DISSERTATION

MATH ANXIETY AND CAREERS AMONG BILINGUAL LATINOS

Submitted by

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WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY GALI GOLDWASER ENTITLED MATH ANXIETY AND CAREERS AMONG BILINGUAL LATINOS BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

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ABSTRACT OF DISSERTATION

MATH ANXIETY AND CAREERS AMONG BILINGUAL LATINOS

Latinos do not enter particular occupational fields at the same rate than other ethnic groups and certainly continue to be underrepresented in math, science, and engineering (MSE) fields. Although math anxiety has been widely studied as a variable influencing MSE careers among European-American college students, such information is lacking for bilingual Latino college students.

The first objective of the study was to create and psychometrically evaluate a Spanish-language Mathematics Anxiety Rating Scale – Short Version (MARS-SV) and to compare it with the English-language MARS-SV in relation to mathematics performance and mathematics avoidance behaviors. The second objective involved an exploratory analysis of possible variables which could have an effect on bilingual Latino students' choice of MSE college majors and careers. Predictors explored included: (1) past failure experiences with math, (2) inadequate preparation for math majors/careers, (3) math being perceived as stressful, (4) lack of guidance towards majors/careers in math, (5) lack of interest in math majors/careers, (6) value of math-related majors/careers for the future, and (7) general dislike for math.

Results suggest that the newly created Spanish-language MARS-SV has good internal reliability, is highly correlated with, and showed similar norms to the English MARS-SV. A principal components analysis with varimax rotation also demonstrated a similar factorial structure to that described in previous literature for the English-language version.

The study found that overall math anxiety did not appear to be related to math performance although a ceiling effect in math performance was observed for the sample used. A small, but significant correlation was observed between math anxiety and MSE-related college major avoidance. However, math anxiety was not associated with number of math courses participants completed in high school or college, or were planning on taking in college, and no differences were found between high math anxious and low math anxious students in regard to number of math courses completed in high school or college, and planning on completing in college. A logistic regression model significantly predicted MSE major and career choice, these included perceiving math as stressful, perceived value for the future, and lack of guidance in math, and finally, lack of interest predicted MSE career, but not MSE major.

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CHAPTER I

INTRODUCTION

A factor that often influences an individual's choice in pursuing college majors or careers associated with quantitative tasks is anxiety about mathematics or manipulating numbers. Students apprehensive about mathematics tend to view doing math as engaging in a sort of punishment, and often experience quantitative tasks as stress provoking (Zaslavsky, 1994). Research suggests that mathematics anxiety is associated with: a feeling of dread (Tobias, 1978), math-related avoidance behaviors (Alexander & Cobb, 1987), physiological arousal (Dew, Galassi, & Galassi, 1984), and if severe enough, with a specific phobia such as "mathophobia" (Lazarus, 1974) or "mathemaphobia" (Gough, 1954) which can be clinically significant and treatable. Richardson and Suinn (1972) defined mathematics anxiety as involving "feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" (p. 551).

Fifty years ago, Dreger and Aiken (1957) had suggested that anxiety about numbers was correlated with students' course grades received at the end of a semester. Since then, substantial evidence has been made available suggesting that individuals who have increased levels of mathematics anxiety tend to perform poorly in tasks that require some form of quantitative reasoning or computation (Ashcraft & Faust, 1994; Hembree, 1990; Meeks, 1997), math classes (Wigfield & Meece, 1988), math aptitude (Hackett &

Betz, 1983), and general math achievement (Ramirez & Dockweiler, 1987). Hembree (1990) conducted a comprehensive meta-analysis investigating 151 individual studies in the mathematics anxiety literature and concluded that higher mathematics anxiety was significantly related to lower mathematics performance.

Measuring Mathematics Anxiety as a Construct

Tobias (1976) points out that math anxiety is an important construct to measure when looking at mathematics avoidance behaviors. The Mathematics Anxiety Rating Scale (MARS; Richardson & Suinn, 1972) was one of the first scales developed aiming to measure the mathematics anxiety construct. The MARS has been described to be one of the most valid and reliable measures available for the measurement of math anxiety (Keyser & Sweetland, 1984) and MARS, as well as scales derived from it, are widely used in the math anxiety and math education literature. The MARS has substantial psychometric documentation (Dew, Galassi, & Galassi, 1983), is psychometrically sound (Alexander & Cobb, 1987; Capraro, Capraro, & Henson, 2001), and is associated with an abundance of empirical literature (Ashcraft & Faust, 1994). Two other mathematics anxiety scales, the Sandman Mathematics Anxiety Inventory (MAI; Sandman, 1979) and the Fennema-Sherman Mathematics Anxiety Scale (MAS, Fennema & Sherman, 1976) which are also available, lack solid psychometric data and are less frequently employed in mathematics anxiety research (Dew, Galassi, & Galassi, 1983). Although there is a plethora of mathematics anxiety research employing MARS and MARS-based scales with English-speaking populations (Alexander & Martray, 1989; Alexander & Cobb, 1987; Bowd & Brady, 2002; Brush, 1978; Dew, Galassi, & Galassi, 1983; Hopko, Mahadevan, Bare, & Hunt, 2003; Levitt & Hutton, 1984; Llabre & Suarez, 1985; Plake &

Parker, 1982; Richardson & Suinn, 1972; Suinn & Winston, 2003), there has been a relatively modest amount of research validating MARS with Latino populations (e.g., Hsi, 1980; Suinn, Taylor, Edwards, 1989). Additionally, to the extent of the author's knowledge, no MARS-related studies exist with Spanish-speaking or bilingual Latino college students in the United States. One purpose of the current study is to psychometrically validate a Spanish-language version of the Mathematics Anxiety Rating Scale – Short Version (MARS-SV; Suinn & Winston, 2003) with a bilingual (Spanish-English) Latino college sample.

Latinos: The Fastest Growing Minority Group in the United States

The 2000 U.S. Census calculated that there were 281.4 million individuals (not including the Commonwealth of Puerto Rico and the U.S. Island Areas) in the United States. In the 2000 U.S. Census, Latinos made up 12.5% of the population or approximately 35.3 million people (U.S. Census Bureau, 2000). The Latino groups represented in the 2000 census were Mexicans (7.3%), other subgroups such as Central and South Americans (3.6%), Puerto Ricans (1.2%), and Cubans (0.4%). The above numbers reflect an extraordinary increase of more than 50% in a ten-year period since the previous census in 1990 (U.S. Census Bureau, 2002). In addition to Latinos being the fastest growing minority group in the United States, recent data indicate that 39.1% of Latino Americans are foreign born individuals, suggesting that many individuals in this segment of the population are likely to be less acculturated and primarily monolingual Spanish-speaking (U.S. Census Bureau, 2001). Spanish is considered to be the second most commonly used language in the United States (Penley, Wiebe, & Nwosu, 2003). The fact that many Latinos in the U.S. are completely or primarily Spanish-speaking points out the need for continued efforts in developing and psychometrically evaluating Spanish-language versions of new, or like in the current study, already existing psychological measures such as the MARS.

Math-related Achievement among Latinos

It is well documented that Latinos fall behind when it comes to achievement in particular academic fields. A National Science Foundation (NSF) report on ethnic/racial minority mathematics, science, and engineering (MSE) education suggests that Latinos have lower levels of achievement in elementary-, secondary-, college-, and graduate-level courses, and as a result, a significant level of underrepresentation currently exists in the workforce for Latinos in MSE careers (NSF, 1994). Studies have established considerable differences in mathematics performance and achievement between Latinos and European-Americans in elementary school (Baxter et al., 1993). Twelfth-grade Latino students have noticeably poorer math proficiency scores than do Asian- or European-American students and are less likely to be enrolled in geometry, chemistry, or physics courses when compared to Asian- or European-American students (NSF, 1994). Differences between Latinos and other ethnic groups continue to be present in quantitative course-completion patterns (NSF, 2000). Moreover, Latinos tend to enroll in decreased amounts of college-preparatory mathematics courses in high school than do European- or Asian-American students (Castambis, 1994; Davenport, Davison, Kuang, Ding, Kim, & Kwak, 1998). Poorer performance in mathematics is strongly related to underrepresentation of Latinos enrolling in math-related college majors, and consequently, less Latinos carve out a path to careers in MSE-related fields (Macias, 1995, as cited in Lopez, 2001). Research suggests that this gap in mathematics education and preparation is somewhat narrowing in recent years, but the gap continues to exist (Acherman-Chor, Aladro, Gupta, 2003) and such disparities may leave Latinos underprepared for success in college-level mathematics courses. This underpreparation in mathematics-related courses may also increase Latinos' levels of mathematics anxiety as a function of poorer levels of exposure to and decreased levels of familiarity with mathematics material in general.

Osborne (2001) investigated the differences in general academic achievement, including math, and its relationship to anxiety as a function of race/ethnicity in a large and representative sample of high school seniors in the United States. Results from this study point out the following: (1) achievement scores for Latinos were significantly lower when compared to European-Americans, (2) Latinos had higher academic-related anxiety scores when compared to European-Americans, and (3) academic achievement was negatively correlated to anxiety (Osborne, 2001). Further worsening the matter, Latinos are underrepresented in high school mathematics classes designed for preparation into math-related college majors and careers (California Department of Education, 1997). Such educational patterns create a "leak in the pipeline" in preparing Latino students in MSE fields, and hence, to experience a smooth transition from high school to college and beyond.

Math-related Anxiety among Latinos

There is a striking hole in the literature that is currently available regarding the level of mathematics anxiety individuals experience as it relates to race/ethnicity and, more specifically, there is a paucity of research about mathematics anxiety in Latinos (Suinn, Taylor, & Edwards, 1989). Latinos, for the most part, continue to be left out of the mathematics anxiety and mathematics anxiety measurement research (Alexander & Martray, 1989; Bowd & Brady, 2002; Hopko, Mahadevan, Bare, & Hunt, 2003; Levitt & Hutton, 1984; Llabre & Suarez, 1985; Plake & Parker, 1982). For example, Hopko and colleagues (2003) completed a well-designed validation study looking at the psychometric properties of an abbreviated version of the already established MARS. However, in their large sample size, only 2% identified as Latino or Hispanic (Hopko et al., 2003). Nevertheless, the scarcity of literature that does exist suggests that Latinos may have higher rates of math anxiety than do other ethnic groups. For example, in Hembree's (1990) meta-analysis, when Latinos were compared to European-American students, increased levels of math anxiety have been found in Latino college students. Additionally, Latino junior high school students also displayed higher levels of math anxiety when compared to other ethnic groups (Hsi, 1980). More recently, Clark (2005) compared math anxiety levels across different ethnicities and grades and found that Latinos in high school had significantly higher levels of mathematics anxiety when compared to previously established norms (Suinn, Taylor, & Edwards, 1988). Conversely, Suinn, Taylor, and Edwards (1989) did not discover math anxiety scores to vary between Latinos and European-Americans at the elementary school level.

Translating MARS from English to Spanish

In order to determine if mathematics anxiety is a factor in Latinos avoiding career paths in MSE majors and careers, it is critical that university educators, researchers, and counseling centers have a means of accurately and reliably measuring mathematics anxiety in a language- and culturally-sensitive manner. Previous research has shown that high quality Spanish translations of previously established psychological inventories in

English can be developed and established to be valid and reliable. For example, the Spanish version of the Beck Depression Inventory–II (BDI-II; Beck, Steer, & Brown, 1996) was demonstrated to have strong reliability with a Spanish-speaking population (Penley, Wiebe, & Nwosu, 2003). Suárez, García, & Moreno (2000) also demonstrated that a Spanish translation of the General Self-Efficacy Scale (Baessler & Schwarcer, 1996) had acceptable reliability and predicative value. Finally, Martinez and Cesar (1996) successfully translated the Statistical Attitude Survey (SAS; Roberts & Bilderback, 1980) to Spanish with as good reliability as English-language version of the SAS.

To the author's knowledge, there is no existing instrument that has been designed and psychometrically validated to measure mathematics anxiety in a Spanish-speaking Latino college population. However, studies have shown that MARS can be successfully translated from English to other languages without compromising the psychometric soundness of the original scale. Recently, Baloğlu (2005) demonstrated that a translation of the English-language MARS to a Turkish-language MARS had high internal consistency, good split-half reliability scores, and evidence for content and concurrent validity. Yoshihisa (1994) established that a Japanese-language version of the MARS had acceptable psychometric. Saigh and Khori (1983) demonstrated that the Mathematics Anxiety Rating Scale for Adolescents (MARS-A) can be translated into Arabic while retaining adequate psychometric properties and the MARS has been used successfully in a Korean-language version (Hwang, 1997). Developing a Spanish-language version of the Mathematics Anxiety Rating Scale – Short Version (MARS-SV) may provide researchers and clinicians with a culturally sound and psychometrically reliable means of measuring math anxiety in a Spanish-speaking population.

Mathematics Anxiety and Student Choices for Math-related Major and Career

Avoiding mathematics, science, or engineering (MSE) college majors or careers involving a significant quantitative or math-related component has been shown to be associated with mathematics anxiety (Lefevre, Kulak, & Heymans, 1992). Research suggests that there is an inverse relationship between mathematics anxiety and number of high school classes in mathematics completed, number of high school terms of Calculus completed, and performance in mathematics classes (Brush, 1978). Students who take more math classes in high school tend to perform better in college math courses, and in turn, have greater chances for selecting MSE careers (NSF, 1994). Students who are exposed to a breadth of mathematics classes in high school and college consequently have the capacity to broaden their accessibility of future careers in regards to available options (Alexander & Cobb, 1987), especially for MSE-related fields.

