really well.
Teresa (LL)	Her older brother, who was not academically successful, and her sister, who had a job in business, both encourage her. Her best friend in junior high also encourages her to do well.
Zulema (LL)	Her mom encourages her, but some of her friends complain about having to take mathematics.

Note. Students who do not appear in a table had no clear response to the question.

Generally, students only mentioned people who had positively influenced their feelings towards mathematics. Students named both males and females as people who had encouraged them. In all cases, the students said that it was either a school faculty member, a family member or a combination of the two who had this positive influence. However, in two cases, the subjects indicated that they were not encouraged to succeed in mathematics by their friends.

Seven of the nine students who responded to this question indicated that a family member had helped give them a positive attitude towards mathematics. The family members most mentioned were an older brother (mentioned by four students) and their mother (mentioned by three students). This finding indicates the importance of the family in encouraging Mexican-American women to pursue mathematics.

Both of the students who had high Anxiety and Confidence scores on the MAS (Marbella and Gloria) indicated that a teacher or administrator had encouraged them to succeed in mathematics. However, only one (Lucia) of the four students who had low scores on the Anxiety and Confidence scales indicated that a teacher had positively influenced her feelings towards mathematics. This may indicate that teacher attitudes towards specific students have a great effect on those students' attitudes towards mathematics. The educational community should also examine whether only Mexican-

American females who appear most interested in mathematics are encouraged to pursue it, while those who are not visibly interested in the subject are not well supported.

Table 17

Feelings About Their Own Mathematical Ability

Subject	Summary of statements on topic
Marbella (HH)	She is "kind of" good because she has pretty good grades and does her best.
Ana (HM)	She thinks she is fairly average because she is currently getting a B.
Ester (HM)	She believes she is good at mathematics because her grades are going up.
Lilia (MH)	Mathematics comes easy for her.
Luisa (MH)	She believes she is good at mathematics because it is easier for her than other subjects, and she gets good grades in it.
Marisol (MM)	She does not feel she is good at mathematics because it is the class where she has the lowest grade. If she ignored grades, she said she would be average.
Rosa (LL)	She said she is not good at mathematics.
Lucia (LL)	She believes she is good at mathematics because she gets good grades and she really enjoys it.
Teresa (LL)	She is not very good at mathematics because she needs someone to help her do it.

It is interesting that reasons students gave for their opinions of their own mathematical abilities were based on grades and ease of the subject. In general, these students had quite good grades. As a group, their average grade point average was 3.38 on a 4.0 scale. Only one student (Lucia) actually indicated that she was good at mathematics because she enjoyed it. Possibly, educators should stress enjoyment of the subject more in determining aptitude for a career in mathematics. Most people enter fields in mathematics

because they like it, not solely because they got good grades or because it was easy for them.

In this area, it is also interesting that the students' attitudes towards mathematics as indicated by the MAS seemed to have no affect on how they viewed their own ability. One would have expected that the way the students viewed their own mathematical ability would be positively related to their Confidence scores on the MAS. However, this was not the case. One possible explanation for this comes from the work of Fennema et al. (1979) on attribution theory. They found that females did not attribute their mathematical successes to ability. This would indicate that students' confidence that they can do well on mathematical tasks may have little to do with their perceptions of their own abilities.

Table 18

Preferred Mathematics Learning Methods

Subject	Summary of statements on topic
Gloria (HH)	She feels that, sometimes, she should work alone to push herself. But, if she does not feel confident about a problem, she feels she should work with others. If she did not know how to do a mathematics problem, she would go to the library to see if they had anything that would help. She likes mathematics projects because she has time to see if something went wrong and correct it.
Marbella (HH)	She wishes the teacher would spend more time explaining problems. She does well on tests because she tries to follow the teacher when he is teaching. She prefers to listen to the teacher and work alone. She will only ask the teacher questions when she does not understand the explanation in the book.
Ana (HM)	She likes to do problems on her own and does not really like listening to the teacher explain the mathematics because he is too boring. She also likes to work with other people because they can help each other.

