GENDER DIFFERENCES IN EXPECTANCY OF ACADEMIC SUCCESS IN MATHEMATICS

by

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ABSTRACT

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Our nation has made great strides toward achieving gender equality in education over the past twenty years. "Until 1980, Ivy League schools such as Columbia University did not even admit women whereas today, the majority of college students are women" (Sadker, 1999, p. 22). Now, more than even before, the door is wide open for women to seek and obtain careers that their mothers would have never thought possible. It is clear that major academic hurdles have been successfully cleared by and for women. It is also clear, though, that the race is not over and that women still fall short in several areas. One specific area of education we need to examine more closely if we truly want to establish complete academic gender equality is mathematics.

The purpose of this study was to examine the expected differences in college students' expectations of success in math. Specifically, the research hypothesis was that there would be a statistically significant difference between expectations of success in math of males and females, with males expecting to be successful more often than females.

Data was collected from 222 students, Freshman-Senior, using a Math Expectancy Questionnaire in Introduction to College Math courses at the University of Wisconsin-Stout in the spring of 2003. The results indicated that although there was no statistical significance in support of the hypothesis, in many cases females did not share the same expectations for mathematical success as did their male counterparts.

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CHAPTER ONE

Introduction

Our nation has made great strides toward achieving gender equality in education over the past twenty years. “Until 1980, Ivy League schools such as Columbia University did not even admit women whereas today, the majority of college students are women” (Sadker, 1999, p. 22). Now, more than ever before the door is wide open for women to seek and obtain careers that their mothers would have never thought possible. It is clear that major academic hurdles have been successfully cleared by and for women. It is also clear, though, that the race is not over and that women still fall short in several areas. One specific area of education we need to examine more closely if we truly want to establish complete academic gender equality is mathematics.

While exploring the gender differences in math achievement, Campbell and Storo (1996) found that certain myths have become widely accepted as truths. Once such myth is that “women are qualitative; men are quantitative” (p. 5). The result of this belief? Girls are much less apt than equally talented boys to go into math-related careers, including engineering and the physical sciences. Another such myth Campbell and Storo uncovered is “there is a sex-linked math gene” (p. 5). The result? Parents and teachers alike hold lower expectations for girls in math and science than they do for boys. In addition to these myths, numerous other explanations have been offered when attempting to explain why, historically, males have a tendency to outperform females in mathematics. Could it be that males are simply better with numbers? Or is it possible that, over the course of their educational careers, females receive subtle negative messages about their math ability, about others’ expectations of their ability, and that these messages have an incredible impact, not only on girls' self-concept about math ability, but also on math achievement.

In truth, it is these gender stereotypical attitudes over the years, held by teachers and absorbed by students, that play a major role in the future mathematical performance of females. In addition to attitudes, most models of orientation to math emphasize social factors such as gender stereotypes. And emphasizing social learning of the stereotype that math is not a domain in which girls can excel, results in girls turning away from math and related subjects (Banaji, Greenwald & Nosek, 2002).

> In support of this belief, Banaji, Greenwald, and Nosek (2002) found that: across all domains that require mathematical expertise, women participate less than men do. As level of education increases, the ratio of female to male participation in math and related sciences declines and at the college level women are poorly represented in math and math-intensive fields such as physical sciences (34%), math/computer science (35%), and engineering (16%). (p. 45)

It is evident that on average, women are less successful in mathematics than are men. Further, it is clear that math- and science-related careers continue to be dominated by men. And evidence is beginning to mount in support of the fact that the difference in mathematical success between men and women lies not within abilities, but within attitudes and expectations of success. Obviously this maladaptive societal attitude renders numerous problems, but perhaps most detrimental of all is the fact that females are not realizing their full potential, thus limiting them not only in the classroom, but also in future career choices.

Before we can attempt to accurately identify and solve this problem, we must first dissect and explore its many roots. The first major issue that needs to be explored is teachers' beliefs about gender differences, specifically in math ability. In his 1999 study of teachers' beliefs and gender differences in mathematics, Li (p. 63) found that "teachers have different beliefs about male and female students. They tend to stereotype mathematics as a male domain." This was evidenced by the fact that teachers had a tendency to overrate male students' mathematics capability, have higher expectations for male students, and hold more positive attitudes about male students.

A second area which needs to be examined is the difference I the amount of attention and the types of attention teachers give to boys as compared to that of girls in the classroom. Streitmatter (1997) found that "females receive less attention, both positive and negative, from teachers than do males" (p. 16). Additionally, Sadker and Sadker found that teachers' questioning methods and praise differed substantially for girls and boys. Specifically, "girls tend to be praised simply for trying, whereas teachers tend to withhold praise for boys until they produce a correct answer" (cited in Streitmatter, 1997, p. 16). Both of these circumstances in turn foster an atmosphere favorable to male learning while overlooking the needs of female students.

The third area which needs additional study is that in the classroom, females are less likely to engage in risk-taking activities such as asking questions and providing answers than are males. In support of this finding, Sadker and Sadker (cited in Streitmatter, 1997) found that "many girls are reluctant to take risks in coeducational classrooms in part due to boys' domination" (p. 18). As Streitmatter (1997) pointed out, the problem with this is that "students who are active participants in their own education tend to be higher achievers" (p. 18). Thus, without engaging in various risk-taking behaviors in the classroom, it is not possible for girls to achieve their full academic potential.