College students with moderate to high levels of mathematics anxiety tend to avoid college majors with significant quantitative prerequisites (Lefevre, Kulak, & Heymans, 1992). Ramirez (1985) found that Latinos who were pursuing low quantitative content majors, such as elementary teaching degrees, reported higher levels of mathematics anxiety than those who were not pursuing such college majors. Eccles (2005) points out that individuals who choose majors in particular fields expect to be successful and eventually master the material in that specific area. However, students who experience high levels of mathematics anxiety in high school or college don't expect to do well in those classes, will avoid college courses involving significant quantitative material, and will subsequently experience a reduction of choices for majors and careers, such as for the MSE fields (Hembree, 1990). It would be helpful for capable Latino and bilingual students who avoid quantitative-based high school classes, college majors, and MSE careers because of mathematics anxiety to be identified, and if possible, treated for anxiety and apprehension towards mathematics as the presence of mathematics anxiety might have lasting academic and career choice consequences.

Predictors of College Student Choices for Math-related Major and Career

In addition to mathematics anxiety having a significant relationship to college students choosing MSE-related majors and careers, the literature points out that other variables may also have predictive value. A comprehensive model used to predict individuals' educational and vocational choice that has previously been validated is the Expectancy Value Model (EVM; Eccles, 1994). The EVM takes into account individuals' personal interests, values, and expectations for success. For example, the model includes: previous academic achievement; perceptions of the actual task; input of parents, teachers, and mentors; and cultural norms. Eccles (2005) suggests that personal value (i.e., individual interest) for a domain-specific area is a significant predictor of college major, as is perceived value for the future (i.e., meeting future goals). Academic guidance during elementary, middle, and high school regarding participation in quantitative-related classes and career fields has also been presented to be an important variable in students' choosing specific college majors and careers (Eccles, 2005). Holt (2006) suggests that for many minorities, including Latinos, to persist in an MSE college major, the mediating factors are personal aspiration and self-confidence. Moreover, Rakow and Bermudez (1993) present an even broader list of potential variables that are suggested to be related to MSE career choice, some of which include: prior level of academic attainment, teacher influences, language of instruction, student learning styles, financial barriers, and career opportunity awareness. Further identifying variables with predictive value for students choosing an MSE major or career, specifically for Latino college students, may in the future be utilized to facilitate in reducing the existing underrepresentation of Latinos in MSE-related fields.

Objectives of the Current Study

The current study presents two general objectives. The first objective of the study is to create and psychometrically evaluate a Spanish-language version of the Mathematics Anxiety Rating Scale – Short Version (MARS-SV) and to compare these results with the English MARS-SV in relation to variables such as mathematics performance and mathematics avoidance behaviors. Therefore psychometric component of the primary objective will be examined through analyses of the reliability and factorial validity of the Spanish-language MARS-SV. Further, because the current study also sets out to determine if measuring math anxiety levels on the Spanish-language MARS-SV produces different results from levels on the English-language MARS-SV for English-Spanish bilingual college student participants, performances on the Spanish-language version are to be compared against the English-language version of the MARS-SV. This involves several additional analyses: (1) comparing the mean level of mathematics anxiety when the English-language scale is the measure versus the mean level of mathematics anxiety when the Spanish-language scale is the measure, and (2) computing the relationship between scores on the English-language scale and mathematics-relevant behaviors, such as mathematics performance and choice of mathematics major and career choices with similar analyses using scores from the Spanish-language scale. Results on both versions of the MARS-SV is compared in order to determine if one version is more valuable in studying how levels of math anxiety influences performance in math courses and/or selection of major and career.

The secondary objective involves an inquiry into mathematics background variables that might have predictive value for students selecting MSE-related majors and careers. Although mathematics anxiety has been widely studied as a variable influencing MSE careers among European-American college students, information regarding MSE vocational career choice, and specific variables that can be used as predictors remains absent in the literature when specifically looking at bilingual Latino college students (Brush, 1978). This general research question represents a secondary goal of the current project: an exploratory analysis of possible variables which could have an effect on bilingual Latino college students' choice of MSE majors and/or careers. The predictor variables of interest for the current study include the following: (1) past failure experiences with mathematics classes/courses, (2) inadequate preparation for mathematics majors/careers, (3) mathematics being perceived as stressful, (4) lack of guidance towards majors/careers in mathematics, (5) lack of interest in mathematics majors/careers, (6) value of mathematics-related majors/careers for the future, and (7) general dislike for mathematics.

CHAPTER II

METHOD

Participants

English-Spanish bilingual Latino undergraduate students from various majors were recruited from the University of Miami (UM) in Miami, Florida to participate in the current study. Participants were contacted and asked to volunteer via Dr. Victoria Noriega, Director of Undergraduate Studies and Academic Services for Psychology at UM, who has agreed to participate as a collaborator and outside consultant on this project. Inclusion criteria for participation in the current study included the following: (1) Ability to read in English and Spanish, (2) currently enrolled in classes at UM, and (3) over the age of 18.

Materials

The original Mathematics Anxiety Rating Scale (MARS; Richardson & Suinn, 1972) is a 98-item measure of mathematics anxiety which has become one of the most widely used by scholars studying mathematics anxiety (Ferguson, 1986). The MARS asks individuals to rate their level of anxiety using a 5-point Likert-type scale (1 = not at all, 5 = very much) with various situations involving mathematics. High scores on the scale reflect high levels of mathematics anxiety, whereas low scores on the MARS suggest lower levels of mathematics anxiety. Normative data describes a mean of 215.38 and a standard deviation of 65.29. Percentile ranks for raw scores include: 5% = 123;

20% = 156; 25% = 165; 40% = 189; 60% = 228; 75% = 255; 80% = 267; and 95% = 325 (Richardson & Suinn, 1972). Test-retest reliabilities have been reported to be .85 (Troy, 1980). Internal consistency alpha coefficients have been reported to be .97 (Richardson & Suinn, 1972; Rounds & Hendel, 1980). Construct validity was also evaluated by employing the Differential Aptitude Test (DAT) which revealed a correlation of –.64, suggesting that high anxiety scores were related to poor math performance (Richards & Suinn, 1972). Additional construct validity was obtained in a series of studies using the MARS to measure math anxiety pre- and post-treatment interventions designed to lower anxiety. The reduction in post-treatment MARS anxiety scores was interpreted as construct validation support (Richardson & Suinn, 1972). Subsequent studies using factor analysis on the original MARS has revealed two primary factors that pertain to mathematics courses or involve the use numerical manipulations (Kazelskis et al., 2000). Studying mathematics, learning mathematics, or being tested on mathematics was identified as one factor and computational concepts involving the actual manipulation of numbers was identified as a second factor (Rounds & Hendel, 1980). More recently, Bowd and Brady (2002) suggested the existence of three factors including: (1) Mathematics Test Anxiety (MTA), (2) Mathematics Course Anxiety (MCA), and (3) Numerical Task Anxiety (NTA). In their analyses, Bowd and Brady (2002) teased out studying/learning math and being tested on math as two separate factors, rather than one, and suggested that their three-factor model accounted for 73% of the variance.

Mathematics Anxiety Rating Scale – Short Version (MARS-SV). Suinn and Winston (2003) recently developed and tested a truncated 30-item version of the original MARS (Appendix A) as a response to the need for a more efficient means of measuring mathematics anxiety regarding administration time, as suggested by various researchers (Plake & Parker, 1982; Rounds & Hendel, 1980; Alexander & Martray, 1989). The 30 items were directly taken from the original 98-item MARS and data confirm that the MARS-SV correlates significantly with the original MARS (r = .92), has high internal consistency (α = .96), and has strong test-retest reliability (r = .90) at a 1-week interval (Suinn & Winston, 2003). The MARS-SV revealed similar factor loadings for the 98-item MARS as demonstrated by previous research (Rounds & Hendel, 1980; Alexander & Cobb, 1987; Alexander & Murray, 1989). To the author's knowledge normative data is not yet available for the MARS-SV.

Spanish Translation of the Mathematics Anxiety Rating Scale – Short Version (MARS-SV). In order to achieve one of the purposes of this study, a Spanish-language version of the MARS-SV was developed (Appendix B). All 30 items from the English version of the MARS-SV were translated from English to Spanish by a professionally-certified Spanish-translator affiliated with the University of Miami. Once translated from English to Spanish, the 30 items were subsequently back-translated by a certified translator in order to increase the accuracy and language validity of the translation.

Brief Demographic Questionnaire (BDQ). A brief demographic questionnaire covering routine information (Appendix C) such as age, gender, and major was also administered. The BDQ includes questions which are intended to facilitate validation of the Spanish-language MARS-SV by comparing the MARS-SV results against performance in prior mathematics courses. This approach has been one standard method for validation of the English version of the MARS in prior research (Suinn & Winston, 2003). Hence the BDQ included questions regarding: previous grades in high school mathematics classes, number of mathematics classes completed in high school, grades in mathematics courses taken in college, number of courses completed in college, and major or planned major in college.

Mathematics Background Questionnaire (MBQ). The MBQ includes several items surveying an interest for mathematics-related careers, perceptions toward mathematics, and previous experiences with mathematics (Appendix D).

Procedure

Participants were asked to volunteer for the study with the help of Dr. Victoria Noriega using the UM Department of Psychology's research subjects pool and procedures. This project received full approval from the University of Miami's Socail and Behavioral Sciences Institutional Review Board. Research assistants aiding in administration were provided with a written standardized protocol (Appendix E) in order to ensure that administration tasks were performed in a uniform manner. Administration instructions were made available in Spanish (Appendix F) for Spanish-dominant students who prefer to receive instructions in Spanish. Administration took place in a medium sized classroom and group sizes varied depending on attendance. The duration for completion of the BDQ, MBQ, English MARS-SV, and Spanish MARS-SV varied in time, but was no longer than 45 minutes, depending upon the students' speed of reading and ability to answer questions on the instruments. Once basic instructions were read, participants worked independently as materials were specifically designed to be self-administering; however, study administrators were made available in case study participants had any questions regarding the questionnaires. Pencils were provided so that students without a pen or pencil could complete the questionnaires. The order in which scales were administered was randomized in order to avoid the possibility of any order effects, including participant fatigue. Arbitrarily assigned numerical codes were utilized for the dual purpose of identifying materials to remain in complete packets (i.e., scale versions, MBQ, BDQ) and retaining participants' anonymity and confidentiality. The co-PI was present during initial data collection sessions in order to supervise study procedures, address any questions that were raised, and debrief participants. Once procedures were deemed to be operating without any problems, the co-PI subsequently trained and supervised a research assistant with a baccalaureate degree in psychology to continue administering questionnaires. Once the co-PI was assured of the research assistant's ability to follow standardized procedures and field any questions, he was given responsibility to run his own sessions.

Proposed Objectives, Hypotheses, and Related Analyses

Primary Objective 1a: Psychometric Evaluation of the Spanish-language MARS-SV

Validity: Factorial Structure of the Spanish MARS-SV

Hypothesis 1a. It is predicted that the Spanish MARS-SV will demonstrate a comparable factorial structure as previous research does with the English MARS-SV. Confirmatory factor analysis using Principal Components Analysis (PCA) and a Varimax rotation will be employed to test this hypothesis. It is expected that results will support that the majority of the variance in the MARS-SV could be explained by a two-factor model including: (1) Mathematics Test Anxiety (MTA), and (2) Numerical Task Anxiety (NTA). However, because some literature also supports a three-factor model, a third factor, Mathematics Course Anxiety (MCA) is also expected (Alexander & Martray, 1989; Bowd & Brady, 2002).

Hypothesis 1b. It is predicted that the English MARS-SV will significantly correlate in a positive direction with the Spanish MARS-SV. A Pearson product-moment correlation will be employed to test this hypothesis.

Hypothesis 1c. It is predicted that individual items from the English MARS-SV will positively correlate with individual items from the Spanish MARS-SV. Pearson product-moment correlations will be employed to test this hypothesis.

Reliability: Internal reliability coefficient

Hypothesis 2a. It is predicted that the English MARS-SV will have acceptable internal consistency. Internal consistency of the English MARS-SV will be tested with a reliability analysis and reported with a Cronbach's alpha coefficient.

Hypothesis 2b. It is predicted that the Spanish MARS-SV will have acceptable internal consistency. Internal consistency of the Spanish MARS-SV will be tested with a reliability analysis and reported with a Cronbach's alpha coefficient.

Primary Objective 1b: Performance on English-language Versus Spanish-language MARS-SV scales

Comparison of Math Anxiety Mean Scores, English versus Spanish Scales

Hypothesis 3a. It is predicted that the mean total scores for the English MARS-SV will not vary from the mean total scores for the Spanish MARS-SV. Total score differences between the English MARS-SV and the Spanish MARS-SV will be tested utilizing a Paired-Samples *t*-test. Differences in the total scores of the two scales by the same sample will suggest that there is a different response pattern possibly as a function of language. This method of comparing means within a bilingual sample has been used in previous studies for the purpose of validating a translation of an already established measure (e.g., Penley, Wiebe, & Nwosu, 2003).

Hypothesis 3b. It is predicted that no item-specific mean differences between the English MARS-SV and the Spanish MARS-SV will be revealed. Item-by-item differences in means will be tested utilizing an additional 30 separate Paired-Sample *t*-tests. This analysis will allow for specific items that participants respond to in a different manner as a function of language to be identified and further investigated.