Ester (HM)	She enjoys the mathematics program she is currently in because they have time to discuss problems. She likes mathematics because she likes to play with numbers. She likes it when the teacher explains a problem step-by-step and then has them try a similar problem. She likes to both work with others and on her own.
Lilia (MH)	In her mathematics class, they review the same type of problem more than once. She prefers to do her mathematics alone because she gets tired of explaining things over and over to other people. She likes the teacher to explain something once or twice, and then let her do the work.
Luisa (MH)	She likes working in groups, but sometimes feels that she is the only person in her group doing the work. She likes to do her homework alone, but for more complex problems, she likes to work with a friend. She feels that she is most successful when the teacher explains a little bit about the mathematics and then lets the students try it on their own. She likes the Problems of the Week because she has to show how she solved the problem, and there are many different ways of solving the same problem.
Marisol (MM)	Her favorite part of mathematics class is the groupwork. But, sometimes, she also likes to listen and concentrate on what the teacher is saying. If she were given a mathematics problem which she did not understand, she would first try to understand it on her own through examples.
Rosa (LL)	She likes to work in groups. But, when she is trying something for the first time, she wants to do it by herself. She said that if there were a problem which she did not know how to do, she would do her best and explain her work, but also explain what she thought she did wrong.
Lucia (LL)	She prefers working by herself when she has to explain her thoughts, and she prefers working with others when they are just starting a problem. She also likes the teacher to explain the mathematics and then give her the chance to do it on her own. She really enjoys presenting to the class because the teacher forces her to go through the problem step-by-step, and that way she knows how to do every part of each problem she presents.
Teresa (LL)	She wants to have a mixture of teacher explanation and student interaction during class time. She likes to work with other people on her mathematics work because she can get help if she does not understand a problem. If she had a mathematics problem she did not know how to do, she would first ask her teacher, and if she were not available, she and her friend would "work it out together."

Zulema (LL)

She prefers working in groups to working on her own because if she has questions, there is someone there to help her. In the past, she did not like the word problems she had in her mathematics classes, but she likes the word problems she gets in this class because they make her think. She feels she learns best if the teacher does some explaining before she starts a problem on her own. She said, "... I need her to explain stuff so I could understand it."

Six of the eleven interviewed subjects felt that there were times they wanted to work on mathematics in groups and times where they wanted to work on it alone. Only two of the students, Marbella and Lilia, wanted to work alone a majority of the time. And, three of the students with less positive attitudes towards mathematics wanted to work in groups all of the time. These data support recent research providing evidence that females prefer mathematics classes which use cooperative learning in small groups (Fennema and Leder, 1990). It also indicates that Mexican-American females seem to respond well to both cooperative and individual learning structures within the same class.

It is interesting to compare these young Mexican-American women's responses to the stages of knowing which Belenky, Clinchy, Goldberger and Tarule (1986) propose in their book, *Women's Ways of Knowing: The Development of Self, Voice, and Mind*. All of the subjects except Ana and Rosa felt that they could solve a mathematics problem best if they first saw an example either presented by the teacher or the textbook. Ana and Rosa both indicated that they liked to try problems on their own first. These responses indicate that most of the subjects are in the "received knowing" stage in which they learn by listening to authority. Becker (1995), in her discussion of *Women's Ways of Knowing: The Development of Self, Voice, and Mind*, suggests that the imitation model of teaching, in which the students mimic what the teacher has done, is not a particularly effective means of learning for women. Rather, she suggests the method of "connected teaching" in which the teacher and students engage in the process of thinking and discovering mathematics

together. This teaching method would hopefully lead to "connected knowing" in which the students support their conclusions by experiences. It is quite interesting that in all but the traditional mathematics classes at this school, a strong effort is made to use connected teaching. However, the students rarely, if ever, mentioned this as a good way for them to learn mathematics. This merits some additional research. There is a strong possibility that students do not feel they are really doing mathematics when the teacher is engaging them in Becker's proposed model of connected teaching.

Table 19

Family's Feelings Towards Education

Subject	Summary of statements on topic
Gloria (HH)	Her mom encourages her to study more mathematics. But, her younger sister is not supportive because she is embarrassed to tell her friends that her sister is in an upper level mathematics class.
Marbella (HH)	She uses mathematics to help her younger siblings, and her older brother helps her.
Ester (HM)	Both of her parents want her to be successful in school because it is an opportunity they did not have. However, they will not let her go out of the house to work with other students.
Lilia (MH)	Her mom encourages her to do well in school. Her dad also encourages her but does not have much time because of work. However, her parents do not want her to go away from home to the same university that her brother is currently attending.
Luisa (MH)	Her parents are completely supportive and go to school-sponsored meetings. She helps her little brothers and sisters with their schoolwork.
Marisol (MM)	Her family is supportive of her having a career as a higher priority than having a family.