This leads to the fourth and final area of examination; girls' lack of self-confidence in their ability to perform math. A number of studies in the past ten years have revealed that the major reason females are not reaching their full potential in math is because of their lack of confidence. In his 1991 article, *Girls, math, and the glass ceiling*, Charles Shields stated:

> Confidence is one part of self-concept and has to do how sure a student is of his or her ability to learn new mathematics and do well on mathematical tasks. Confidence influences as student's willingness to approach new material and to persist when the material becomes difficult. Despite the immediate difficulty of the task, the student persists when she is confident that a solution will be found or that the material will be understood.

Thus, the key to unlocking females' full potential in mathematics is by fostering confidence in their abilities, beginning with the first math experience. Evidence that this has been accomplished will come in the form of girls, at all ages, demonstrating confidence in their mathematical abilities and holding the same high expectations for mathematical success as their male counterparts at all ages. To prove, however, that this is currently not the case, this study will explore the differences in perception of math abilities of students who have been through the primary education system and have accepted and fostered the belief that males are more successful in math than are females.

Statement of the Problem

The purpose of this study was to examine the expected differences in college students' expectations of success in math. Data was collected through a survey given to students in all seven sections of Introduction to College Math I at the University of Wisconsin-Stout in March of 2003.

Research Hypothesis

There will be a statistically significant difference between expectations of success in math of males and females, with males expecting to be successful more often than females.

Assumptions

This study assumed the seven sections of spring, 2003, Introduction to College Math I course would provide an ample and representative sample of students at the University of Wisconsin-Stout. Further, this study assumed the survey designed by the researcher was an adequate tool for measuring success expectations. Finally, this study assumed all participants would complete the survey in an honest and appropriate manner.

Limitations

Although the researcher expected a sample size large enough to be able to make generalizations specific to the University of Wisconsin-Stout, she was aware the sample size may not be large enough to make generalizations to other universities. Additionally, the date the survey was distributed to several of the College Math I sections, a test followed. Thus, students' anxiety level and level or preparedness for the test may have affected student responses to the survey. Additionally, the definition of academic success could vary substantially among students. Finally, the researcher was aware her survey may not have been sensitive enough to accurately reflect each student's expectations.

CHAPTER TWO

Literature Review

One hundred years ago, people believed it was not "healthy" for women to receive an education. Specifically, "doctors warned that education redirected blood, initially destined for the ovaries, to the brain. The result: Educated women would be less likely to reproduce and more likely to go insane" (Sadker, 1999, p. 24). Although a seemingly ridiculous statement today, that particular belief kept many women far from education years ago.

In the twenty-first century, we are seeing great advances in the area of women wanting and receiving an education. Unfortunately, there are still many misconceptions that keep women from receiving their Title IX right to access and opportunity in educational contexts where they previously had been excluded or only marginally included (Streitmatter, 1997).

Banaji, Greenwald, and Nosek, in their 2002 study, found that "stereotypes regarding women in math and sciences are well known (e.g., women do not like math, men are better at math)" (p. 50). These stereotypes are accepted by teachers and students early on in the student's academic career and over the years, are fostered by many. Unfortunately, various tests, including the SAT and the ACT, and other high-stakes tests continue to reflect a gender gap (Sadker, 1999). So it is, in fact, clear that when it comes to mathematics, a difference in performance level occurs between males and females. What is not clear is why the difference. What specific elements account for the differences in males' and females' level of performance in mathematics? And is it actually a deficit in abilities, or does it have more to do with environment than skill level?

This chapter will explore the four primary elements suspected to be responsible for the difference in mathematical performance of males and females. The first element of focus is teachers' beliefs about gender differences in math ability. The second element this chapter focuses on is the difference in the amount of attention and the types of attention teachers give to boys as compared to what they give girls in the classroom. The third element of focus is lack of classroom risk-taking behavior by females. The fourth and final element of focus in this chapter is girls' lack of self-confidence in their ability to perform math.

Teachers' Beliefs about Gender Differences in Math

In order to completely understand the gender gap in mathematical performance, one's attention must first be turned toward the beliefs and attitudes held by teachers. In his 1999 study, *Teachers' beliefs and gender differences in mathematics*, Li (p. 64) stated that "teacher behaviours are substantially influenced and even determined by teacher beliefs. These behaviours, in turn, substantially impact upon student beliefs and behaviours." Another gender and math study performed by Fennema et al. (cited in Li, 1999), found that teacher beliefs about male and female students in mathematics were different. And interestingly enough, Casserly (cited in Li, 1999) found that teachers do in fact believe that boys are better than girls at mathematics.

It has been said that a student will perform up or down to a teacher's expectations. Thus, if a teacher believes that his or her male students will perform better in math than will the female students, that will often be the case. And since Meyers and Koehler (cited in Shields, 1991) found that girls perceive their teachers and peers as having lower expectations for their success in math simply because they are girls, is it any surprise that female performance in mathematics lags behind male performance?