Comparison of Results of Math Anxiety and Performance in Math Classes

Hypothesis 4a. It is predicted that math anxiety will be negatively correlated with performance in college math courses. For the purposes of the current study, math performance will be operationalized as grades earned in math courses as self-reported on the BDQ. It is expected that a high level of math anxiety will associated with decreased performance in college math courses. This will be tested using a Pearson product-moment correlation.

Hypothesis 4b. It is predicted that math anxiety will be negatively correlated with performance in high school math classes. For the purposes of the current study, math performance will be operationalized as grades earned in math high school classes as self-reported on the BDQ. It is expected that a high level of math anxiety will be associated with decreased performance in high school math. This will be tested using a Pearson correlation.

Comparison of Results on College Math Avoidance Behaviors

Hypothesis 5a. It is predicted that level of math anxiety will be negatively correlated with math-related major; that is, a high level of math anxiety will be associated with participants choosing non-math-related majors. In order to test this hypothesis, non-math-related majors will be assigned a "0" and math-related majors will be assigned a "1" according to the amount of math involved in obtaining a degree in a particular field (e.g., art history = 0; physics = 1). Point-biserial correlations will be employed to test this hypothesis.

Hypothesis 5b. It is predicted that level of math anxiety will be negatively correlated with math-related career choice; that is, a high level of math anxiety will be associated with participants choosing non-math-related careers. In order to test this hypothesis, non-math-related careers will be assigned a "0" and math-related careers will be assigned a "1" according to the amount of math involved in that particular field (e.g., social work = 0; engineering = 1). Point-biserial correlations will be employed to test this hypothesis.

Hypothesis 5c. It is predicted that math anxiety will be significantly correlated in a negative direction with number of math courses completed in college plus the number of math courses the student is planning on completing. It is expected that a high level of math anxiety is associated with math avoidance behaviors and therefore a decreased number of completed college courses in math. This will be tested using a Pearson correlation.

Hypothesis 5d. It is predicted that there will be a significant difference between high math anxious (HMA) students and low math anxious (LMA) students when math avoidance behaviors are compared. For the purposes of the proposed hypothesis, math avoidance behaviors will be operationalized as the total number college of math courses students completed. It is expected that HMA students will have increased math avoidance behaviors than individuals in the LMA group. This hypothesis will be tested using a one-way Analysis of Variance (ANOVA).

Comparison of Results on Math Anxiety and High School Math Avoidance Behaviors

Hypothesis 6a. It is predicted that math anxiety will be significantly correlated in a negative direction with the number of math courses completed in high school. It is expected that a high level of math anxiety is associated with math avoidance behaviors and therefore a decreased number of completed high school courses in math. This will be tested using a Pearson product-moment correlation.

Hypothesis 6b. It is predicted that there will be a significant difference between high math anxious (HMA) students and low math anxious (LMA) students when math avoidance behaviors are compared. For the purposes of the proposed hypothesis, math avoidance behaviors will be operationalized as the total number of high school math courses students completed. It is expected that HMA students will have increased math avoidance behaviors than individuals in the LMA group. This hypothesis will be tested using a one-way Analysis of Variance (ANOVA).

Secondary Objective: Exploratory Analysis of Possible Variables Influencing Vocational Choice

The Mathematics Background Questionnaire (MBQ) items will be examined as predictors for students pursuing a math or non-math related major and a math or non-math related career. The MBQ items covered seven factors: (1) past failure experiences, (2) inadequate preparation, (3) math perceived as stressful, (4) lack of guidance, (5) lack of interest, (6) perceived value for the future, and (7) dislike for math.

For the following exploratory analysis, specific hypotheses for the predictive power of individual variables will not be made given the wide range of predictors that have been suggested for college students choosing majors with and without a significant quantitative component (see Chapter I for literature review). In order to test the predictability of items from the MBQ, a Binary Logistic Regression using the forced entry method will be employed. Two dependent variables were studied: choice of college major, and choice of future career.

Hypotheses 7a. This hypothesis explores which independent factors from the MBQ surface as significant predictors of choice of college major.

The self-reported college major will be used as the dichotomous dependent variable and the MBQ items as independent variables. College majors excluding a significant quantitative component (i.e., art, literature) will be coded as"0" and college majors including a considerable quantitative component (i.e., physics, math) will be coded "1."

Hypothesis 7b. This hypothesis explores which independent factors from the MBQ surface as significant predictors of choice of future career.

The self-reported future career was used as the dichotomous dependent variable. Careers excluding a significant quantitative component (i.e., social work, nursing) will be coded "0," and conversely, careers including a significant quantitative component (i.e., accounting, chemistry) will be coded "1."

CHAPTER III

RESULTS

Participant Demographics

One hundred four University of Miami students (24 men and 80 women), from different classes (65 freshmen, 12 sophomores, 19 juniors, and 8 seniors) with a mean age of 19.06 (*SD* = 1.54) volunteered to participate in the current study. Participants were English-Spanish bilingual students able to read in Spanish and 53% were non-MSE majors. Participants lived in the United States an average of 14.71 years (*SD* = 6.35) and countries of origin included the United States and a wide range of Latin American countries (Table 1).

Proposed Objectives, Hypotheses, and Related Analyses

<u>Primary Objective 1a: Psychometric Evaluation of the Spanish-language MARS-SV</u>

Descriptive Statistics of the English and Spanish MARS-SV

English MARS-SV total scores ranged from 32-104, with a mean of 61 (*SD* = 16.0) and a median of 61. Percentile ranks for raw scores include: 10% = 41; 25% = 49; 50% = 61; 75% = 70; 90% = 85. Item means ranged from 1.11 (Watching someone work with a calculator) to 3.33 (Thinking about an upcoming test five minutes before) with higher scores indicating higher math anxiety levels. Table 2 presents English MARS-SV item means and standard deviations for the current sample. A histogram displaying the distribution of total scores, along with a normal curve, for the English MARS-SV is provided in Figure 1.

Table 1

Participants' Countries of Origin

Country	Frequency	Percent
United States	61	58.7
Columbia	11	10.6
Cuba	10	9.6
Mexico	4	3.8
Venezuela	4	3.8
Peru	3	2.9
Puerto Rico	3	2.9
Dominican Republic	2	1.9
Argentina	2	1.9
Panama	1	1.0
Uruguay	1	1.0
Spain	1	1.0
Brazil	1	1.0

Spanish MARS-SV total scores ranged from 33-102, with a mean of 61 (*SD* = 16.4) with a median of 59. Percentile ranks for raw scores include: 10% = 42; 25% = 49; 50% = 61; 75% = 71; 90% = 87. Table 3 presents means and standard deviations for the Spanish MARS-SV for the current sample.

Table 2

English MARS-SV Means, Standard Deviations, and Percentage of Students Endorsing Some Anxiety on Specific Items

Item	*M*	*SD*	%	Item	*M*	*SD*	%
1	3.14	1.11	93.3	16	1.60	.90	32.7
2	2.33	.97	78.0	17	1.13	.40	11.5
3	3.07	1.14	93.3	18	1.13	.44	10.6
4	3.30	1.18	94.2	19	1.37	.66	30.0
5	3.33	1.23	95.2	20	1.50	.74	38.0
6	2.92	1.30	84.6	21	1.20	.56	14.4
7	2.77	1.34	81.7	22	2.10	1.15	66.0
8	2.44	1.30	70.2	23	1.55	.74	42.3
9	3.20	1.22	92.3	24	2.01	1.07	60.0
10	2.24	1.06	71.2	25	1.70	.95	47.1
11	2.84	1.25	85.6	26	1.60	.76	44.2
12	2.48	1.09	82.7	27	1.11	.42	7.7
13	1.50	.78	35.6	28	1.45	.70	36.0
14	2.70	1.27	81.7	29	1.18	.41	17.3
15	2.00	1.00	60.6	30	1.20	.51	16.3

Note. Percentage endorsing some anxiety are for those who reported a ≥ 2 for that item.

Item means ranged from 1.12 (Reading a cash register receipt after your purchase) to 3.31 (Thinking about an upcoming test five minutes before). A histogram displaying the distribution of total scores, along with a normal curve, for the Spanish MARS-SV is provided in Figure 2. For both the English and Spanish MARS-SV respondents rated "Thinking about an upcoming test five minutes before" as producing the most anxiety. Table 4 presents a comprehensive listing of percentile ranks scores for English and Spanish MARS-SV, as well as a comparison of percentile scores to the original MARS-SV normative group scores in Suinn and Winston (2003).

Validity: Factorial Structure of the Spanish MARS-SV

Hypothesis 1a. The well-established literature base for the factorial structure of the MARS and MARS-derived scales led the current study to predict that the Spanish MARS-SV would be composed of the same factorial structure as previous research found with the English MARS-SV. It was expected that results would support that the majority of the variance in the MARS-SV could be explained by a two-factor model including: (1) Mathematics Test Anxiety (MTA) and (2) Numerical Task Anxiety (NTA). However, because recent literature also supports a three-factor model, a third factor, Mathematics Course Anxiety (MCA), was also expected as a component (Bowd & Brady, 2002).

Prior to completing the factor analysis, certain measures were taken into consideration to assess the suitability of applying a factor analysis to the current data. First, Kaiser's criterion, or only accepting factors with eigenvalues larger than 1.0 was applied to the current analysis. Second, a Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy was applied to the data. The KMO index ranges in value from zero

Table 3

Spanish MARS-SV Means, Standard Deviations, and Percentage of Students Endorsing Some Anxiety on Specific Items

Item	*M*	*SD*	%	Item	*M*	*SD*	%
1	2.93	1.11	91.3	16	1.60	.89	37.5
2	2.23	1.05	72.1	17	1.15	.44	12.5
3	3.07	1.05	96.2	18	1.12	.38	9.6
4	3.28	1.21	96.2	19	1.43	.71	34.6
5	3.31	1.27	94.2	20	1.46	.64	39.4
6	2.86	1.25	89.4	21	1.36	.64	27.9
7	2.71	1.29	81.7	22	2.21	1.14	68.3
8	2.34	1.20	71.2	23	1.48	.72	36.5
9	3.19	1.18	94.2	24	1.96	1.05	36.5
10	2.13	.94	71.3	25	1.70	.94	47.1
11	2.73	1.27	83.7	26	1.56	.77	41.3
12	2.48	1.04	85.6	27	1.14	.58	7.7
13	1.43	.60	37.5	28	1.49	.71	37.5
14	2.63	1.23	80.8	29	1.17	.43	15.4
15	1.97	.97	64.4	30	1.18	.46	15.4

Note. Percentage endorsing some anxiety are for those who reported a ≥ 2 for that item.

Table 4

Percentile Scores of the English and Spanish MARS-SV Compared to Normative Group Scores

Percentile	English MARS-SV	Spanish MARS-SV	Normative Group*
5	37	37	34
10	41	42	37
20	48	47	43
25	49	49	46
35	54	53	51
40	55	54	55
50	61	61	59
60	65	64	65
70	68	69	74
75	70	71	78
80	75	74	84
85	80	82	90
90	85	87	97
95	93	95	108
99	104	102	120

* Source: Suinn & Winston, 2003.

to one. A .6 or greater is typically suggested as the minimum value for an adequate factor analysis (Tabachnick & Fidell, 2001). The Spanish MARS-SV data revealed a KMO index of .85 suggesting a more than adequate index for a factor analysis. Third, a Bartlett's Test of Sphericity, $\chi^2(435) = 1948.39$, $p < .001$, which also confirms that a factor analysis can be performed with the data at hand, suggested that the Spanish MARS-SV data was satisfactory for a factor analysis. And lastly, Catell's Scree Test (Catell, 1966) was employed to determine which factors in the Spanish MARS-SV contributed most in explaining the variance. Catell's Scree Test is completed by plotting eigenvalues of the factors involved in the instrument and examining the plot to determine at which point the curve changes to a more horizontal direction. Catell recommends utilizing only those factors above the change in direction on the plot as this suggests that components begin to account for increasing levels of variance (Figure 3), and hence have larger eigenvalues. The Scree Test for the current analysis suggested retaining three components for explaining the majority of the variance in the scale.

Confirmatory factor analysis using Principal Components Analysis (PCA) and a subsequent Varimax rotation revealed that Mathematics Test Anxiety (MTA), Numerical Test Anxiety (NTA), and Mathematics Course Anxiety (MCA) accounted for 22.16%, 19.43%, and 11.62% (Total = 53.21%) of the variance, respectively. Detailed lists of the factor loadings for the components MTA, NTA, and MCA with absolute values greater than .3 are shown in Table 5. A comprehensive list of all factor loadings is provided in Appendix G. Regarding hypothesis 1a, it can therefore be concluded that the three-factor model (i.e., MTA, NTA, and MCA) explains the majority of the variance in the Spanish-language MARS-SV.

Table 5

Varimax Rotated Component Loadings for Math Test Anxiety, Numerical Test Anxiety, and Math Course Anxiety

	Component		
Spanish MARS-SV Items	MTA	NTA	MCA
3	.882		
4	.852		
5	.795		
1	.785		
12	.697		.366
2	.693		
7	.668		
10	.654		.370
6	.645		
15	.639		.360
9	.572		.383
17		.782	
16		.742	
30		.739	
28		.685	
21		.663	
18		.633	
23		.631	
22	.322	.625	
19		.610	.302
29		.593	
24		.559	.470
20		.448	.347
14			.702
13	.315		.604
8	.429		.524
26		.380	.522
25		.393	.494
11	.400	.332	.487
27		.351	.450

Note. Extraction method was Principal Components Analysis (PCA). For complete list of Spanish MARS-SV items, refer to Appendix B.