Rosa (LL)	Her father does not encourage her much, but does tell her to do better when she gets poor grades. Her mom is very interested and always asks about her progress. She wants her to do well so she can be successful later on. In general, she felt that female students in Mexican-American families have to help out around the house and deal with the distractions of younger children more than in Anglo families.
Lucia (LL)	Her dad encourages her to take college preparatory classes, but her mom does not really understand the education system. Her family does not want her to work in the fields like they do. However, she says her mom has her do lots of housework.
Teresa (LL)	Her mother encourages Teresa because she had a hard time due to her own lack of education. Her mother had to take care of her own younger brothers and sisters when she was growing up.

Generally, these students think that their families value education very highly. The most common reason given for this was that education is an opportunity their parents did not have when they were growing up. In two cases, students explicitly stated that their families knew succeeding in school would help their daughter have a better life than they had. These results are similar to the support Gándara (1995) found in the families of educationally ambitious Mexican-American women. She found that women were encouraged to do well in school in general while males were more often directed toward a particular career goal. These young women are told that education is important and therefore may be more likely to take advantage of special programs to encourage Mexican-American females to pursue mathematics-related careers, such as MESA.

However, it also appears that in some cases, the home environment and traditional expectations are not conducive to success in school. Ester's parents want her to succeed in school, yet will not let her out of the house to work with her peers on schoolwork. Lilia's parents encourage her to do well in school, yet will not allow her to go away to college. Rosa mentioned that young Mexican-American women are frequently distracted by younger siblings and are expected to help out around the house quite a bit. Lucia echoed this

sentiment when she said that her dad encourages her to take college preparatory classes while her mom expects her to help out around the house a lot. Based on these four subjects, it seems quite likely that positive parental attitudes towards schooling and expectations for young Mexican-American women at home may clash in some cases. Again, parent education on the requirements to be a successful student in high school and college is a necessity in cases such as these four women's.

Table 20

Changes Which Would Happen if She Were Male

Subject	Summary of statements on topic
Gloria (HH)	There would be no changes.
Marbella (HH)	Her mom and dad would let her out of the house more.
Ester (HM)	Her dad wants Ester to be more successful than her older brothers who are working. If she were male, her mom would expect her to go outside the house and work.
Lilia (MH)	There would be no problem with her moving away from home to go to the same university that her brother goes to.
Luisa (MH)	Her dad expects more from the females in her family than the males and expects them to get higher paying careers. If she were male, she would not be as close to her mom, and her mom would not ask as much about her schoolwork as she does now.
Rosa (LL)	Her dad would let her go out more.
Lucia (LL)	Her father would push her harder for fear she would slack off. Her mom would not make her do as much housework, and she could go play sports.
Teresa (LL)	She would be able to play soccer.
Zulema (LL)	Her mom would let her go out more. Her mom has higher expectations for the females in the family than for the males.

Only one student indicated that she would be treated no differently if she were male. The rest said that they would have more freedom to do what they wanted, whether it be “going out” more, playing soccer or going away to college. It was also very interesting that four of the young women indicated that they felt one of their parents had higher expectations for them than if they were male. One might expect that parents would have the highest expectations for their oldest child, but of the four females who indicated that one of their parents had higher expectations for them than if they were male, only Luisa was the oldest child. This indicates that society should not assume that Mexican-American women are all expected to become solely homemakers.

Table 21

Differences Noticed Between Males and Females in the Mathematics Classroom

Subject	Summary of statements on topic
Gloria (HH)	Females are more quiet and more serious. Males are more distracted.
Marbella (HH)	Males act up more. Females are more shy.
Ana (HM)	Males seem to get frustrated more easily than females. However, she also felt males were better at mathematics because they pay attention more.
Luisa (MH)	Females pay more attention than males. Females ask more questions. Males do not say anything if they do not understand.
Marisol (MM)	Females concentrate more in class than males.
Rosa (LL)	Males are louder, but both will not pay attention. Males understand mathematics a little bit better because females always ask questions, but females get better grades. Males look at others' work and criticize, but do not do any work themselves.
Lucia (LL)	Males do not pay as much attention. Females get better grades overall.

Teresa (LL)	Males do not pay as much attention in mathematics due to peer pressure.
Zulema (LL)	Males do not seem like they care.