> Teachers perceived male students as being their best students. They tended to explain males' success in mathematics in terms of ability more often than they did for females, whose success was described more often in terms of effort. This way of attributing causation for female students is widely believed to have a negative impact on students' achievement. (p. 70)

Fennema et al. (cited in Li, 1999) found that teachers believed males in their classroom, when compared to females, where more "competitive, more logical, more adventurous, volunteered answers more often to mathematics problems, enjoyed mathematics more and were more independent in mathematics" (p. 70). Fennema et al. (cited in Li, 1999) also found that over all, teachers tend to stereotype mathematics as being a male domain. Such stereotyping results partially in differential treatment of males and females in the classroom and undoubtedly influences the development of gender differences in mathematics.

Campbell (cited in Li, 1999) believed that not only are teachers failing to lessen the gender gap, but they are a large part of the cause of differential gender differences that exist today. And although teachers claim to strive for equality in the classroom, Eccles and Parson (cited in Li, 1999) found that many math teachers are still reinforcing traditional behaviors and occupational plans for males and females, regardless of where student interest or talents lie. Additionally, Fox, Brody, and Tobin (cited in Li, 1999) found that quite commonly teachers tend to actively discourage non-traditional (e.g. mathematical) female interests. These actions by teachers are a major contributor in Sadker's (1999) finding that the majority of females who attend college choose to major in English, French, Spanish, music, drama, and dance, whereas the majority of males choose computer science, physics, and engineering programs as their major. And in a recent study of 14 school-to-work programs, the American Association of University Women Educational Foundation (cited in Sadker, 1999) found that more than 90 percent of females cluster in a few traditional careers including health care, teaching and education, graphic arts, and office technology.

So it is clear that teacher beliefs have had a devastating impact on female students. Teachers often view females as inadequate as compared to their male counterparts when it comes to math. Further, they view math as a male domain. And not only do these beliefs effect female mathematical performance, but they limit girls from realizing their full potential in their career opportunities.

Difference in Amount and Types of Attention

Although some differences in teacher interactions with males and females are overt in nature, others appear far more subtle. In *Failing at fairness*, Sadker and Sadker (cited in Sadker, 1999) described what they termed a "syntax of sexism," which is so elusive that most teachers and students are completely unaware of its influence. And albeit easy to point the finger at the teacher, the truth is that teacher education and staff development programs don't do nearly enough to prepare today's teachers to recognize these subtle, often unintentional, but none-the-less damaging gender biases that still characterize the classrooms (Sadker, 1999). Whether they are aware of it or not, though, the fact still remains that teachers interact with male students differently than they do with female students.

Interested in understanding further these gender differences in teacher-student interaction, Feldhusen and Willard-Holt (1993) found that teachers unconsciously make males the center of instruction. They also give males more frequent and focused attention than they do females. Although this attention wasn't necessarily wanted by the boys, or even noticed by the girls, it negatively impacted both.

In addition to focusing more of their attention toward the male students in their class, teachers also tend to focus different types of attention on students based on their gender. In her 1997 study, Streitmatter found that questioning methods and praise differed substantially for girls and boys. Specifically, she found that "girls tend to be praised simply for trying, whereas teachers tend to withhold praise for boys until they produce a correct answer" (p. 16). Because of this, both the male and female students in the classroom eventually recognize that the teacher expects more from the boys than the girls. And since Sadker (1999) found that increased teacher attention contributes to enhanced student performance, it is clear that "girls lose out in this equation" (Sadker, 1999, p. 24).

So why are teachers focusing more of their attention on their male students? There are several possible reasons, but the most recent research in this area found "that teachers tend to call upon boys more in class, partly because time is tight and teachers need to move the lesson along" (Angelo & Branch, 2002, p. 10). Thus, the classrooms may be moving along at a pace that is satisfactory to the teacher, but once again, it is at the expense of the female students.

Difference in Classroom Risk-Taking Behavior

Children partake in numerous forms of risk-taking behavior on a daily basis. Some of these risk-taking behaviors are deemed appropriate, while others are not. Streitmatter (1997) posited that "one appropriate place for young people to take risks as they explore who they are and will become is in the classroom" (p. 18). Further, she believes that encouraging children to partake in classroom risk-taking behaviors is not only necessary, but crucial as "classroom behavior is important to students' educational and psychosocial development" (p. 18). So the more a child engages in appropriate risk-taking behaviors in the classroom, the more fully developed he or she will become.

One particular childhood behavior that research has identified as risk-taking in the classroom is asking and answering questions. Although some may find humor in the idea that raising a hand in the classroom should be deemed a risk-taking behavior, the truth is that this behavior could result in a number of consequences, some quite unpleasant. Thus, it is clear that raising one's hand truly is taking a risk. Sadker and Sadker (cited in Streitmatter, 1997) found that "boys are much more likely to engage in classroom behaviors such as asking and answering questions than are girls" (p. 16). Additionally, they (cited in Streitmatter, 1997) found that "many girls are reluctant to take risks in coeducational classrooms in part due to boys' domination" (p. 18).

When testing her hypothesis that girls would, in fact, be more willing to take risks in all-female classrooms, Streitmatter (1997) found it true that "the students in a girls-only math program took academic risks repeatedly during their work with the teacher and each other" (p. 20). And with exception to the times when the teacher was talking, that there were very few moments throughout the class when a student was not asking a question. Overall, Streitmatter (1997) found that "the outgoing behavior of the girls, their sense of freedom to make their presence known in the girls-only class, and their willingness to take academic risks stood in sharp contrast to the behavior of most of the girls in the mixed-gender class" (p. 21).