Hypothesis 1b. It was predicted that the English MARS-SV would correlate significantly in a positive direction with the Spanish MARS-SV. A Pearson product-moment correlation revealed a robust positive correlation, $r(103) = .95$, $p < .001$. This result suggests that there is a strong relationship between the two measures in the two different languages.

Hypothesis 1c. It was predicted that individual items from the English MARS-SV would correlate in a positive direction with individual items from the Spanish MARS-SV. Pearson product-moment correlations were employed to test this hypothesis and results are displayed in Table 6. Results showed that individual items in the English and Spanish MARS-SV are strongly related as every inter-item correlation reached significance at less than the .01 level.

Reliability: Internal Reliability Coefficient

Hypothesis 2a. It was predicted that the English MARS-SV would have acceptable internal consistency using Cronbach's alpha coefficient. Results showed the internal reliability coefficient to be .93 for the English MARS-SV. This finding is consistent with other studies and also demonstrates the reliability of the English MARS-SV with a bilingual student sample.

Hypothesis 2b. It was predicted that the Spanish MARS-SV would also have acceptable internal consistency using Cronbach's alpha coefficient. Results showed the internal reliability coefficient to be .93 for the Spanish MARS-SV. This confirms that the Spanish MARS-SV with a bilingual sample has acceptable reliability.

Table 6

Intercorrelations Between Individual Item-Pairs of the English and Spanish MARS-SV

Item-Pair	Correlation (*r*)	Item-Pair	Correlation (*r*)
E1-S1	.78*	E16-S16	.67*
E2-S2	.81*	E17-S17	.89*
E3-S3	.77*	E18-S18	.78*
E4-S4	.82*	E19-S19	.84*
E5-S5	.86*	E20-S20	.70*
E6-S6	.83*	E21-S21	.42*
E7-S7	.75*	E22-S22	.86*
E8-S8	.86*	E23-S23	.78*
E9-S9	.86*	E24-S24	.86*
E10-S10	.64*	E25-S25	.76*
E11-S11	.87*	E26-S26	.79*
E12-S12	.73*	E27-S27	.82*
E13-S13	.70*	E28-S28	.76*
E14-S14	.89*	E29-S29	.75*
E15-S15	.74*	E30-S30	.78*

Note. E = English, S = Spanish. $^*p < .01$.

Primary Objective 1b: Performance on English-language Versus Spanish-language MARS-SV scales

Comparison of Math Anxiety Mean Scores, English versus Spanish Scales

Hypothesis 3a. It was predicted that the mean total score for the English MARS-SV would not vary from the mean total score for the Spanish MARS-SV. Utilizing a Paired-Samples t-test, the current study found no evidence of total score differences between the English MARS-SV ($M = 61.47$, $SD = 15.96$) and the Spanish MARS-SV ($M = 60.89$, $SD = 15.99$; $t = 1.14$ (102), $p > 05$). Therefore, it can be concluded that the English and Spanish MARS-SV results are comparable. Hence the language in which math anxiety is measured for this bilingual student sample did not affect their assessed level of anxiety.

Hypothesis 3b. It was predicted that no item-specific mean differences between the English MARS-SV and the Spanish MARS-SV would be observed. Item-by-item differences in means were tested utilizing 30 separate Paired-Sample t-tests and differences were observed in only four of the 30 items or 13% of the total items. Items that differed significantly were test item pairs: #1 (Taking an examination (final) in a math course), #16 (Dividing a five digit number by a two digit number in private with pencil and paper), #21 (Being given a set of numerical problems involving addition to solve on paper), and #22 (Having someone watch you as you total up a column of figures)(see Discussion for possible explanations). Results for all of the Paired-Sample t-tests comparing item means across language, including those with significant differences, are shown on Table 7 in Appendix H. Results suggest that for the majority of items (87%) the English and Spanish MARS-SV are adequately comparable.

Comparison of Results of Math Anxiety and Performance in Math Classes

Hypothesis 4a. It was predicted that math anxiety would be correlated in a negative direction with performance in college math courses. For the purposes of the current study, math performance in college was operationalized as grades earned in math courses as self-reported on the Brief Demographic Questionnaire (BDQ) and was tested using a Pearson product-moment correlation. The current study failed to find a relationship between math anxiety as measured by the English MARS-SV and math performance in college courses (see Discussion for explanation considering small sample sizes for each of the categories) when considered individually. Results are shown in Table 8. These findings do not support the hypothesis that mathematics anxiety on the English MARS-SV has a significant influence on math performance in individual college math courses, perhaps due to the small sample sizes. However, when an aggregate score for math performance was calculated averaging grades earned in college algebra and trigonometry – data with the largest number respondents – a significant negative correlation was found, $r(11) = -.55$, $p < .05$, although still with a small sample size. The current study found a significant negative correlation between math anxiety and performance in college level Finite math when the Spanish MARS-SV was used as a measure of math anxiety (Table 9). The current study failed to find a relationship between math anxiety as measured by the Spanish MARS-SV and performance in other individual college courses (see Discussion for explanation considering small sample sizes in each of the categories). Results are shown in Table 9. Therefore, these findings do not support the hypothesis that mathematics anxiety has a significant influence on math performance in individual college math course, perhaps due to the small sample sizes.

Table 8

Correlations Between Performance in College Math Courses and English MARS-SV

Math Course	*r*	*p*	n
Finite	-.57	.07	8
Algebra I	-.30	.09	22
Algebra II	-.53	.32	3
Trigonometry	.31	.31	5
Pre-calculus	.27	.17	14
Calculus I	-.02	.47	17
Calculus II	-.35	.16	10
Statistics	.14	.36	13
Aggregate	-.55	<.05	11

However, when an aggregate score for math performance was calculated averaging grades earned in college algebra and trigonometry, a significant negative correlation was observed, $r(11) = -.58, p < .05$, but, the sample size for this analysis remained small.

Hypothesis 4b. It was predicted that math anxiety would be correlated in a negative direction with performance in high school math. For the purposes of the current study, math performance was operationalized as grades earned in math high school classes self-reported on the BDQ. It was expected that a high level of math anxiety would be associated with decreased performance in high school math and was tested using a Pearson product-moment correlation. The current study found no significant

Table 9

Correlations Between Performance in College Math Courses and Spanish MARS-SV

Math Course	*r*	*p*	n
Finite	-.70	.03	8
Algebra I	-.20	.19	22
Algebra II	-.37	.38	3
Trigonometry	.23	.36	5
Pre-calculus	.23	.21	14
Calculus I	.29	.20	17
Calculus II	.40	.13	10
Statistics	.21	.25	13
Aggregate	.58	<.05	11

correlations between performance in individual high school math classes and level of math anxiety as measured by the English MARS-SV (Table 10). In addition, the current study did not find any significant relationship between any aggregate high school math performance score and the English MARS-SV, $r(66) = .03$, $p > .05$ (see Discussion for an explanation of a possible ceiling effect with math performance). Therefore, these findings do not support the hypothesis that mathematics anxiety has a significant influence on math performance in high school classes.

Additionally, the current study found no significant correlations between performance in individual high school math classes and level of math anxiety as

Table 10

Correlations Between Performance in High School Math and English MARS-SV

Math Class	*r*	*p*	n
Algebra I	-.04	.37	71
Geometry	-.09	.20	88
Algebra II	-.06	.30	84
Trigonometry	.04	.40	50
Analytical Geometry	-.11	.32	19
Calculus I	-.03	.43	45
Calculus II	-.19	.20	22

measured by the Spanish MARS-SV. Results are shown in Table 11. Lastly, the current study did not find any significant relationship between any aggregate high school math performance score and the Spanish MARS-SV, $r(66) = .05$, $p > .05$ (see Discussion for an explanation of a possible ceiling effect with math performance). Therefore, these findings do not support the hypothesis that mathematics anxiety has a significant influence on math performance in high school classes.

Comparison of Results on College Math Avoidance Behaviors

Hypothesis 5a. It was predicted that level of math anxiety would be negatively correlated with math-related major; that is, a high level of math anxiety would be associated with participants choosing non-math-related college majors. In order to test this hypothesis, non-math-related college majors were assigned a "0" and math-related

Table 11

Correlations Between Performance in High School Math and Spanish MARS-SV

Math Class	*r*	*p*	n
Algebra I	-.03	.41	72
Geometry	-.10	.17	89
Algebra II	-.03	.34	85
Trigonometry	.12	.20	50
Analytical Geometry	-.07	.40	19
Calculus I	-.11	.24	45
Calculus II	-.06	.40	22

college majors were assigned a "1" according to the amount of math involved in obtaining a degree in a particular field (e.g., art history = 0; physics = 1).

Point-biserial correlations suggested a small, but significant relationship between level of mathematics anxiety and college major choice, $r_{pb}(103)$, -.17, $p < .05$, when the English MARS-SV was used as a measure of math anxiety. In addition, a small but significant negative correlation was also found between college major choice and math anxiety when the Spanish MARS-SV was used as a measure of math anxiety to test the hypothesis, $r_{pb}(104)$, -.20, $p < .05$. These findings suggest that those with higher math anxiety tend to avoid college majors with a focus on quantitative coursework. Furthermore, the findings suggest that math anxiety measured in Spanish and English yield similar results.

Hypothesis 5b. It was predicted that level of math anxiety would be negatively correlated with math-related future career choice; that is, a high level of math anxiety would be associated with participants choosing non-math-related future careers. In order to test this hypothesis, non-math-related careers were assigned a "0" and math-related careers were assigned a "1" according to the amount of math involved in that particular field (e.g., social work = 0; engineering = 1). Point-biserial correlations suggested no evidence for there being a relationship between future career interests and math anxiety using either the English MARS-SV, $r_{pb}(103)$, -.12, $p > .05$ or the Spanish MARS-SV, $r_{pb}(104)$, -.13, $p > .05$ as measures of math anxiety. These findings do not support the hypothesis that mathematics anxiety has a significant influence on future career choices for Hispanic college students in this sample.

Hypothesis 5c. It was predicted that math anxiety would be significantly correlated in a negative direction with number of math courses completed in college plus the number of math courses the student is planning on completing. It was expected that a high level of math anxiety would be associated with math avoidance behaviors, and therefore a decreased number of completed or planned college courses in math. A Pearson product-moment correlation was used to test this hypothesis and no relationship was observed, $r(104) = -.06$, $p > .05$ when the English MARS-SV was used as a measure of math anxiety. Additionally, when the Spanish MARS-SV was employed as the measure of math anxiety, the current study was unable to observe any relationship, $r(104) = -.08$, $p > .05$ therefore providing no support for the hypothesis that math anxiety would be associated with avoidance of college courses with mathematical content.

Hypothesis 5d. It was predicted that there would be a significant difference between high math anxious (HMA) students and low math anxious (LMA) students in the amount of college math courses completed and planning on completing. A median split was used in order to group students into the HMA and LMA groups. It was expected that HMA group would have increased math avoidance behaviors by completing and/or planning on completing less college math courses than the LMA group. A one-way Analysis of Variance (ANOVA) did not reveal differences between the HMA ($M = 2.09$, $SD = 1.26$) group and the LMA ($M = 2.27$, $SD = 1.23$) group, $F(1, 103) = .54, p > .05$ when comparing total number of college math courses completed and/or planning on completing and using the English MARS-SV as a measure of math anxiety. Similarly, when employing the Spanish MARS-SV as the measure of math anxiety, results suggested insignificant differences between the HMA group ($M = 2.06$, $SD = 1.26$) and the LMA group ($M = 2.31$, $SD = 1.23$), $F(1,103) = 1.05, p > .05$.

Comparison of Results on Math Anxiety and High School Math Avoidance Behaviors

Hypothesis 6a. It was predicted that math anxiety would be significantly correlated in a negative direction with the number of math courses completed in high school. It was expected that a high level of math anxiety would be associated with math avoidance behaviors and therefore a self-reported decreased number of completed high school courses in math. A Pearson product-moment correlation was used to test this hypothesis and no relationship was observed when math anxiety was measured with the English MARS-SV, $r(104) = .01, p > .05$, or with the Spanish MARS-SV, $r(103) = .02, p > .05$. These results failed to support the hypothesis that math anxiety is not associated with avoidance of high school classes with mathematical content.

Hypothesis 6b. It was predicted that there would be a significant difference between high math anxious (HMA) students and low math anxious (LMA) students regarding the number of high school math classes completed. A median split was used in order to group students into the HMA and LMA groups. It was expected that the HMA group would have completed significantly less high school math classes than individuals in the LMA group. A one-way Analysis of Variance (ANOVA) revealed that HMA students ($M = 4.02$, $SD = 1.25$) and LMA ($M = 4.06$, $SD = .77$), $F(1, 103) = .04$, $p > .05$ displayed no differences in the number of high school math classes completed when using the English MARS-SV as a measure of math anxiety. Similarly, when employing the Spanish MARS-SV as the measure of math anxiety, results suggested insignificant differences between the LMA group ($M = 3.96$, $SD = .97$) and the HMA group ($M = 4.12$, $SD = 1.11$), $F(1,103) = .56$, $p > .05$ in total number of high school math classes completed.