All of the young women, regardless of their own attitudes towards mathematics, felt that the main differences between males and females in their mathematics classes were that the males tended to act up more and seemed to care less about mathematics. However, all of the young women except Zulema also scored high on the Male Domain section of the MAS, indicating that they felt mathematics was primarily a male field (see Tables 3 through 13). This question was interesting because the majority of students interviewed did not verbalize the stereotypical attitude that males were better than females in mathematics. If they mentioned this at all, it was only after they had discussed the behavioral differences between males and females in mathematics classes. However, when academic performance differences between the sexes was mentioned, the subjects either said that males were “better” at mathematics or that females got better grades. This may indicate that young women still feel that they have to work much harder to succeed in mathematics than males. This shows that educators have succeeded in showing these young women that they can successfully do mathematics, yet we still need to work to increase the confidence of young women in their own abilities and to change their view of mathematics as primarily a male domain.

Table 22

Family Versus Career

Subject	Summary of statements on topic
Marbella (HH)	Both parents feel her career should be a higher priority than marriage, although this was not true for them.

Ana (HM)	She plans to have a job before a family, but if she had to make a choice, she would choose her family. She also plans to live with her parents for quite a long time, possibly even after she gets married.
Ester (HM)	She wants to go to school and have a career before starting a family.
Lilia (MH)	She plans to have a career started before marriage and family.
Marisol (MM)	She plans to start a career and then possibly get married. If she had to choose, she would choose a career.
Lucia (LL)	She plans to have both. It is very important to her that the caregivers for her children are family members or people she knows well rather than just daycare.
Zulema (LL)	She wants to get married and have children, but her first priority is a career. She does not want to just follow the Mexican tradition.

Of the students that responded to this question, most indicated that they wanted to have both family and a career, but that a career was currently their higher priority. In most cases, their families were supportive of this decision. It is important for society to counter the widely held belief that most Mexican-American women make it their highest priority to become homemakers. Based on these interviews, this is not true at the high school level.

Table 23

Differences Noticed Between Mexican-American and Anglo Culture

Subject	Summary of statements on topic
Gloria (HH)	Mexican-American culture typically does not push females to be anything except housewives while males are encouraged to at least graduate from a community college.
Marbella (HH)	She went to school in Mexico through eighth grade. She felt that the level of mathematics is lower in the United States than in Mexico. In the United States, there are students who do not want to be in school.

Ana (HM)	She went to elementary school in Mexico and thought mathematics was boring. When she came to the United States in middle school, she began to think that mathematics was fun.
Ester (HM)	In Mexican-American culture, parents are more strict and make the women work at home and men work outside the home. In class in Mexico, teachers are much more strict.
Lilia (MH)	Anglo students and parents tend to be more involved in the school system because many Mexican-Americans spend so much time working in the fields. Mexican-American parents do not always have the knowledge to help their children because they had a limited education themselves.
Luisa (MH)	In Mexican-American culture, one is always expected to do well, but in Caucasian culture, a person can do better next time if they did not do well the first time.
Marisol (MM)	In Mexico, mathematics education is more advanced and stricter. Also, males are encouraged to study mathematics more than females.
Rosa (LL)	Anglos do more homework so they get better grades. Anglos have smaller families so the kids have more chance to work in a quiet environment. Mexican-American males tend to be aggressive when they want their own way.
Lucia (LL)	Mexican-Americans have more fun at parties. Anglo culture is more permissive about dating at a younger age.
Teresa (LL)	In Anglo culture, parents encourage children to go to school.
Zulema (LL)	Teachers in Mexico are much stricter and expect more work from students than teachers in the United States. She feels that the school system is better in Mexico because people have to pay to go to school. Here, it is free so people do not care about it. She also notices differences between treatment of elderly in the two cultures. In Mexican-American culture, they do not put their elderly in retirement homes.

Three of the four students who had the most positive attitudes towards mathematics were educated in Mexico for part of their lives. Only two of the remaining seven students indicated that they had gone to school in Mexico. Of the students who did go to school in Mexico, all of them indicated that education was much more strict there. Based on these interviews, it appears that young women who have been educated in Mexico and come to

the United States have fairly positive views towards mathematics. Researchers should continue to examine mathematics education in Mexico so that mathematics teachers have a better understanding of the mathematics background of our first generation Mexican-American students.

Three of the seven students who had less positive attitudes towards mathematics felt that Anglo students got more support from their parents for reasons such as smaller families, less work pressure and a better understanding of the school system. This indicates that there should be a concerted effort to educate Mexican-American parents about how to best support their children in the United States school system.