In her 1994 study, Orenstein (cited in Streitmatter, 1997) spoke with several female students about their participation in coeducational math classes. The following is one of those responses:

> I don't raise my hand in my classes because I'm afraid I have the wrong answer and I'll be embarrassed. My self-confidence will be taken away, so I don't want to raise my hand even if I really do know. (p. 16)

Echoing that sentiment, another girl added "I'm not shy. But it's like, when I get into class, I just…I just can't talk" (p. 16).

When Orenstein (cited in Streitmatter, 1997) asked a teacher in the study to discuss how the girls and boys in her class viewed math, she got the following response:

> The boys see math as something that shows they're brainy and they like being able to show off that way. They're more risk-taking than the girls, so they'll do better on tests every time, even if the girls turn in all their work and the boys don't. (p. 16)

By no means does it seem a feasible solution to separate public classrooms according to gender. Yet one cannot help but acknowledge the fact that research indicates females feel safer and are more willing to contribute in classrooms that aren't male-dominated. The answer, then, lays not in separation of the sexes, but in providing equal, safe environment for all students.

Girls' Lack of Self-Confidence in Math Ability

Our Nation's education system sends girls a very clear message. "Math is not a domain in which girls can excel" (Banaji, Greenwald, & Nosek, 2002, p. 45). Although this message is sent beginning at a very early age, its full impact isn't always recognized until much later. The result: Girls gradually lose self-confidence in their ability to perform mathematical tasks and eventually turn away from math and related subjects all together. In her 1997 study, Streitmatter found that:

> Girls in elementary school describe themselves as confident in doing math. However, as they go through middle school, this confidence, and the degree to which girls consider math a subject in which it is appropriate for girls to achieve, decline. (p. 17)

And as a number of studies during the last decade point out (Tapia & Marsh, 2000; Streitmatter, 1997; Shields, 1991), the true barrier standing between girls and reaching their full potential in mathematics is lack of confidence.

Fennema and Sherman created an instrument known as the Fennema-Sherman Mathematics Attitude Scale to further explore the correlation between math confidence and math performance. Their findings (cited in Shields, 1991, p. 8) indicated that "when a gender difference in mathematics achievement in favor of males was found, it was accompanied by a gender difference in confidence, also in favor of males." Interestingly enough, the Fennema and Sherman studies (cited in Shields, 1991) found that gender differences in confidence existed even when there were no differences in achievement. "At both the middle and high school levels, females reported lower levels of confidence in their ability to learn mathematics than did males" (p. 8).

Additional research in this area by Shields (1991) found that:

> confidence has become so important a factor in understanding why girls don't generally score as well on math tests as boys, or why they don't take as many math courses, that it

has begun to eclipse what was earlier thought to be at the heart of gender differences in math achievement. (p. 8)

Frost, Hyde, and Fennema (cited in Odell & Schumacher, 1998) found males to be more confident in their ability to perform mathematical tasks, more expectant of mathematical success, and more positive in their attitudes about mathematics. Having confidence in one's abilities and having the expectation of success, then obviously increases one's chances for success. Similarly, having the expectations of failure and being filled with self-doubt strongly increases the likelihood of failure.

In addition to the obvious problems with lack of self-confidence in one's ability to perform in math, it can also be damaging in other, smaller ways. For example, it is a well-known fact that math is a step-by-step process, often compared to that of putting together a puzzle. In order to get the correct answer in the end, or to complete the puzzle, each step or piece of the equation leading up to the final answer must be performed flawlessly. For a student who believes in his or her mathematical abilities, he or she perseveres toward the final answer in spite of the challenges along the way. For a student who is not confident in his or her abilities, however, one minor setback could cause him or her to give up on the entire problem as he or she believes the final answer will be incorrect. Thus, the student who lacks self-confidence leading to a lack in self-motivation will most likely be unsuccessful.

Charles Morrow, co-director of Summermath, an all-girls math program at Mount Holyoke College in South Hadley, Massachusetts (cited in Shields, 1991), stated that "as you go along in learning math, the farther you go, the less clear it becomes how much progress you're making toward solving the problem. To succeed requires the ability to be self-motivated" (p. 9). Clearly, a student who is not self-confident cannot and will not be self-motivated.

In their exploration of the idea that gender inequities still exist, Angelo and Branch (2002) found that "the key to improving the balance between boys and girls when it comes to math and science lies in reaching the student early" (p. 10). It is not acceptable to attempt to begin fostering female self-confidence in math abilities in high school or college. Research (Angelo & Branch, 2002) has proven that, in fact, "it's almost too late by the fifth grade" (p. 10). The goal should not be to intervene and fix the damage that has already been done. Instead a proactive approach is far more feasible. From the first moments of a female student's interactions with math, she must be encouraged and her self-confidence must be fostered to ensure that her confidence in her mathematical abilities will be equally as strong as that of her male counterparts.