Secondary Objective: Exploratory Analysis of Possible Variables Influencing Vocational Choice

For the following analyses, the Mathematics Background Questionnaire (MBQ) items were examined to identify possible predictors for students pursuing a math or non-math related major and a math or non-math related career. Although the MBQ originally included eight items asking the participant to rate on a 5-point scale specific experiences with mathematics (see Appendix D), the following analyses uses only seven of the eight variables. Two of the items, item #1 (I tried math and did not do well) and item #8 (I tried math in high school and did not do well) were strongly correlated, $r(89) = .70$, $p < .001$. Tabachnick and Fidell (2001) recommend that when using independent variables as predictors, it is preferable not to have predictors be highly correlated so that predictors with correlations greater than .70 be consolidated into the same predictor. For this reason, items #1 and #8 were collapsed into one predictor called "past failure experiences." Hence, the seven predictor variables used in the following regression model are: (1) past failure experiences, (2) inadequate preparation, (3) math perceived as stressful, (4) lack of guidance, (5) lack of interest, (6) perceived value for the future, and (7) dislike for math.

Hypotheses 7a. For the following exploratory analysis, specific hypotheses for the predictive power of individual variables were not made given the wide range of predictors that have been suggested for college students choosing majors with and without a significant quantitative component (see Chapter I for literature review). In order to test the predictability of the seven variables, a Binary Logistic Regression using the forced entry method was employed. The self-reported college major was used as the dichotomous dependent variable and the seven MBQ items corresponding to the above constructs as independent variables. College majors excluding a significant quantitative component (i.e., art, literature) were coded as"0" and college majors including a considerable quantitative component (i.e., physics, math) were coded "1."

Prior to completing the Binary Logistic Regression analysis to predict college major, certain precautions to ensure that the data was adequate for use as predictors were taken into account. First, multicollinearity, or the extent to which the predictor variables correlate with each other was assessed. For a Binary Logistic Regression it is preferable not to have a great deal of multicollinearity (Pallant, 2005). Except for two items in the MBQ, item one and item eight which were collapsed into one, the present data met the requirements for the multicollinearity assumption. MBQ items one/eight combined, two, three, four, five, six, and seven all obtained inter-correlations that did not exceed the recommended .70 (Tabachnick & Fidell, 2001) when using variables as predictors. In addition, two other values to assure that assumptions for the analysis were not being violated were calculated. The Tolerance value is a measure of the amount of variability in the model for a specified independent variable that is not explained by another variable. Tolerance values less than .10 are typically indicative of present multicollinearity among the independent variables (Pallant, 2005). For the current analysis, all values were above .45 (Table 12) suggesting the predictors' suitability for placement into a regression model. Finally, the Variance Inflation Factor (VIF) was also calculated to determine adequacy of the predictors for the regression model. The VIF is similar to the Tolerance value in that it checks for multicollinearity. Any VIF values over 10 are typically considered problematic for placement into a regression model. All of the MBQ predictors for the current analysis were well below a 10 (Table 12) suggesting that the set of predictors are adequate for placement into a regression model.

Results of the Binary Logistic Regression for seven predictor variables for math or non-math major including: (1) past failure experiences, (2) inadequate preparation, (3) math perceived as stressful, (4) lack of guidance, (5) lack of interest, (6) value for the future, and (7) dislike for math are presented in Table 13. An Omnibus Test of Model Coefficient which tests the overall performance of the model entered using a chi-square goodness of fit value suggests adequate viability for the model entered, $\chi^2 = 27.33, p < .001$. In addition, a Hosmer and Lemeshow Goodness of Fit Test supports the entered model, which is indicated by a significance level greater than .05, $\chi^2 = 5.28, p > .05$.

Table 12

Multicollinearity Assessment for Adequacy of Predictor Variables of the MBQ

MBQ Item	Construct	Tolerance	VIF
1/8	Past failure experience	.49	2.03
2	Inadequate preparation	.59	1.67
3	Math perceived as stressful	.52	1.92
4	Lack of guidance	.84	1.19
5	Lack of interest	.63	1.58
6	Value for the future	.69	1.46
7	Dislike for math	.45	2.20

Note. MBQ = Mathematics Background Questionnaire, VIF = Variance Inflation Factor. All Tolerance levels > .10, All VIF levels < 10.

The current study suggests that, in ranked order of relative predictive power, the following variables contribute to the predictive ability for college students choosing between a math and a non-math major: math perceived as stressful (Wald = 6.18), perceived value for the future (Wald = 5.20), and lack of guidance (Wald 4.76). The percentage accuracy in classification (PAC) was 75%, suggesting that the model accurately predicted 75% of the cases in choosing a quantitative or a non-quantitative college major.

Table 13

Binary Logistic Regression for Seven MBQ Predictors of Math or Non-math Major

Predictor	B	SE	Wald	df	Sig.	Exp(B)
Past failure	.14	.27	.29	1	.59	1.15
Inadequate preparation	.70	.38	3.48	1	.06	2.02
Perceived as stressful	-.81	.33	6.18	1	.01*	.44
Lack of guidance	.63	.29	4.76	1	.03*	1.88
Lack of interest	-.20	.24	.73	1	.39	.82
Value for future	-.69	.30	5.20	1	.02*	.50
Dislike of math	-.16	.32	.24	1	.63	.86

Note. * $p < .05$

Hypothesis 7b. For the following exploratory analysis, specific hypotheses for the predictive power of individual variables were not made given the wide range of predictors that have been suggested for college students choosing careers with and without a significant quantitative component (see Chapter I for literature review). In order to test the predictability of the seven MBQ variables, a Binary Logistic Regression using the forced entry method was employed. The self-reported future career was used as the dichotomous dependent variable. Careers excluding a significant quantitative component (i.e., social work, nursing) were coded "0," and conversely, careers including a significant quantitative component (i.e., accounting, chemistry) were coded "1." The checks on adequacy of data for calculating a Binary Logistic Regression described above (i.e., multicollinearity, Tolerance, and VIF) also apply to the current hypothesis as they are part of the same set of predictors, hence such tests are not repeated for the current analysis.

Results of the Binary Logistic Regression for seven predictor variables of math or non-math career including: (1) past failure experiences, (2) inadequate preparation, (3) math perceived as stressful, (4) lack of guidance, (5) lack of interest, (6) value for the future, and (7) dislike for math, are presented in Table 14. An Omnibus Test of Model Coefficient which tests the overall performance of the model entered using a chi-square goodness of fit value suggests good viability for the model entered, $\chi^2 = 27.97$, $p < .001$. In addition, a Hosmer and Lemeshow Goodness of Fit Test also supports the entered model, which is indicated by a significance level great than .05, $\chi^2 = 8.24$, $p > .05$.

The current study suggests that, in ranked order of relative predictive power, the following variables contribute to the predictive ability for college students choosing between a math and a non-math career: lack of guidance (Wald = 8.50), perceived value for the future (Wald = 5.99), lack of interest (Wald 5.03), and math perceived as stressful (Wald = 4.80). The PAC was 80%, suggesting that the model accurately predicted 80% of the cases in choosing a math or a non-math career.

Table 14

Binary Logistic Regression for Seven MBQ Predictors of Math or Non-math Career

Predictor	B	SE	Wald	df	Sig.	Exp(B)
Past failure	.27	.27	.98	1	.32	1.31
Inadequate preparation	.21	.35	.37	1	.54	1.24
Perceived as stressful	-.74	.34	4.80	1	.03*	.48
Lack of guidance	.91	.31	8.50	1	.01**	2.50
Lack of interest	-.54	.24	5.03	1	.03*	.58
Value for future	-.77	.32	5.99	1	.01*	.46
Dislike of math	.31	.33	.89	1	.38	1.37

Note. * $p < .05$, ** $p < .005$

CHAPTER IV

DISCUSSION

To the author's knowledge, this was a first attempt at psychometrically validating an instrument specifically designed to measure mathematics anxiety in a Spanish-English bilingual Latino college population. Research suggests that mathematics anxiety can be a barrier to college students pursuing majors and careers with significant amounts of quantitative reasoning. Further, because Latino college students enter mathematics, science, and engineering (MSE) majors and careers at lower rates than do European-American students, it behooves educators and counselors to have a valid, reliable, and language-sensitive means of assessing for mathematics anxiety in a bilingual population. One of the aims of the current study was to create and test a newly developed Spanish-language version of the Mathematics Anxiety Rating Scale – Short Version (MARS-SV) with bilingual Latino college students. The second objective of the currently study involved an exploration into mathematics background variables that might have predictive value for bilingual Latino students selecting MSE-related majors and careers.

Validity: Factorial Structure of the Spanish MARS-SV

As a first step to validating the Spanish-language version of the MARS-SV, a factorial analysis was completed in order to determine the scale components that would explain the majority of the variance. Previous literature on the factorial structure of the

MARS, MARS-SV, and MARS-related measures (Alexander & Cobb, 1987; Alexander & Martray, 1989; Bowd & Brady, 2002; Suinn & Winston, 2003; Rounds & Hendel, 1980), led the current study to expect that the Spanish MARS-SV would be composed of a similar factorial structure as that found with the English MARS-SV. The current study established that the Spanish-language version of the MARS-SV has a comparable factorial structure to that previously reported in the literature for the English-language MARS-SV (Bowd & Brady, 2002; Kazelskis et al., 2000; Rounds & Hendel, 198; Suinn & Winston, 2003). The current study supports the three-factor model including: (1) Mathematics Test Anxiety (MTA), (2) Numerical Task Anxiety (NTA), and (3) Mathematics Course Anxiety (MCA). The third component, MCA, although not always identified in the literature (D'Ailly and Bergering, 1992; Suinn & Winston, 2003), but found in some (Bowd & Brady, 2002) explained a significant amount of the variance and therefore the current study supports the consideration of this additional component as contributing to the variance of the Spanish-language MARS-SV.

In addition, as part of the psychometric validation process of the Spanish-language MARS-SV, two more hypotheses were proposed. It was expected that the English-language MARS-SV would be highly correlated to the Spanish-language MARS-SV. The current study supported this hypothesis suggesting that in the two different languages, the scales appear to be measuring a similar construct. Related, it was also proposed that individual scale items from the English-language MARS-SV would correlate significantly with individual items from the Spanish-language MARS-SV. The current study found that all of the items from both MARS-SV correlated significantly in a positive direction. The study supports the convergent validity of the Spanish-language

MARS-SV by having a strong relationship with each of the items from the English-language version.

Reliability: Internal Reliability Coefficient

The current study proposed that there would be adequate internal reliability for the MARS-SV in each of the two languages. Results of the study illustrate that the internal reliability coefficient obtained for the English-language MARS-SV was comparable to that reported in a previous study (Suinn & Winston, 2003) and demonstrates internal reliability of the English MARS-SV with a bilingual student sample. For the Spanish-language MARS-SV, results also demonstrate the internal reliability coefficient to be similarly high and comparable to previous research on the English-language MARS-SV. Therefore, the current study shows that the Spanish MARS-SV with a bilingual sample has sound internal reliability.

Comparison of Math Anxiety Mean Scores, English versus Spanish Scales

The total scores for the English-language MARS-SV did not statistically vary in any significant manner from the total scores for the Spanish-language MARS-SV. Means were nearly identical, as were standard deviations. Lack of differences in the total scores of the two scales suggests that the language in which math anxiety was measured with a bilingual Latino student sample did not affect their measured level of mathematics-related anxiety.

It is important to note that bilingual college student response patterns between the English-language and Spanish-language MARS-SV in the current study were so similar that the need for a Spanish-language scale for a bilingual sample appears to be open to discussion. However, this does not take away from the need to have a Spanish-language measure of mathematics anxiety for monolingual Spanish-speakers. This study supports the conclusion that the Spanish MARS-SV can be such an assessment tool. The various results just reported confirm that results from the Spanish MARS-SV are nearly identical to results obtained from the English MARS-SV.

Additionally, of the 30 test items, the current study suggests that only four item-differences in the means exist between the two different MARS-SV. Items that showed significantly different results were test item pairs: #1 (Taking an examination (final) in a math course), #16 (Dividing a five digit number by a two digit number in private with pencil and paper), #21 (Being given a set of numerical problems involving addition to solve on paper), and #22 (Having someone watch you as you total up a column of figures). It is unclear as to why different results were found in the above four items between the two languages. All items were translated by a certified translator and subsequently back translated, so there is no reason to suspect translation inaccuracies. For instance, all items have a clear and straightforward translation from English to Spanish, without there being much possibility for error, such as is the case when investigating cultural differences or specific group nuances. Further, the way in which the MARS was originally designed was to query about behavioral situations that are straightforward (Richardson & Suinn, 1972), which leaves less room for misinterpretation, and MARS has successfully been translated into various languages including: Arabic, Turkish, Japanese, and Korean (Baloğlu, 2005; Hwang, 1997; Saigh & Khori, 1983, Yoshihisa, 1994) while demonstrating acceptable psychometric properties. Nevertheless, it is feasible to suspect within group differences in interpretation of specific items as the current sample was quite diverse regarding countries of origin, and as a result, having considerable variability in Spanish-language use. When translating already existing psychological measures from English to Spanish, previous studies have found differences in responses to specific items, but with the scale in question continuing to retain psychometric adequacy (Azocar, Areán, Miranda, & Muñoz, 2001).

Yet another possibility is that the current study did not assess the extent to which students were proficient at either Spanish or English other than advertising the study as requiring participants to be English-Spanish bilingual with ability to read in both languages. It is feasible to expect that some students were English-dominant and some students Spanish-dominant bilingual, which may or may not have distorted the results. Not assessing language proficiency in the current study is a limitation. The general findings, however, do not suggest the differences in these four items to be of great concern and the overall psychometrics suggests that the Spanish-language MARS-SV is a reliable and valid measure for use with Spanish-speaking individuals to measure mathematics anxiety.