Summary

The student surveys and interviews conducted in this study give a fairly positive view of young Mexican-American women's views towards mathematics. Almost all of the students interviewed enjoyed the mathematics programs they were currently enrolled in. All of the young women ended up taking at least three years of college preparatory mathematics in high school, and most took four. This is an indicator that this group is not eliminating themselves from mathematics-related careers due to lack of participation in high school courses. Most of the interviewed females felt they would need mathematics in their future, and they all planned to take courses beyond high school. Gándara (1995) found that this early orientation towards college was a trait present in women who achieved high levels of academic success. This is also extremely positive for these students' futures in technological fields based on Leder's (1990) finding that students who find mathematics more useful are more likely to pursue it.

Almost all of the young women had both career plans and family plans. For a majority of the subjects, career was their first priority. This supports Leder's (1990) finding that females who planned to get married and have children were less likely to take

accelerated mathematics classes than females who did not. A majority of these students were taking accelerated mathematics classes and, although they had plans to marry and have a family, their more immediate plans were to begin a successful career. Stallings (1985) found that the most important factors influencing women's decisions to enroll in advanced mathematics classes included parents' encouragement and support, successful experiences in mathematics classes, and career plans. It appears that for most of these subjects, each of these three components was in place. For those who are not as successful in mathematics, these are three areas to explore and work to enhance.

Generally, the students felt that their families were very supportive of their doing well in school. This is definitely supported by findings in the literature on Hispanic attitudes towards success in school (see MacCorquodale, 1984). In fact, four of the young women indicated that they felt one of their parents had higher expectations for them than if they were male. Traditionally, Mexican-American families are quite protective of their daughters. Many of the females expressed this by saying that, if they were male, they would have more freedom to do what they wanted. However, only one student (Lilia) verbalized that this would affect her opportunities after high school graduation. She mentioned that her parents would not let her go away to college even though they let her brother go away. Another student (Ester) mentioned that she could not go study with her peers because her parents would not allow her out of the house after school. Students also mentioned that, as females, they were expected to do quite a bit of work around the house cleaning or taking care of younger siblings. Based on these findings, it appears that parental expectations of their daughters at home and in school may conflict. The young women know their parents want them to succeed in school, yet are not given the freedom or time to reach their full academic potential. For this reason, support for these young women must include outreach to their parents concerning the requirements to be a successful high school student and the opportunities a college education provides.

All of the young women, regardless of their own attitudes towards mathematics, felt that the main differences between males and females in their mathematics classes were that the males tended to act up more and seemed to care less about mathematics. However, almost all of the young women also indicated that mathematics was primarily a male domain on the MAS. This indicates that, although females may enjoy mathematics and see its use in their future, they do not necessarily see themselves doing mathematics in their careers. This makes complete sense due to the lack of role models for Mexican-American young women interested in mathematics. As educators, we need to create more role models by giving special attention to the many young Mexican-American women who enjoy and excel in mathematics. We need to show them the excitement of a career in mathematics or the sciences.

Limitations of the Study

This study was intended to look at an academically heterogeneous group of Mexican-American females. However, it appears from the interviews that the group was actually composed mainly of college-bound students. The students' transcripts support this hypothesis. The interview subjects took almost exclusively college preparatory subjects during high school, and their average grade point average was 3.38 on a 4.0 scale. This inadvertent selection resulted from the fact that the students who volunteered to take a mathematics survey during their lunch period, regardless of rewards, probably were not an accurate cross-section of the overall student population. According to Gándara (1995), the college orientation of these students is a characteristic of Mexican-American women who will go on to be successful in college.

Economic status and the length of time their families had lived in the United States were not considered in this study. However, based on interview results, this may affect students' attitudes towards mathematics. Students mentioned that because their parents had

to work so hard, they were not able to offer their daughters much academic support. Also, the students who said they were educated in Mexico for part of their lives tended to have more positive attitudes towards mathematics. According to the AAUW report, *How Schools Shortchange Girls* (1992), socioeconomic status is the best predictor of both grades and test scores. Care needs to be taken not to assume all young Mexican-American women react to mathematics in the same way, regardless of family background or socioeconomic status.

English ability was not considered in this study. Clearly, limited English skills will negatively influence a student's ability to learn mathematics taught in English. These students were taught primarily in English, and there was no attempt to discover if the language affected their attitude towards mathematics. The students were all interviewed by the researcher in English. Although language did not seem to be a problem for most students, it is possible that they would have been better able to express themselves in Spanish. The students also knew that the interviewer was a part-time mathematics teacher at the school. This may have positively influenced their responses to the interview questions.