CHAPTER THREE

Methodology

Introduction

This chapter includes how the sample was selected, a description of the sample from which the data was collected, the procedure for determining what data was used, how it was obtained, and the methods that were used for analyzing the statistical data. This chapter will conclude with the methodological limitations.

Subject Selection and Description

The University of Wisconsin-Stout is a mid-sized, public, Midwestern institution with an enrollment of approximately 7,000 full-time students. All subjects in this study were students enrolled at the University of Wisconsin-Stout and were in one of the seven sections of the 2003 spring semester Introduction to College Math I course. Each of the Introduction to College Math I professors was contacted for the purposes of requesting permission to distribute surveys to their students, and each professor granted the researcher permission to distribute those surveys.

Instrumentation

The survey for this study was designed so students could fill it out easily and efficiently. It consisted of three basic demographic questions (age, gender, and major) and twelve Likert items, focusing on individual student perceptions in four areas: math talent, success expectations in math, math interest, and the utility of math. Some of the items were constructed using another research instrument (Watt, 2001). However, that instrument did not meet the specific needs of this study, so an original survey was designed. Because it was constructed specifically for this study, no measures of validity or reliability were performed on this instrument. A copy of the finalized survey is located in Appendix A.

Data Collection

Permission to collect data for the purpose of this research was sought from the University of Wisconsin-Stout in February of 2003. Upon being granted permission to conduct this research, a current timetable providing a list of all sections of the Introduction to College Math I was obtained through AccessStout and from that timetable, the list of professors teaching all sections of Introduction to College Math I was obtained. In March of 2003, permission to collect data was sought and granted from the professors of all seven sections of Introduction to College Math I. Subsequently, paper surveys were distributed to students in all seven sections after being provided with a brief explanation of the study by the researcher. Students were given ample time to complete all items on the survey, with the average time of completion being between two and three minutes, and the survey was collected by the researcher.

Data Analysis

The data was analyzed using a computerized statistics package called SPSS-X for the PC. Data was ordinal in nature, therefore all appropriate descriptive statistics were utilized. In addition, cross tabulations to determine whether there were differences between genders were run on the data. Kendall's tau-b and Gamma were also run to determine whether there were statistically significant differences by gender.

Limitations

One limitation of the instrument is that no measure of validity or reliability was performed prior to its distribution. Also, although all seven sections of Introduction to College

Math I were surveyed, no other math classes at the University participated in this research. Therefore, results should be used exclusively for the purpose of making generalizations about the University of Wisconsin-Stout's Introduction to College Math I students, not other populations.

CHAPTER FOUR

Results

Introduction

This chapter will include the results of this study. Demographic information and item analysis will also be discussed. The chapter will then conclude with the research hypothesis under investigation.

Demographic Information

The demographic information was ordinal in nature and was, therefore, analyzed using all appropriate descriptive statistics. All students present for class in all seven sections of Introduction to College Math I on the day surveys were distributed participated in this research. Thus, the total number of students who participated in this research was 222.

Of the 222, 108 (48.6%) were male students and 114 (51.4%) were female students. One hundred and twenty of the participants (54.1%) were freshman; 56 (25.2%) were sophomores; 28 (12.6%) were juniors; and 18 (8.1%) were seniors.

Of the 28 undergraduate majors offered at the University of Wisconsin-Stout, 25 of these majors were represented in this study. For a complete list of those majors represented, please refer to Appendix B attached hereto.

Item Analysis

Item analysis was done using Kendall's tau-b and Gamma to determine whether there were statistically significant differences by gender. Item 4 of the survey asked "Compared to other students in your current math class, how talented do you consider yourself to be in math?" Student responses ranged between 1 (not at all talented) and 7 (very talented). Eight (3.6%) of the students surveyed, responded by circling a 1, indicating that they were not at all talented; 17 (7.7%) of the students circled a 2; 24 (10.8%) of the students circled a 3; 61 (27.5%) of the students circled a 4; 66 (29.7%) of the students circled a 5; 36 (16.2%) of the students circled a 6; and 10 (4.5%) of the students surveyed circled a 7, indicating that they were very talented.

Item 5 of the survey asked "Compared to your FEMALE friends, how talented do you consider yourself to be in math?" Student responses ranged between 1 (not at all talented) and 7 (very talented). Nine (4.1%) of the students circled a 1; 16 (7.2%) of the students circled a 2; 28 (12.6%) of the students circled a 3; 63 (28.4%) of the students circled a 4; 56 (25.2%) of the students circled a 5; 39 (17.6%) of the students circled a 6; and 10 (4.5%) of the students circled a 7.

Item 6 of the survey asked "Compared to your MALE friends, how talented do you consider yourself to be in math?" Student responses ranged between 1 (not at all talented) and 7 (very talented). Eight (3.6%) of the students circled a 1; 21 (9.5%) of the students circled a 2; 33 (14.9%) of the students circled a 3; 57 (25.7%) of the students circled a 4; 60 (27%) of the students circled a 5; 36 (16.2%) of the students circled a 6; and 6 (2.7%) of the students circled a 7.

Item 7 asked "How well do you expect to do on your next math exam/quiz?" Student responses ranged between 1 (not at all well) and 7 (very well). Only one (.5%) student circled a 1; 7 (3.2%) of the students circled a 2; 21 (9.5%) of the students circled a 3; 31 (14%) of the students circled a 4; 60 (27%) of the students circled a 5; 72 (32.4%) of the students circled a 6; and 30 (13.5%) of the students circled a 7.