Comparison of Results of Math Anxiety and Performance in Math Classes

The current study did not observe a relationship between mathematics anxiety as measured by the English MARS-SV and math performance in college courses when performance in college courses were considered individually. This finding corroborates with the work by Llabre and Suarez (1985) in which authors established that after controlling for mathematics ability, college mathematics course grades could not be well predicted by mathematics anxiety. Likewise, Resnick, Viehe, and Segal (1982) also report that mathematics anxiety tends to be a poor predictor of mathematics performance in a sample of college students with extensive mathematics experience, and more recently, Jacob (2005) was not able to observe any relationship between mathematics anxiety and final mathematics course grades in an open admission college. Conversely, work by Ashcraft and Kirk (2001) suggests that mathematics anxiety disrupts an individual's working memory capacity, and therefore it is expected to disrupt math performance.

Results of the current study, however, should be interpreted with caution because of the small sample size that resulted from separating out individual college courses as a measure of performance (see Tables 8 & 9 for the sample sizes, which ranged from 3 to 22). Students sampled in the current study had not taken many math courses and for those that had taken courses, took different courses from each other. The findings reported in the current study are conceivably due to these small sample sizes. With this in mind, in addition to examining individual college mathematics courses, the current study computed an aggregate performance score for math by calculating average grades earned in college algebra and trigonometry. This resulted in a larger sample size. In using this as a measure of mathematics performance, the current study found a significant negative correlation. This negative correlation suggests that those with increased levels of math anxiety tended to have poorer performance. These results should nevertheless continue to be interpreted with caution because this additional analysis was likewise conducted with a small sample size ($n = 11$).

In addition, the current study found a significant negative correlation between mathematics anxiety and performance in college level Finite math, but only when the Spanish-language MARS-SV was used as a measure of math anxiety. The current study was not able to observe a relationship between mathematics anxiety as measured by the

Spanish-language MARS-SV and performance in other individual college math courses. Therefore the results failed to support the hypothesis that mathematics anxiety levels will be related to math performance levels in individual college math courses.

Huang and colleagues suggest that attending a private university (such as the University of Miami), as opposed to a public university, can be a factor associated with academic success (Huang et al., 2000, as cited in Holt, 2006) and it appears that this was the case with the current study – the sample of bilingual Latino college students attained above average grades. Within the current sample, 91% of students received an A or B in college algebra, 100% received an A or B in college trigonometry, and 93% received an A or B in college pre-calculus. This lack of distribution of grades along with the small sample size may be one explanation for the overall lack of significance when math anxiety levels were correlated with college course performance. Another interpretation is that high achieving students, such as those sampled in the current study, who have math anxiety may also have a means of coping with this math anxiety, possibly because of previous success with academic challenges and related self-efficacy.

The current study also expected that mathematics anxiety would be correlated in a negative direction with performance in high school math. The current study was not able to find a relationship between performance in individual or aggregated high school math classes and level of math anxiety as measured by either the English-language MARS-SV or the Spanish-language MARS-SV. These findings thus failed to support the hypothesis that mathematics anxiety levels will be associated with math performance levels in high school classes. However, again such results should be interpreted with caution because it is apparent that a ceiling effect was observed with the sample used for the study. The distribution of performance scores for mathematics was non-symmetrical and negatively skewed, with few participants scoring at the lower end of the distribution. As stated earlier, participants were students from a private four-year institution with high standards for admission and thus almost all students achieved above average grades in high school. As reported in the University of Miami website (University of Miami, 2007), entering students achieve well above average scores on standardized tests and 68% of students entering the university are in the top tenth percentile in their high schools. This is in essence a type of self-selection in that the majority of students had to perform quite well in their high school math classes in order to get accepted into the university. With this lack of variability in the high school math performance data used for the study any relationship between math anxiety and high school math performance would be attenuated. Holt (2006) points out that placement in accelerated math classes in high school predicts math achievement. In examining the high school classes completed by the current sample, many students in fact completed advanced math high school classes. Knowing this information now, it is clear that any future studies on math anxiety and performance should include participants with more diverse math grades. Meeks (1997), for instance, studied community college students and found the expected result that higher levels of math anxiety were associated with poorer performance.

Thus for various reasons, the findings from the current study failed to confirm the hypothesis that mathematics anxiety and math performance in high school classes are related at least for this special sample of high-achieving students. However, such a lack of results is consistent with at least one other cross-cultural report. Ho and colleagues (2000) examined math performance in cross-national samples of middle school students from the United States, China, and Taiwan and maintain that the relationship between mathematics performance and mathematics anxiety is actually quite small.

Finally, it is important to note that this study's sample of ethnic minority bilingual college students displayed strong academic skills in math performance. Although research typically points to deficits that minority students may have in regard to success in college, this study may in fact suggest that this particular subgroup of Latinos may have some quite adaptive academic coping skills. This observation may be an interesting topic for further investigation when examining ethnic minorities, math anxiety, and math performance.

Comparison of Results on College Math Avoidance Behaviors

The current study expected that elevated levels of mathematics anxiety would be associated with students choosing non-math-related college majors. The current study found a small, but significant relationship between college major choice and mathematics anxiety when the English-language MARS-SV was used as a measure of math anxiety. In addition, a small but significant negative correlation was also found between college major choice and math anxiety when the Spanish MARS-SV was used as a measure of math anxiety. The findings from the current study suggest that those with elevated math anxiety tend to avoid college majors with a focus on quantitative coursework. Finally, these findings suggest that math anxiety measured in both Spanish and English yielded similar results when investigating the relationship between mathematics anxiety and choice of college major.

The current study also set out to determine whether or not mathematics anxiety would be associated with math-related future career choice. The findings from the current study failed to support the hypothesis that there would be a relationship between career interests and math anxiety when the test involved either the English-language MARS-SV or the Spanish-language MARS-SV as measures of math anxiety. However despite failing to reach statistical significance, the biserial correlations were close to the significant correlation found between math anxiety scores and choice of major: r_{pb}.English MARS-SV-major = -0.17; r_{pb}.English MARS-SV-future career = -0.12; r_{pb}.Spanish MARS-SV-future career = -0.13. Furthermore, the analyses using Binary Logistic Regression did identify perceiving mathematics as stressful as a significant predictor of future career choice. Hence the total pattern of statistical analyses are suggestive that math anxiety levels do influence choice of future careers. Future research is needed to determine if this is the case.

The current study expected that mathematics anxiety would be associated with number of math courses completed in college plus the number of math courses the student is planning on completing. The current study was unable to observe any relationship between mathematics anxiety and number of mathematics college courses the participants completed and were planning on completing when either the English or the Spanish MARS-SV was used. One possible explanation involves the fact that the majority of the participants were freshman, who composed 63% of the sample. Thus it might be too early for them to have participated in other than core requirements.

Comparison of Results on Math Anxiety and High School Math Avoidance Behaviors

The current study expected that mathematics anxiety would be associated with the number of math courses completed in high school. Results failed to support the hypothesis using the English-language MARS-SV or the Spanish-language MARS-SV.

However, because of the nature of the student sample in this study (discussed previously), these results should be interpreted with caution. Almost every single participant in the current study completed all of the usual mathematics classes typically offered in high school and many completed high school math courses typically considered to be advanced (e.g., calculus).

In summary, the results from the current study found little relationship between mathematics anxiety and math avoidance behaviors in both high school and college. It is important to note that the literature provides support for self-efficacy having a major role in students seeking out mathematics experiences and having an effect on students' level of motivation (Bandura, 1993). Further, previous research suggests that self-efficacy may play a larger role in Latinos than in European Americans (Stevens, Olivarez, Lan, & Tallent-Runnels, 2004). The sample in the current study was generally a group of college students with above average academic success, which might be expected to possess higher self-efficacy from such success, and hence may not be subject to mathematics avoidance behaviors. This stronger mathematics background may engender more than adequate self-efficacy for completing mathematics courses, even when anxiety is experienced. Since the current study did not directly assess self-efficacy, it will be up to further research to determine the proper explanation for the current lack of results.

Variables Influencing Vocational Choice

Studies specifically investigating the factors associated with minorities aspiring to continue in science and math careers are quite sparse (Mau, 2003). The current study sought to complete an exploratory investigation into variables that might predict students continuing to pursue math, science, and engineering (MSE) college majors and future

careers. The study found support for several variables which significantly predicted whether a student would enter into an MSE college major and career. For choice of major, the variables included perceiving math as stressful, perceived value, and lack of guidance. For choice of future career, the variables were also perceiving math as stressful, perceived value, lack of guidance, and in addition, lack of interest.
The findings identifying the variables value and interests support the Expectancy Value Model (EVM; Eccles, 1994) which maintains that personal values and interests are strong predictors for career choice. Further, perceiving mathematics to be stressful was a good predictor for students' choosing MSE or non-MSE college major and career choice, which supports previous findings on math anxiety and math avoidance behaviors. However, the negative results for past failure experiences were surprising because self-efficacy might be expected to predict MSE major and career choice. The past failure experiences item was designed to tap into two possible factors: actual failure and/or the effect of failure on self-efficacy. It appears that because the majority of the current sample has been successful in mathematics as evidenced by previous grades earned, the past failure question was actually meaningless. Hence the expected relationship between past failure and choice of major or career was not observed in the current study. Research with a sample with a more diverse failure/success history in math courses could clarify this study's lack of results.

Of final interest are the results regarding the variable "lack of guidance" in predicting MSE college major and career. The actual data in the current study found that guidance was a significant predictor but in a direction opposite from that which was expected – the less guidance a student received, the more students were likely to choose an MSE major or career. It is difficult to interpret this finding since "guidance" was not defined in detail by the questionnaire in the current study. There are two ways of offering "guidance": a) guiding a student to select an MSE field or b) guiding a student to avoid an MSE field. As an example of the latter, the student might have heard the message, "you should reconsider a career in the mathematics field, it is very competitive and challenging, and you might not succeed"; such guidance would motivate the student not to pursue a career in MSE fields. Since the type of guidance received by the current study's participants was not specified, future studies should more specifically measure what is meant by guidance as a follow-up to this unique finding.

In summary, three variables predicted MSE major and career choice, these included perceiving math as stressful, perceived value, and lack of guidance. Additionally, lack of interest predicted MSE career. If these predictor variables are replicated, then it provides some ideas for increasing the number of Latinos in MSE fields. Early attention should be paid to reducing levels of math anxiety that might result from negative classroom experiences, or reduction through intervention programs such as systematic desensitization (Genshaft, 1982; Kovarik, 2000; Richardson & Suinn, 1973). Latino students could also develop higher valuing or interest in such careers where they can be exposed to role models, who could address the relevance and importance of their work. Further research on the meaning of the results on "lack of guidance" can also be useful for counseling and guidance services.

Limitations of the Current Study

First, a general limitation of the current study is the skewed distribution of certain aspects of the data. For example, two items from the list of predictors, past failure experiences and inadequate preparation were both negatively skewed in the current sample. The large majority (80%) of students did not report a history of failure experiences with mathematics which contributed to the limited variability of this predictor, and similarly, 81% of students reported that it was either moderately or very inaccurate that they did not have the background courses. Additionally, a limited distribution of mathematics performance scores (grades) was observed, which contributed to a ceiling effect making it difficult to draw a clear conclusion for any relationships between math anxiety and performance.

A second limitation for the current study is that it did not include any measures of either English-language or Spanish-language fluency. It is therefore unknown to what extent the sample was English-dominant or Spanish-dominant. Participants were required to have the ability to read and comprehend self-report measures as inclusion criteria into the study, but language fluency was not assessed in any manner other than asking participants if they could complete measures in Spanish and English.

A third limitation is that acculturation measures were not incorporated into the current study. Measuring acculturation may have provided some insight into more specific cultural experiences and specific within group identities of the sample used for the study, and therefore might have offered further clarification of results.

A fourth limitation is the reliance upon students from a private university with high entry standards. This limits the generalizability of the results, and also contributed to the lack of distribution of math performance scores.

A fifth limitation is the way in which math performance was measured. The current study relied on self-reported grades earned in math. Participants may have over reported performance in math, possibly contributing to the ceiling effect of performance scores observed. A uniform approach in measuring math performance, such as standardized scores on a quantitative achievement test, would have provided a more accurate measure of math performance, as well as a continuous variable with possibly more variability in scores.

Finally, the MBQ was not pre-tested to determine its validity and this may be viewed as a limitation even though the MBQ was used solely for exploratory purposes. Results did uncover some possible variables that could be valuable for future research, using more standard measures such as interest/values or efficacy measures.

Implications for Future Research

Future studies should measure mathematics anxiety in a variety of Latino populations, such as community college, public university, and non-college populations to assure a broader distribution of performance scores. Populations with more diverse mathematics background variables might provide a different pattern of results. Continued psychometric research into the newly created Spanish-language MARS-SV with these different populations would also be beneficial. Because mathematics anxiety research continues to distinguish between mathematics anxiety and other types of general academic anxiety (Hopko, 2003), it would be productive to further our understanding of how mathematics anxiety may disrupt individuals' ability to engage in math-related behaviors and pursue MSE careers. The University of Miami's bilingual student group showed nearly identical performance on the English and Spanish MARS-SV thereby providing validity support for the Spanish-language version. Hence this makes the

Spanish MARS-SV available for future cross-cultural studies with monolingual Spanish-language populations.