Finally, there has been recent research questioning the validity of the Mathematics as a Male Domain scale of the MAS in current research (Forgasz, Leder and Gardner, 1996). Forgasz et al. concluded from their analysis of four separate research studies that some of the items on the Mathematics as a Male Domain scale require revision if the scale is to accurately measure subjects' attitudes towards mathematics as a male domain. When the scale was developed, there was no consideration that mathematics might be considered a female domain. For example, disagreement with items such as "Studying mathematics is just as appropriate for women as men," may indicate that the subject thinks it is more appropriate for women. However, disagreement with statements such as these on the MAS would lead the researcher to believe that the subject classified mathematics as a male domain. This phenomenon would indicate more of an attitude towards mathematics as a

male domain than actually exists. Forgasz et al. found reason to believe that scores on the Male Domain scale may also indicate less of an attitude toward mathematics as a male domain than truly exists because subjects are aware of the socially acceptable response, and do not classify mathematics as a male domain on the survey even though their actions might indicate otherwise. Another study that Forgasz et al. investigated indicated that the internal consistency of the scale was much higher when the scale was published in the 1970s than 20 years later. All of this evidence points to the need to revise the Mathematics as a Male Domain scale for the 1990s. Generally, the students in this survey classified mathematics as primarily a male domain. The results of the interviews indicated that the survey results were more extreme than the subjects' actual beliefs. Possibly, revisions in the Mathematics as Male Domain scale would have resulted in more accurate survey results in this area.

Suggestions for Future Research

Generally, the results of this study were quite optimistic about the attitudes towards mathematics of young Mexican-American women. However, these positive attitudes and plans for taking mathematics in college will not necessarily translate into an increased number of Mexican-American women entering mathematics-related careers. It would be quite interesting to study a similar group of young Mexican-American women through their high school years and the years following to see if they follow through with their career aspirations and if their enjoyment of mathematics in high school leads them towards careers in this area.

It would also be extremely interesting to interview a group of academically unsuccessful and unmotivated Mexican-American females to examine what characteristics or background traits separate them from the group that was interviewed in this study. The interview would need to focus on areas of teacher and parental support, career and family aspirations and educational background.

Finally, it seems that school environment must play a role in the successes of the subjects in this study. There were many positive things at the school for these young women. Three of the students participated in MESA, and all but two were enrolled in new mathematics programs which encouraged the students to become more involved in their own mathematics learning. The fact that the students chose these programs themselves could indicate that the young women already had positive attitudes towards mathematics. Or, the positive attitudes of these subjects could be evidence that programs such as MESA and the integrated, activity-based mathematics programs do positively influence students' attitudes towards mathematics. Again, it would be interesting to interview a group of young Mexican-American women who began high school with relatively negative views towards mathematics, but still participated in programs such as MESA or enrolled in more activity-based mathematics programs to see if their long-term attitudes towards mathematics changed.

The school itself also had characteristics which may have encouraged positive attitudes towards education, and specifically mathematics, among Mexican-American females. The majority of the school was Mexican-American, and the Mexican-American students played very visible roles in all areas of student life including academics, student government and athletics. Most of the mathematics teachers at this school were female, and the department prided itself on encouraging females and minorities to take four years of mathematics in high school. It would be fascinating to conduct similar interviews with Mexican-American students at a high school with a small Mexican-American population or with a traditional, male-dominated mathematics faculty to examine how much school and mathematics department characteristics factor into students' enjoyment and attitudes towards mathematics.

APPENDIX A

Survey Instructions

Please fill in the following identification information on your answer sheet and darken in the appropriate circles below each box:

1. Your name (last, first, middle initial), class level, sex.
2. Do not mark anything in the sections titled "TEST" or "YOUR SOCIAL SECURITY NO."
3. Under "COURSE I.D.", fill in your four-digit student identification number if you know it. Begin with the box on the far left.
4. In the box on the far left, under "SPECIAL CODES", fill in the number which best describes you according to the categories below:

1 - African American	5 - Native American
2 - Asian	6 - Pacific Islander
3 - European American	7 - Filipino
4 - Latino	
5. Write the title of your mathematics class and your instructor's name on top of the right-hand column on Side 1 of your answer sheet

On the following pages, you will find a series of statements. There are no correct answers to these statements. They have been set up in a way which permits you to indicate the extent to which you agree or disagree with the ideas expressed. Do not spend too much time with any statement, but be sure to answer every statement. Work fast but carefully.

As you read each statement, you will know whether you agree or disagree. Fill in the circle which corresponds to the level of your agreement or disagreement based on the descriptions below. Only fill in one response per question. Begin answering the questions on Side 1 of your answer sheet.