Item 8 asked “How well do you expect to do in this math class for this semester?” Student responses ranged between 1 (not at all well) and 7 (very well). Only one (.5%) student circled a 1; 6 (2.7%) of the students circled a 2; 20 (9%) of the students circled a 3; 28 (12.6%) of the students circled a 4; 72 (32.4%) of the students circled a 5; 66 (29.7%) of the students circled a 6; and 29 (13.1%) of the students circled a 7.

Item 9 asked “How well do you expect to do, overall in math, throughout your college career?” Student responses ranged between 1 (not at all well) and 7 (very well). Two (.9%) students circled a 1; 6 (2.7%) of the students circled a 2; 16 (7.2%) of the students circled a 3; 45 (20.3%) of the students circled a 4; 88 (39.6%) of the students circled a 5; 51 (23%) of the students circled a 6; and 13 (5.9%) of the students circled a 7.

Item 10 asked “How much do you like math, compared with other classes you are currently taking?” Student responses ranged between 1 (much less) and 7 (much more). Thirty-nine (17.6%) of the students circled a 1; 44 (19.8%) of the students circled a 2; 31 (14%) of the students circled a 3; 36 (16.2%) of the students circled a 4; 40 (18%) of the students circled a 5; 17 (7.7%) of the students circled a 6; and 15 (6.8%) of the students circled a 7.

Item 11 asked “How interesting do you find math?” Student responses ranged between 1 (not at all interesting) and 7 (very interesting). Thirty-two (14.4%) of the students circled a 1; 38 (17.1%) of the students circled a 2; 38 (17.1%) of students circled a 3; 50 (22.5%) of the students circled a 4; 47 (21.2%) of the students circled a 5; 12 (5.4%) of the students circled a 6; and 5 (2.3%) of the students circled a 7.

Item 12 asked “How enjoyable do you find math?” Student responses ranged between 1 (not at all enjoyable) to 7 (very enjoyable). Thirty-eight (17.1%) of the students circled a 1; 42

(18.9%) of the students circled a 2; 43 (19.4%) of the students circled a 3; 42 (18.9%) of the students circled a 4; 36 (16.2%) of the students circled a 5; 15 (6.8%) of the students circled a 6; and 6 (2.7%) of the students circled a 7.

Item 13 asked "How useful do you believe math to be?" Student responses ranged between 1 (not at all useful) and 7 (very useful). Six (2.7%) of the students circled a 1; 21 (9.5%) of the students circled a 2; 21 (9.5%) of the students circled a 3; 46 (20.7%) of the students circled a 4; 54 (24.3%) of the students circled a 5; 45 (20.3%) of the students circled a 6; and 29 (13.1%) of the students circled a 7.

Item 14 asked "How useful do you think math is in the everyday world?" Student responses ranged between 1 (not at all useful) and 7 (very useful). Two (.9%) of the students circled a 1; 22 (9.9%) of the students circled a 2; 26 (11.7%) of the students circled a 3; 43 (19.4%) of the students circled a 4; 57 (25.7%) of the students circled a 5; 43 (19.4%) of the students circled a 6; and 29 (13.1%) of the students circled a 7.

Item 15 asked "How useful do you think math skills will be in your future career?" Student responses ranged between 1 (not at all useful) and 7 (very useful). Four (1.8%) of the students circled a 1; 25 (11.3%) of the students circled a 2; 29 (13.1%) of the students circled a 3; 52 (23.4%) of the students circled a 4; 39 (17.6%) of the students circled a 5; 44 (19.8%) of the students circled a 6; and 29 (13.1%) of the students circled a 7.

Cross Tabulations

Cross tabulations to determine whether there was a difference between genders was also run on Items 5 and 6. Item 5 asked "Compared to your FEMALE friends, how talented do you consider yourself to be in math?" Student responses ranged between 1 (not at all talented) and 7 (very talented). Of the 9 students who circled a 1, indicating that they were not at talented, 6 (66.7%) were male and 3 (33.3%) were female. Of the 16 students who circled a 2, 9 (56.3%) were male and 7 (43.8%) were female. Of the 28 students who circled a 3, 12 (42.9%) were male and 16 (57.1%) were female. Of the 63 students who circled a 4, 36 (57.1%) were male and 27 (42.9%) were female. Of the 56 students who circled a 5, 27 (48.2%) were male and 29 (51.8%) were female. Of the 39 students who circled a 6, 11 (28.2%) were male and 28 (71.8%) were male. Of the 10 students who circled a 7, indicating that they were very talented in math compared to their female friends, 6 (60%) were male and 4 (40%) were female.

Item 6 asked "Compared to your MALE friends, how talented to you consider yourself to be in math?" Student responses ranged between 1 (not at all talented) and 7 (very talented). Of the 8 students who circled a 1, 3 (37.5%) were male and 5 (62.5%) were female. Of the 21 students who circled a 2, 10 (47.6%) were male and 11 (52.4%) were female. Of the 33 students who circled a 3, 12 (36.4%) were male and 21 (63.6%) were female. Of the 57 students who circled a 4, 32 (56.1%) were male and 25 (43.9%) were female. Of the 60 students who circled a 5, 28 (46.7%) were male and 32 (52.3%) were female. Of the 36 students who circled a 6, 17 (27.2%) were male and 19 (52.8%) were female. Of the 6 students who circled a 7, indicating that they were very talented in math compared to their male friends, 5 (83.3%) were male and 1 (16.7%) was female.