Future studies should take into account efficacy. Self-efficacy can play a larger role for Latinos than for European-Americans (Stevens, Olivarez, Lan, & Tallent-Runnels, 2004), and is also a significant variable in college students choosing to persist in math and science majors (Betz & Hackett, 1983). Siegel, Galassi, and Ware (1985) compared two models for predicting mathematics performance. These models included Bandura's (1977) Social Learning Model and an alternative model considering mathematics anxiety and aptitude. Authors reported that Bandura's (1977) model did a better job at predicting mathematics performance than did the model including mathematics anxiety. Therefore, future studies should incorporate measures of mathematics self-efficacy when looking at predictors of MSE major and career choice in Latinos. In conclusion, research should continue to discover causes of and ways to repair the "leaky pipeline" found in Latinos going from high school to college to MSE careers, as Latinos are clearly underrepresented in MSE fields.

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Appendix A

MATHEMATICS ANXIETY RATING SCALE: SHORT VERSION

The items in the questionnaire refer to things that may cause fear or apprehension. For each item place a check in the box under the column that describes how much you are frightened b it nowadays. Work quickly but be sure to consider each item individually.

	Not at all	A little	A fair amount	Much	Very much
1. Taking an examination (final) in a math course.	☐	☐	☐	☐	☐
2. Thinking about an upcoming math test one week before.	☐	☐	☐	☐	☐
3. Thinking about an upcoming math test one day before.	☐	☐	☐	☐	☐
4. Thinking about an upcoming math test one hour before.	☐	☐	☐	☐	☐
5. Thinking about an upcoming math test five minutes before.	☐	☐	☐	☐	☐
6. Waiting to get a math test returned in which you expected to do well.	☐	☐	☐	☐	☐
7. Receiving your final math grade in the mail.	☐	☐	☐	☐	☐
8. Realizing that you have to take a certain number of math classes to fulfill the requirements in your major.	☐	☐	☐	☐	☐
9. Being given a "pop" quiz in a math class.	☐	☐	☐	☐	☐
10. Studying for a math test.	☐	☐	☐	☐	☐
11. Taking the math section of a college entrance exam.	☐	☐	☐	☐	☐
12. Taking an examination (quiz) in a math course.	☐	☐	☐	☐	☐
13. Picking up the math text book to begin working on a homework assignment.	☐	☐	☐	☐	☐
14. Being given a homework assignment of many difficult problems which is due the next class meeting.	☐	☐	☐	☐	☐
15. Getting ready to study for a math test.	☐	☐	☐	☐	☐
16. Dividing a five digit number by a two digit number in private with pencil and paper.	☐	☐	☐	☐	☐
17. Adding up 976 + 777 on paper.	☐	☐	☐	☐	☐
18. Reading a cash register receipt after your purchase.	☐	☐	☐	☐	☐

19. Figuring the sales tax on a purchase that costs more than $1.00.	☐	☐	☐	☐	☐
20. Figuring out your monthly budget.	☐	☐	☐	☐	☐
21. Being given a set of numerical problems involving addition to solve on paper.	☐	☐	☐	☐	☐
22. Having someone watch you as you total up a column of figures.	☐	☐	☐	☐	☐
23. Totaling up a dinner bill that you think overcharged you.	☐	☐	☐	☐	☐
24. Being responsible for collecting dues for an organization and keeping track of the amount.	☐	☐	☐	☐	☐
25. Studying for a driver's license test and memorizing the figure involved, such as the distance sit takes to stop a care going at different speeds.	☐	☐	☐	☐	☐
26. Totaling up the dues received and the expenses of a club you belong to.	☐	☐	☐	☐	☐
27. Watching someone work with a calculator.	☐	☐	☐	☐	☐
28. Being given a set of division problems to solve.	☐	☐	☐	☐	☐
29. Being given a set of subtraction problems to solve.	☐	☐	☐	☐	☐
30. Being given a set of multiplication problems to solve.	☐	☐	☐	☐	☐

Appendix B

MATHEMATICS ANXIETY RATING SCALE: SHORT VERSION (SPANISH)

MARS-SV (S)

Los ejemplos que aparecen en el cuestionario se refieren a cosas que pueden causar temor o aprehensión. Con respecto a cada uno de los ejemplos ponga una marca (√) en el cuadrito que está en la columna que describe cuánto miedo actualmente eso le da. Llénelo rápido pero asegúrese de considerar cada uno de los ejemplos individualmente.

	Nada en absoluto	Un poco	Bastante	Mucho	Muchísimo
1. Tomar un examen (final) en un curso de matemática.	☐	☐	☐	☐	☐
2. Pensar una semana antes acerca de una prueba de matemática que se avecina.	☐	☐	☐	☐	☐
3. Pensar un día antes acerca de una prueba de matemática que se avecina.	☐	☐	☐	☐	☐
4. Pensar una hora antes acerca de una prueba de matemática que se avecina.	☐	☐	☐	☐	☐
5. Pensar cinco minutos antes en una prueba de matemática que se avecina.	☐	☐	☐	☐	☐
6. Esperar a que le devuelvan una prueba de matemática en la cual usted esperaba haber sacado buena nota.	☐	☐	☐	☐	☐
7. Recibir su nota final de matemática por correo.	☐	☐	☐	☐	☐
8. Darse cuenta de que tiene que tomar un determinado número de clases de matemática para satisfacer los requisitos de su especialidad.	☐	☐	☐	☐	☐
9. Que le den una prueba "sorpresiva" (*pop quiz*) en una clase de matemática.	☐	☐	☐	☐	☐
10. Estudiar para una prueba de matemática.	☐	☐	☐	☐	☐

11. Tomar la sección de matemática de un examen de entrada a la universidad.	□	□	□	□	□
12. Tomar un examen (una prueba menor) en un curso de matemática.	□	□	□	□	□
13. Agarrar el libro de matemática para comenzar a hacer la tarea.	□	□	□	□	□
14. Que le den a hacer de tarea unos problemas muy difíciles que se deben entregar en la próxima clase.	□	□	□	□	□
15. Prepararse para estudiar para una prueba de matemática.	□	□	□	□	□
16. Dividir por escrito un número de cinco dígitos por un número de dos dígitos.	□	□	□	□	□
17. Sumar 976 + 777 por escrito.	□	□	□	□	□
18. Leer el recibo de una caja registradora después de hacer una compra.	□	□	□	□	□
19. Calcular los impuestos sobre la venta en una compra que cuesta más de $1.00.	□	□	□	□	□
20. Calcular su presupuesto mensual.	□	□	□	□	□
21. Que le den una serie de problemas numéricos en que tenga que sumar para resolverlos por escrito.	□	□	□	□	□
22. Tener a alguien mirándolo mientras está sumando una columna de cifras.	□	□	□	□	□
23. Sumar la cuenta de una cena cuando cree que le cobraron de más.	□	□	□	□	□
24. Ser responsable de cobrar las cuotas de una organización y llevar cuenta de la cantidad.	□	□	□	□	□

25. Estudiar para la prueba de la licencia de conducción y memorizar las cifras correspondientes, tales como la distancia a la que un auto se detiene a distintas velocidades.	□	□	□	□	□
26. Sumar las cuotas recibidas y los gastos de un club al cual pertenece.	□	□	□	□	□
27. Observar a alguien trabajar con una calculadora.	□	□	□	□	□
28. Que le den a resolver una serie de problemas de división.	□	□	□	□	□
29. Que le den a resolver una serie de problemas de sustracción.	□	□	□	□	□
30. Que le den a resolver una serie de problemas de multiplicación.	□	□	□	□	□

Appendix C

1. **Gender:** ____ Male ____ Female

2. **Age:** _____ years

3. **Place of Birth (Country):** _____________

4. **How long have you lived in the US?** ______ years ______ months

5. **Year in School:** ___ Freshman ___ Sophomore ___ Jr. ___ Sr. ___ Graduate

6. **Math Courses Taken in High School:**
   (Put the grade that you received next to each course that you took in high school.)

1st Year Algebra ____ Geometry ____ 2nd Year Algebra ____ Trigonometry ____
Analytical Geometry ____ Calculus ____ Advanced Calculus____
Other (please write course name and grade)_________________________

7. **How many math classes did you take in high school?** _______

8. **Math Courses Taken in College:**
   (First, list the math courses and grades that you received for each course that you have taken so far in college. Next, list the math courses that you plan to take or are currently taking.)

Have taken	Grade	Plan to take or taking now
___________________________	_____	________________________
___________________________	_____	________________________
___________________________	_____	________________________

9. **Major:** Which group of majors does you current UM major fit into? If you are undecided, which group of majors do you think your eventual major will most likely fit into? (Please check one only).

___ Physics, Chemistry, Biological/Biomedical/Neuro Sciences, Earth/Geological/Meteorological Sciences

___ Mathematics, Engineering (any type, except Biomedical), Accounting, Economics, Finance

___ Other major that does not fit into the above categories, please list: ___________________

10. Future Career: Which career area do you think best describes your eventual career plans? (Please check one only).

___ Physics, Chemistry, Biological/Biomedical/Neuro Sciences, Earth/Geological/Meteorological Sciences

___ Mathematics, Engineering (any type, except Biomedical), Accounting, Economics, Finance

___ Other career that does not fit into the above categories, please list: ___________________

11. My parents' occupations/jobs are:

Male Parent (or male who raised you): ___________________

Female Parent (or female who raised you): ___________________

Appendix D

For the following questions, please consider the reasons why you have decided NOT to pursue a major or a career in a field involving the use of mathematics. If you have decided to in a major or career involving mathematics, skip this section. Please use the following scale to rate each of the reasons:

1 = Very Inaccurate
2 = Moderately Inaccurate
3 = Neither Inaccurate nor Accurate
4 = Moderately Accurate
5 = Very Accurate

If you are not considering a major or a career involving mathematics (e.g., engineering, economics, computer science, chemistry, physics, biomedicine) is it because:	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate nor Accurate	Moderately Accurate	Very Accurate
1. I tried math and did not do well.	1	2	3	4	5
2. I don't have the background courses to prepare me.	1	2	3	4	5
3. I find math stressful.	1	2	3	4	5
4. Nobody ever talked to me about these fields.	1	2	3	4	5
5. I have never been interested in a career in these fields.	1	2	3	4	5
6. I don't see these fields valuable for my future.	1	2	3	4	5
7. I tried math in high school and did not like it.	1	2	3	4	5
8. I tried math in high school and did not do well.	1	2	3	4	5

Appendix E

Instructions for Administration of Questionnaires

Student Arrival to Administration Room

- Please allow sufficient time (approximately five minutes) for students to settle into their seats

- There will be students running behind schedule, so allow some time for tardy students to settle into their seats as well so as not to disrupt the administration process

- **IMPORTANT:** As students are walking into the room, have a table nearby with stacks of consent forms. Ask every student to take two copies, one signed copy we keep, the other they keep for their own records.

Introduction to the Study

- Administrator(s) will briefly introduce themselves and say:

    - *Please let me know at any point during the study if you have any questions*

- Announce the Study and Thank Participants

    - *Welcome to and thank you for participating in this study*

- Following Directions

    - *It is important that you follow directions in order for materials to be filled out correctly, please listen carefully to my instructions*

Preparing Students to Begin Completing Questionnaires

- Please make sure that all students are seated with appropriate distance apart, this will allow students some additional privacy and will aid in letting students respond as honestly as possible, if needed ask students to move.

- *Make sure all desks are clear of clutter, books, newspapers, magazines, backpacks, and music players. Please turn off your I-Pods and put away anything that is on top of the desk.*

- **IMPORTANT:** Make sure students are NOT listening to music with headphones at ANY point during the instructions or actual administration.

Consent Forms

- When students are settled in and things are put away say:
    - *I will start handing out the questionnaires in a few minutes, but before I do please listen carefully to the following instructions*
    - *On the way in you got the Consent Form for the study, one copy of this form needs to be signed and returned to us, the other is for your own records.*
    - **NOTE**: Verbally, but briefly, summarize the Consent Form and cover major points
    - *Please pass down the Consent Form with your signature to the left side, your signature should be facing down.*
    - Collect Consent Forms all on one side of the room

Beginning Administration

- Once all Consent Forms are collected and every student has signed it, say:
    - *I will now start passing out the questionnaire and you can begin as soon as you get it, take as long as you need to fill it out, but it should not take you more than 45 minutes to complete*
    - *When you get your questionnaire, you will notice a card with a number on it, this is your PARTICIPANT ID.*
    - *Please bubble in this number on all of your sheets right now, before you start. DO NOT PUT YOUR NAME ON THIS SHEET.*
    - *Notify me at any point if you have any questions.*
    - *When you are done, bring your packet up to the front, and you may leave quietly.*
    - *Are there any questions?*

Ending Administration

- ALLOW STUDENTS TO COMPLETE SURVEY
- **IMPORTANT:** Make sure to hand each student a Debriefing Form on the way out.

THANK YOU FOR YOUR HELP WITH THIS STUDY

Appendix F

Instrucciones para la administración de cuestionarios

Llegada del estudiante al sitio de la administración

- Por favor dé un plazo y suficiente tiempo (aproximadamente cinco minutos) para los estudiantes que llegan tarde

- Habrá estudiantes que funcionan detrás de horario, así que dé un plazo de un cierto tiempo para los estudiantes tardíos para colocar en sus asientos también para no interrumpir el proceso de la administración

- IMPORTANTE: Cuando los estudiantes están llegando, tenga una mesa cerca con los apilados de formas del consentimiento. Pida que cada estudiante tome dos copias, una copia firmada que guardamos, la otra guardan para sus propios expedientes.