A	Strongly agree
B	Agree with reservations; that is, agree but not completely
C	Neither agree or disagree; are uncertain or undecided; cannot answer the question
D	Disagree
E	Strongly disagree

Survey Based on Fennema-Sherman Mathematics Attitude Scales

1. Females are as good as males in geometry.
2. My father thinks I could be good in mathematics.
3. My mother wouldn't encourage me to plan a career which involves mathematics.
4. It would make me happy to be recognized as an excellent student in mathematics.
5. As long as I have passed, my father hasn't cared how I have done in mathematics.
6. I see mathematics as a subject I will rarely use in my daily life as an adult.
7. My father thinks advanced mathematics is a waste of time for me.
8. My mathematics teachers would encourage me to take all the mathematics I can.
9. My father hates to do mathematics.
10. My father wouldn't encourage me to plan a career which involves mathematics.
11. Winning a prize in mathematics would make me feel unpleasantly conspicuous.
12. My father has shown no interest in whether or not I take more mathematics courses.
13. My mind goes blank and I am unable to think clearly when working mathematics.
14. Figuring out mathematical problems does not appeal to me.
15. My father thinks I need to know just a minimum amount of mathematics.
16. My mother thinks I'll need mathematics for what I want to do after I graduate from high school.
17. If I got the highest grade in mathematics, I'd prefer no one knew.
18. I almost never have gotten shook up during a mathematics test.
19. For some reason even though I study, mathematics seems unusually hard for me.
20. Mathematics makes me feel uneasy and confused.
21. It's hard to believe a female could be a genius in mathematics.
22. My teachers think I'm the kind of person who could do well in mathematics.
23. I like mathematics puzzles.
24. I'm not the type to do well in mathematics.

25. I don't understand how some people can spend so much time on mathematics and seem to enjoy it.
26. I'd be proud to be the outstanding student in mathematics.
27. I'm no good in mathematics.
28. Mathematics will not be important to me in my life's work.
29. I'll need mathematics for my future work.
30. I would rather have someone give me the solution to a difficult mathematics problem than to have to work it out for myself.
31. Studying mathematics is just as appropriate for women as men.
32. I would trust a woman just as much as I would trust a man to figure out important calculations.
33. As long as I have passed, my mother hasn't cared how I have done in mathematics.
34. My father thinks that mathematics is one of the most important subjects I have studied.
35. My father thinks I'm the kind of person who could do well in mathematics.
36. A mathematics test would scare me.
37. I haven't usually worried about being able to solve mathematics problems.
38. Mathematics teachers have made me feel I have the ability to go on in mathematics.
39. My mathematics teachers have been interested in my progress in mathematics.
40. Most subjects I can handle O.K., but I have a knack for flubbing up mathematics.
41. In terms of my adult life, it is not important for me to do well in mathematics in high school.
42. Mathematics is a worthwhile and necessary subject.
43. Mathematics has been my worst subject.
44. I expect to have little use for mathematics when I get out of school.
45. My mother thinks advanced mathematics is a waste of time for me.
46. My mother hates to do mathematics.
47. Mathematics puzzles are boring.

48. My teachers have encouraged me to study more mathematics.
49. I'd be happy to get top grades in mathematics.
50. My father thinks I'll need mathematics for what I want to do after I graduate from high school.
51. I would expect a woman mathematician to be a masculine type of person.
52. I study mathematics because I know how useful it is.
53. Mathematics is enjoyable and stimulating to me.
54. I usually have been at ease in mathematics classes.
55. Knowing mathematics will help me earn a living.
56. I am sure that I can learn mathematics.
57. I can get good grades in mathematics.
58. My mother has shown no interest in whether or not I take more mathematics courses.
59. My father has always been interested in my progress in mathematics.
60. I think I could handle more difficult mathematics.
61. My mother thinks I need to know just a minimum amount of mathematics.
62. My father has strongly encouraged me to do well in mathematics.
63. It would be really great to win a prize in mathematics.
64. Being regarded as smart in mathematics would be a great thing.
65. I get a sinking feeling when I think of trying hard mathematics problems.
66. Mathematics is of no relevance to my life.
67. If I had good grades in mathematics, I would try to hide it.
68. My mother thinks that mathematics is one of the most important subjects I have studied.
69. My mother has strongly encouraged me to do well in mathematics.
70. My mother has always been interested in my progress in mathematics.
71. Being first in a mathematics competition would make me pleased.