<u>Research Hypothesis</u>

There will be a statistically significant difference between expectations of success in math of males and females, with males expecting to be successful more often than females. With respect to this hypothesis, no statistical significance was found. Therefore, this researcher has rejected the hypothesis.

CHAPTER FIVE

Discussion, Conclusions, and Recommendations

Introduction

This chapter will include a discussion of results from the Math Expectancy Questionnaire, focusing on Question 4. This chapter will then refer back to the four primary elements suspected to be responsible for the differences in mathematical performance of males and females, previously discussed in Chapter Two, and the research hypothesis posed Chapter One. This chapter will conclude with recommendations for further study in this area of research.

Discussion of Math Expectancy Questionnaire - Question 4

The results of the Math Expectancy Questionnaire indicated that the effect of the variable gender was insignificant when determining students' success expectations in mathematics. As was mentioned in Chapter 4, questions were based on a seven-point scale. The researcher's interpretation of this scale was that students choosing to respond to questions by circling a 1 held absolutely no expectancy for success in their mathematical abilities. Students responding by circling either a two or a three held fairly low expectations for success. Students circling a 4 held average expectations for success in mathematics. Students circling either a 5 or a 6 held high expectations for success in mathematics. Finally, students answering questions by circling a 7 held the highest possible expectations for mathematical success.

Of the eight students who responded to Question 4 by circling a 1, four students were male and four were female indicating no disparity between genders with respect to holding the lowest expectations for academic success in mathematics. However, of the 41 students who responded to Question 4 by circling either a 2 or a 3, indicating that they had fairly low expectations for success in their mathematical abilities, just slightly more than half (21) were females, while twenty were males, indicating a very subtle difference in expectancy of mathematical success where females held lower expectations than did males. Of the students responding to Question 4 by circling a 4 (hold an expectation of average success), 36 (57.1%) were males and 27 (42.9%) were females. This shows a greater difference in expectations of success, with males expecting average success in math more often than females. Interestingly enough, of the 95 students who indicated by circling either a 5 or a 6 that they held high expectations for mathematical success, 57 were females, while only 38 were males. Finally, of the 10 students who reported that they held the highest expectations for their success in mathematics, 6 were males and 4 were females.

Discussion of Four Primary Elements and Research Hypothesis

In Chapter Two, the researcher described what were believed to be the four primary elements responsible for the differences in mathematical performance of males and females. Those elements were teachers' beliefs about gender differences in math ability; differences in the amount and types of attention teachers give to boys as compared to what they give girls in the classroom; lack of classroom risk-taking behaviors by females, and girls' lack of self-confidence in their ability to perform math. Some would say that based on the results of this study, those elements are no longer a factor, as males and females appear to have no significant differences in expectations of mathematical success. But the conclusions to be drawn from the data collected in the Math Expectancy Questionnaire could be interpreted several different ways. Yes, it is true that no statistical significance was found to support the hypothesis of a difference between expectations of success in math of males and females, with males expecting to be successful slightly more often than females. However, the data does show that gender differences, however slight they may be, do exist in expectancies of mathematical success, and that the four primary elements outlined earlier continue to have a negative impact on females' self-confidence to perform mathematics. The only time female expectations surpassed those of male expectations for success was when females were expecting "average" or "slightly above average" success. At no time did female expectations of being successful in math match or surpass males when talking about expectancy of the highest level of mathematical success.

As was stated in Chapter Two, Fox, Brody, and Tobin (cited in Li, 1999) found that quite commonly teachers tend to actively discourage non-traditional (e.g. mathematical) female interests. These actions by teachers are a major contributor in Sadker's (1999) finding that the majority of females who attend college choose to major in English, French, Spanish, music, drama, and dance, whereas the majority of males choose computer science, physics, and engineering programs as their major. Although the University of Wisconsin-Stout does not offer many of the majors Sadker (1999) identified as being chosen most often by females, it does offer two of the three majors listed as being chosen most often by males, those being computer science and engineering. And of the 14 participants in the current research who identified either computer science or engineering as their major, twelve were males and only two were females; thus, lending modest support to Sadker's (1999) previous findings.

Another finding stated in Chapter Two was that of 14 school-to-work programs, the American Association of University Women Educational Foundation (cited in Sadker, 1999) found that more than 90 percent of females cluster in a few traditional careers including health care, teaching and education, graphic arts, and office technology. The University of Wisconsin-

Stout offers several of the majors which would lead to those careers listed in said study, those being early childhood/art education, art (graphic design), human development and family studies, and vocational rehabilitation. Twenty-six of the participants in this study listed one of these three categories as their major and of those 18 were females and 8 were males. Although this doesn't support the 90 percent female cluster found in the American Association of University Women Educational Foundation (cited in Sadker, 1999), it does indicate that well over fifty percent of the women in the current study have intentions of seeking a career in one of the fields traditionally labeled as being "female oriented."