Introducción al estudio

- Administrador(es) se introducirá brevemente y dirá:
    - *Por favor en cualquier punto durante el estudio si usted tiene cualquiera preguntas, me puedes preguntar*

- Anuncia el estudio y agradece los participantes

Siguiendo Direcciones

- *Es importante que usted sigue direcciones en la orden para que los materiales sean completados correctamente, escucha por favor cuidadosamente mis instrucciones*

Preparación de estudiantes comenzar a llenar los cuestionarios

- Por favor que asienten a todos los estudiantes con distancia apropiada aparte, esto no prohibirá a estudiantes una cierta aislamiento adicional y la ayudará en dejar a estudiantes responder tan honesto como sea posible, si es necesario pide que los estudiantes se muevan.

- *Cerciórese de que todos los escritorios estén claros de cosas, de libros, de periódicos, de backpacks, y de jugadores de música. Por favor apaga a sus I-PODS y guarda cualquier cosa que está encima del escritorio.*

- IMPORTANTE: Cerciórese de que los estudiantes no estén escuchando a música con los auriculares en CUALQUIER punto durante las instrucciones o la administración real.

Formas Del Consentimiento

- Cuando colocan a los estudiantes adentro y las cosas están puesto <u>diga</u>:
    - *Comenzará a repartir los cuestionarios en algunos minutos, pero antes de que satisfaga escucha las instrucciones siguientes*
    - *La forma del consentimiento para el estudio, una copia de esta forma necesita ser firmada y vuelto a nosotros, la otra es para usted.*
    - NOTA: Verbalmente, pero brevemente, resuma la forma del consentimiento y cubra los puntos importantes
    - *Pasa la forma del consentimiento con su firma al lado izquierda, su firma debe hacer en lado abajo.*
    - Recoge las formas todas del consentimiento en un lado del cuarto

Administración Que comienza

- Una vez que se recojan todas las formas del consentimiento y cada estudiante la ha firmado, <u>diga</u>:
    - *Comenzará a pasar el cuestionario y usted puede comenzar tan pronto como usted lo consiga, toma el tiempo que usted necesita completarla, pero no debe tomarle más de 45 minutos para terminar*
    - *Cuando usted consigue su cuestionario, usted notará una tarjeta con un número en él, éste es su identificación del PARTICIPANTE.*
    - *Burbujea por favor, este número en todas sus hojas ahora, antes de que usted comience. NO PONGA SU NOMBRE EN ESTA HOJA.*
    - *Me notifica en cualquier punto si usted tiene cualquier pregunta.*
    - *Cuando terminas, trae su paquete hasta el frente, y usted puede irse reservado.*
    - *Hay preguntas?*

Concluir el Administración

- PERMITE QUE LOS ESTUDIANTES TERMINEN EXAMEN
- IMPORTANTE: Se cerciora de dar a cada estudiante una forma debreifing en la salida.

GRACIAS POR SU AYUDA CON ESTE ESTUDIO

Appendix G

Complete List of Varimax Rotated Component Loadings for Math Test Anxiety, Numerical Test Anxiety, and Math Course Anxiety

	Component		
Spanish MARS-SV Items	MTA	NTA	MCA
6	.882	.104	.053
7	.852	.223	.220
8	.795	.126	.355
3	.785	.097	-.027
13	.697	.064	.366
4	.693	.110	.004
7	.668	.223	.220
10	.654	.029	.370
6	.645	.104	.053
15	.639	-.018	.360
9	.572	.124	.383
17	-.041	.782	.038
16	.165	.742	.247
30	.142	.739	.136
28	.205	.685	.177
21	.125	.663	.089
18	-.047	.633	.065
23	.172	.631	.455
22	.322	.625	.235
19	.096	.610	.302
29	.102	.593	.229
24	.190	.559	.470
20	.201	.448	.347
14	.301	-.036	.702
13	.315	.064	.604
8	.429	.126	.524
26	.196	.380	.522
25	.185	.393	.494
11	.400	.332	.487
27	-.120	.351	.450

Note. Extraction method was Principal Components Analysis (PCA). For complete list of Spanish MARS-SV items, refer to Appendix B.

Appendix H

Table 7

Item Differences between the English and Spanish

Mathematics Anxiety Rating Scale – Short Version (MARS-SV)

Item Pair	Language	*M*	*SD*	*t*	*p*
1	English	3.14	1.10	2.94**	.01
	Spanish	2.93	1.11		
2	English	2.33	.97	1.55	.12
	Spanish	2.23	1.05		
3	English	3.07	1.14	0.00	1.00
	Spanish	3.07	1.05		
4	English	3.30	1.18	.28	.78
	Spanish	3.28	1.21		
5	English	3.33	1.23	.34	.73
	Spanish	3.31	1.27		
6	English	2.92	1.29	.93	.36
	Spanish	2.86	1.25		
7	English	2.77	1.39	.70	.49
	Spanish	2.71	1.29		
8	English	2.44	1.30	1.49	.14
	Spanish	2.34	1.20		
9	English	3.20	1.22	.14	.89

	Spanish	3.19	1.18		
10	English	2.24	1.06	1.38	.17
	Spanish	2.13	.94		
11	English	2.84	1.25	1.65	.10
	Spanish	2.73	1.27		
12	English	2.47	1.09	-.13	.90
	Spanish	2.48	1.03		
13	English	1.49	.78	1.06	.29
	Spanish	1.43	.60		
14	English	2.70	1.27	1.30	.21
	Spanish	2.63	1.23		
15	English	1.97	1.00	.00	1.00
	Spanish	1.97	.97		
16	English	1.41	.65	-2.80**	.01
	Spanish	1.60	.90		
17	English	1.13	.37	-1.00	.32
	Spanish	1.15	.47		
18	English	1.13	.44	.71	.48
	Spanish	1.12	.38		
19	English	1.38	.67	-1.51	.13
	Spanish	1.43	.71		
20	English	1.50	.74	.73	.47
	Spanish	1.46	.64		

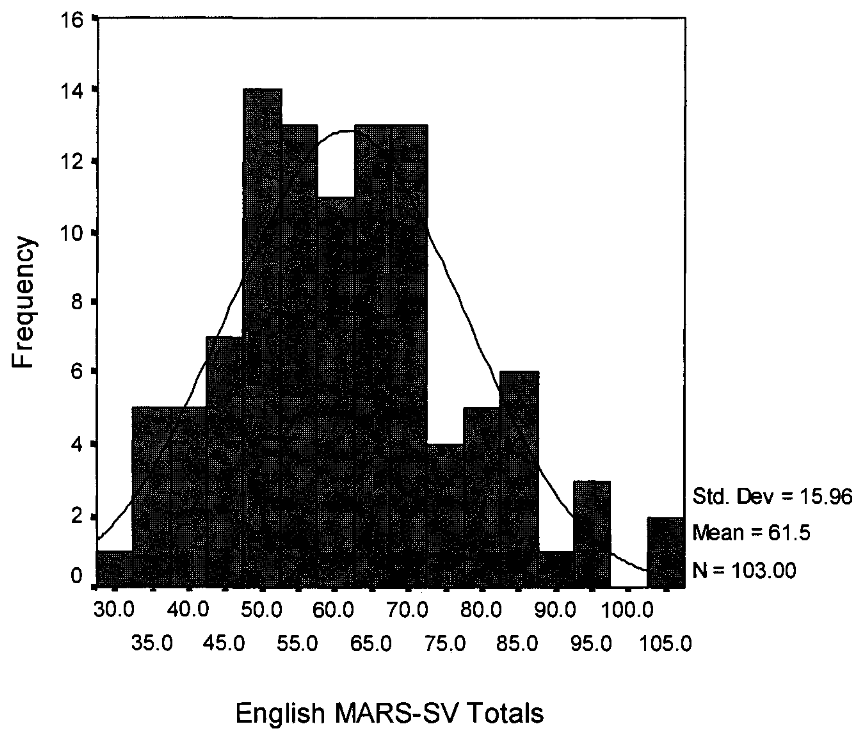
21	English	1.20	.56	-2.41*	.02
	Spanish	1.36	.64		
22	English	2.08	1.15	-2.28*	.03
	Spanish	2.21	1.14		
23	English	1.55	.74	1.41	.16
	Spanish	1.48	.72		
24	English	2.01	1.07	.87	.38
	Spanish	1.96	1.05		
25	English	1.70	.95	.15	.88
	Spanish	1.69	.94		
26	English	1.58	.76	.39	.70
	Spanish	1.56	.77		
27	English	1.11	.42	-1.16	.25
	Spanish	1.14	.58		
28	English	1.45	.70	-.85	.40
	Spanish	1.49	.71		
29	English	1.18	.41	.33	.74
	Spanish	1.17	.43		
30	English	1.20	.51	.58	.57
	Spanish	1.18	.46		

Note. Means are based on the MARS-SV 1 to 5 scale.

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

Figure Caption

Figure 1. Histogram displaying the distribution of total scores with a normal curve included for the English MARS-SV.



16
14
12
10
8
6
4
2
0
Frequency
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
35.0
45.0
55.0
65.0
75.0
85.0
95.0
105.0
Std. Dev = 15.96
Mean = 61.5
N = 103.00
English MARS-SV Totals

Figure Caption

Figure 2. Histogram displaying the distribution of total scores with a normal curve included for the Spanish MARS-SV.

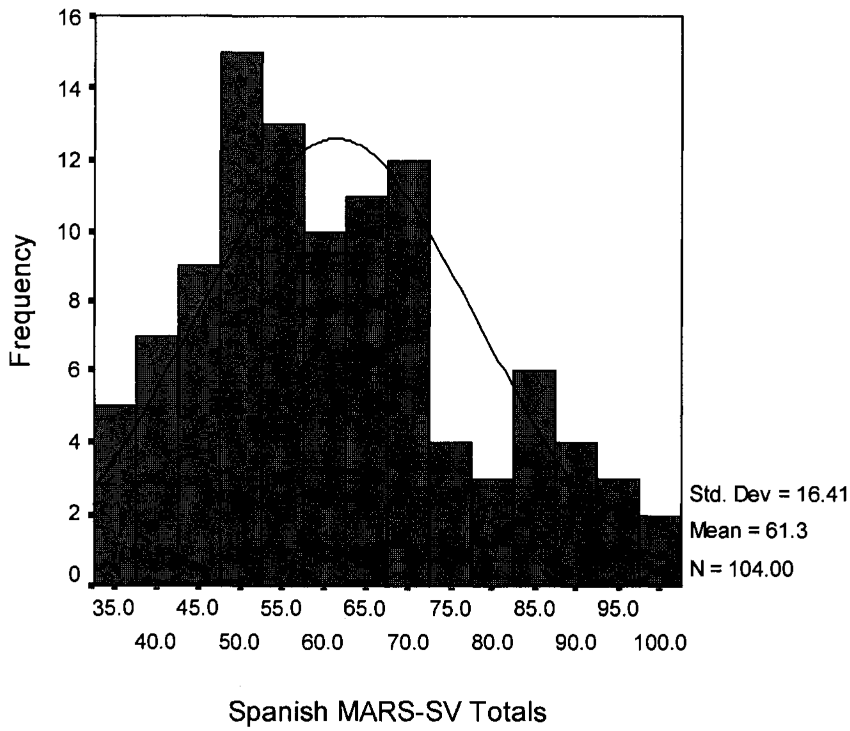
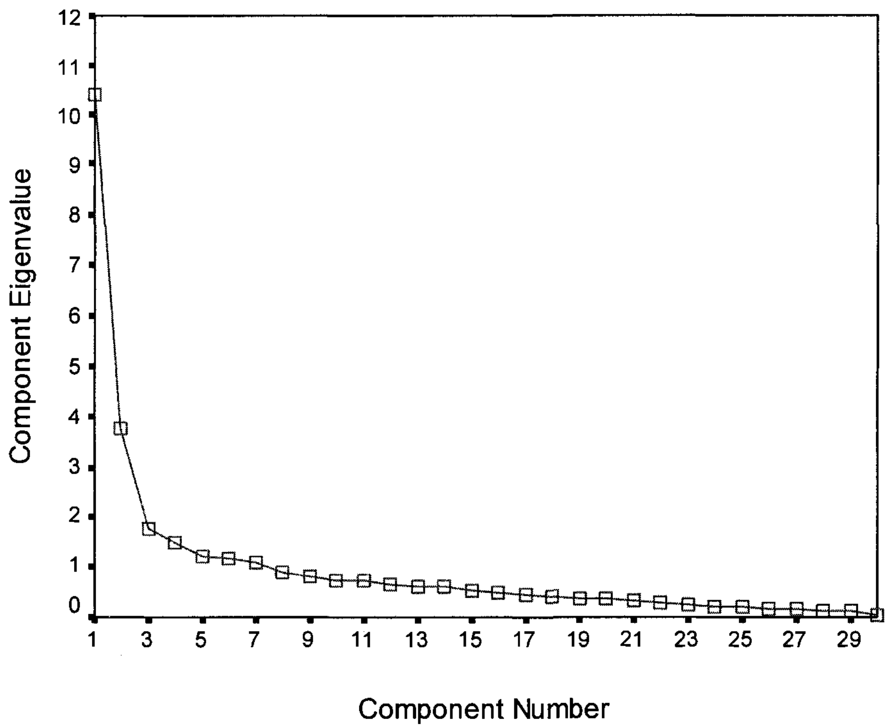

16
14
12
10
8
6
4
2
0
Frequency
35.0
45.0
55.0
65.0
75.0
85.0
95.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Spanish MARS-SV Totals
Std. Dev = 16.41
Mean = 61.3
N = 104.00

Figure Caption

Figure 3. Catell's Scree Test utilized in determining which components of the Spanish Mathematics Anxiety Rating Scale – Short Version (MARS-SV) to inlcude in the factor analysis.


Component Eigenvalue
12
11
10
9
8
7
6
5
4
3
2
1
0
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
Component Number