72. I don't think I could do advanced mathematics.
73. Mathematics doesn't scare me at all.
74. The challenge of mathematics problems does not appeal to me.
75. I have had a hard time getting teachers to talk seriously with me about mathematics.
76. My teachers would think I wasn't serious if I told them I was interested in a career in science and mathematics.
77. I am challenged by mathematics problems I can't understand immediately.
78. When a question is left unanswered in mathematics class, I continue to think about it afterward.
79. I have a lot of self-confidence when it comes to mathematics.
80. I usually have been at ease during mathematics tests.
81. Taking mathematics is a waste of time.
82. I'll need a firm mastery of mathematics for my future work.
83. I would talk to my mathematics teachers about a career which uses mathematics.
84. When it comes to anything serious I have felt ignored when talking to mathematics teachers.
85. I am sure I could do advanced work in mathematics.
86. People would think I was some kind of a grind if I got A's in mathematics.
87. I do as little work in mathematics as possible.
88. My mother thinks I could be good in mathematics.
89. I don't like people to think I'm smart in mathematics.
90. My mother thinks I'm the kind of person who could do well in mathematics.
91. I will use mathematics in many ways as an adult.
92. It would make people like me less if I were a really good mathematics student.
93. Once I start trying to work on a mathematics puzzle, I find it hard to stop.
94. When a mathematics problem arises that I can't immediately solve, I stick with it until I have the solution.
95. Generally, I have felt secure about attempting mathematics.

96. I have found it hard to win the respect of mathematics teachers.
97. Mathematics is for men; arithmetic is for women.
98. Mathematics makes me feel uncomfortable, restless, irritable, and impatient.
99. My teachers think advanced mathematics is a waste of time for me.
100. Mathematics usually makes me feel uncomfortable and nervous.
101. Getting a mathematics teacher to take me seriously has usually been a problem.
102. Girls can do just as well as boys in mathematics.
103. Males are not naturally better than females in mathematics.
104. Women certainly are logical enough to do well in mathematics.
105. When a woman has to solve a mathematics problem, it is feminine to ask a man for help.
106. I would have more faith in the answer for a mathematics problem solved by a man than a woman.
107. Girls who enjoy studying mathematics are a bit peculiar.
108. It wouldn't bother me at all to take more mathematics courses.

APPENDIX B

Means for Interview Subjects on the MAS

Subject	MD	F	M	S	U	T	An	EM	C
Zulema (LL)	3.42	3.00	3.08	3.25	2.83	2.58	2.08	2.67	2.83
Rosa (LL)	5.00	2.67	4.00	3.50	3.58	3.00	2.33	3.00	3.25
Lucia (LL)	4.67	3.92	3.50	4.00	4.17	4.17	2.58	3.42	3.00
Teresa (LL)	4.50	4.33	5.00	4.50	4.00	4.25	3.00	2.67	2.50
Marisol (MM)	4.17	3.17	3.58	4.50	4.58	4.45	3.09	4.33	3.92
Luisa (MH)	5.00	4.58	4.75	5.00	4.58	4.67	3.33	4.42	4.17
Lilia (MH)	5.00	3.92	4.33	4.58	5.00	4.50	3.25	3.00	4.92
Ester (HM)	4.67	4.50	3.67	3.75	4.67	3.92	4.08	3.58	3.33
Ana (HM)	4.67	4.17	3.67	4.00	4.17	3.50	4.50	3.58	3.50
Marbella (HH)	4.67	4.55	4.75	4.45	3.64	4.33	4.45	3.42	4.70
Gloria (HH)	4.67	3.00	4.83	5.00	4.92	4.67	4.55	4.10	4.75
Mean Scores for Interviewed Students	4.59	3.80	4.11	4.23	4.19	4.00	3.39	3.47	3.72

Note. HH = high Anxiety score and high Confidence score on the MAS; HM = high Anxiety score and medium Confidence score on the MAS; MH = medium Anxiety score and high Confidence score on the MAS; MM = medium Anxiety score and medium Confidence score on the MAS; LL = low Anxiety score and low Confidence score on the MAS.

Note. MD = Mathematics as a male domain scale; F = Father's attitude toward subject as a learner of mathematics scale; M = Mother's attitude toward subject as a learner of mathematics scale; S = Attitude toward success in mathematics scale; U = Usefulness of mathematics scale; T = Teacher's attitude toward subject as a learner of mathematics scale; An = Anxiety towards mathematics scale; EM = Effectance motivation in mathematics scale; C = Confidence in learning mathematics scale.

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