Conclusions

As the researcher stated previously, the key to unlocking females' full potential in mathematics is by fostering confidence in their abilities, beginning with the first math experience. Evidence that this has been accomplished will come in the form of girls, at all ages, demonstrating confidence in their mathematical abilities and holding the same high expectations for mathematical success as their male counterparts at all ages. Based on the findings in this study that at the college level female expectations neither matched nor surpassed male expectations for achieving the highest level of mathematical success, it is clear that in fact females' full potential in mathematics has not been reached at all ages. Even though many females reported being confident in their mathematical abilities, others did not. And while doubt is still being housed in the minds of many who have yet to overcome the belief that females are inferior in their abilities to perform mathematics at the same level of success as their male counterparts, expectations will continue to favor male students and be a disadvantage to female students.

Recommendations for Future Research

In addition to recommending a larger sample size and distributing the questionnaire to a wider age-range of subjects to include elementary, middle, and high school students, future research studies should continue to focus on expectations of mathematical success in students, as the researcher believes that further studies and investigation would yield statistical significance to support the position that indeed males do expect mathematical success more often than do females.

One possible way to increase the chances of finding statistical significance in this area would be to make revisions to the Math Expectancy Questionnaire. One suggested revision would be the removal of the words “your female friends” in Questions 5 and replacement with the words “other females.” The same change would be suggested in Question 6 with the removal of the words “your male friends” and replacement with the words “other males”. These changes are suggested based on the fact that the researcher fears using the words “your female friends” and “your male friends” might have had a negative and/or limiting impact on the answers provided by subjects in the current study.

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APPENDIX A

MATH EXPECTANCY QUESTIONNAIRE
PAGE 1

1. What is your college major? ____

2. What year are you? Freshman ____ Sophomore ____ Junior ____ Senior ____

3. What is your gender? Male _____ Female _____

4. Compared to other students in your current math class, how talented do you consider yourself to be in math?
   (not at all talented) (very talented)
   1 2 3 4 5 6 7

5. Compared to your FEMALE friends, how talented do you consider yourself to be in math?
   (not at all talented) (very talented)
   1 2 3 4 5 6 7

6. Compared to your MALE friends, how talented do you consider yourself to be in math?
   (not at all talented) (very talented)
   1 2 3 4 5 6 7

7. How well do you expect to do on your next math exam/quiz?
   (not at all well) (very well)
   1 2 3 4 5 6 7

8. How well do you expect to do in this math class for this semester?
   (not at all well) (very well)
   1 2 3 4 5 6 7

9. How well do you expect to do, overall in math, throughout your college career?
   (not at all well) (very well)
   1 2 3 4 5 6 7

10. How much do you like math, compared with other classes you are currently taking?
    (much less) (much more)
    1 2 3 4 5 6 7

PLEASE CONTINUE ON PAGE 2

PAGE 2

11. How interesting do you find math?

(not at all interesting)						(very interesting)
1	2	3	4	5	6	7

12. How enjoyable do you find math?

(not at all enjoyable)						(very enjoyable)
1	2	3	4	5	6	7

13. How useful do you believe math to be?

(not at all useful)						(very useful)
1	2	3	4	5	6	7

14. How useful do you think math is in the everyday world?

(not at all useful)						(very useful)
1	2	3	4	5	6	7

15. How useful do you think math skills will be in your future career?

(not at all useful)						(very useful)
1	2	3	4	5	6	7

Additional comments:

Thank you for your participation in this study.

APPENDIX B

B.S. in Apparel Design and Development
- Apparel Design
- Apparel Development
- Apparel Product Management

B.S. in Applied Mathematics and Computer Science
- Actuarial Science
- Business Management
- Software Development

B.S. in Applied Science
- Technical Sales and Support
- Scientific Laboratory Management

B.F.A. in Art
- Graphic Design
- Industrial Design
- Interior Design
- Multimedia Design

B.S. in Art Education

B.S. in Career, Technical Education and Training

B.S. in Construction

B.S. in Dietetics

B.S. in Early Childhood
- General Program
- Certification Program

B.S. in Engineering Technology
- Facilities
- Mechanical Design
- Plastics
- Production Operations

B.S. in Family and Consumer Sciences Education

B.S. in Food Systems and Technology
- Food Communication

Food Merchandising and Distribution
Food Science
Food Systems Management

B.S. in General Business Administration

B.S. in Graphic Communications Management

B.S. in Hotel, Restaurant and Tourism Management

B.S. in Human Development and Family Studies
Child Development and Family Services

B.S. in Industrial Management

B.S. in Manufacturing Engineering

B.S. in Marketing Education
Business Education Certification

B.S. in Packaging

B.A. in Psychology

B.S. in Retail Merchandising and Management
Buying/Management
Fashion Marketing
Human Resource Management
Interior Decorating

B.S. in Service Management

B.S. in Technical Communication

B.S. in Technology Education

B.S. in Telecommunication Systems

B.S. in Vocational Rehabilitation
Community Based Rehabilitation
Criminal Justice
Independent Living Rehabilitation
Individualized

Psychiatric Rehabilitation
Recreational Rehabilitation
Rehabilitation Counseling
Rehabilitation Technology
Social Work
Special Education Certification