# THE RELATIONSHIP OF MOTIVATION TO PEER TUTORING AND GRADES IN COLLEGE MATHEMATICS

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ABSTRACT

The two studies reported here investigated the efficacy of peer tutoring offered in the setting of a university tutoring center as an intervention to improve academic performance among students enrolled in a college algebra course. The Motivated Strategies for Learning Questionnaire (MSLQ) was used to investigate the motivational profiles of those who used the tutoring center and those who did not. Motivational profiles were examined in order to determine if a particular profile would predict help-seeking behavior (i.e., utilizing the university tutoring center).

This research utilized two samples and was divided into two parts. The sample for study one included 1124 college students who attended a large urban university in the northeastern United States and were enrolled in a college algebra course during the fall semester of 2008. One Hundred Ninety Six of the students in this sample used the university tutoring center at least one time during that semester. The sample population involved in study two included 254 students from the study one sample who volunteered to complete the motivation subscales from the MSLQ. One Hundred Ten of the students in the second sample used the tutoring center at least one time during that semester.

Results of an ANOVA demonstrated that the difference in the final algebra grade between students who used the Center and those who did not was not statistically significant. A Pearson correlation computed between the number of times a student visited the tutoring center and final course grade in college algebra was not significant. An ordinary least squared (OLS) regression revealed that high school GPA, SAT Quantitative score, gender, and ethnicity were significant predictors of final course grade. A MANOVA revealed that tutoring center users possessed significantly lower self-efficacy for learning and performance and control of learning beliefs than non-users. A binary logistic regression demonstrated that self-efficacy for learning and performance significantly predicted tutoring center usage above and beyond all demographic variables. An ordinary least squares regression revealed that low self-efficacy for learning, higher task value, higher year in school, and low test anxiety were significant predictors of more frequent tutoring center usage. A MANOVA revealed that those who used the tutoring center most frequently had significantly lower self-efficacy and control of learning beliefs and were significantly higher in age and year in school.

Dedicated to my mother, Sybil Mendelsohn.

I would not have made it this far

without you.

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# CHAPTER 1

## INTRODUCTION

The national economic landscape in the United States has become increasingly difficult for today's young adults to navigate. Gainful employment is harder to come by and possessing the necessary skills for jobs that are available has become more essential than ever before. College degrees hold more value today than they may have in the past due to increasing competition in the job market and the increasing scarcity of unskilled jobs that one may have obtained with only a high school diploma in the past. According to a report from the Urban Institute for US Department of Labor (1999), demand for skilled labor continues to rise due to technological advancements, deregulation of industry, and the decline in labor unions. The United States Department of Labor's (2014) data on employment for citizens age 25 and up shows that, as of September 2014, the unemployment rate for those who have completed a four-year college degree program was 2.9 percent, while it was 5.3 percent for those who have only obtained a high school diploma. In addition to being in less demand in the labor force, individuals who have only obtained a high school diploma earn significantly less than those with college degrees. According to the United States Department of Education

National Center for Education Statistics (2014), the median yearly earnings for an individual with a college degree in 2012 was $46,900, while individuals with only high school diplomas had a median yearly income of $30,000. This pattern has remained steady since 1995.

Despite the importance of a college degree, the rate of attrition from college is high. According to Bound and Turner (2011), about half the students that enroll in college in the United States fall short of receiving a bachelor's degree within five years. This trend has remained steady since the 1970s. The rate of attrition among those in the STEM (science, technology, engineering, and math) fields is even higher than that of students in other fields. According to Daempfle (2004), first year math and science majors are at an increasingly higher risk of switching majors than those majoring in other areas. Chang, Cerna, Han, and Saenz (2008) found that approximately 40 percent of students that had planned to major in math-oriented fields like engineering and science end up switching to other subjects or dropping out of school entirely. The majority of these students drop out within their first two years of enrollment. This is double the rate of attrition when compared to all other majors, and this rate increases to 60 percent for students who are pre-

med. According to a report from the U.S. Congress Joint Economic Committee (2012), the demand for workers in STEM fields is steadily increasing yet colleges and universities are failing to produce graduates in STEM areas. The report further states that the overall number of bachelor's degree holders has increased, the number of bachelor's degrees earned in STEM fields has decreased. A decrease in the number of American workers with STEM degrees has a negative effect on the nation's ability to compete in the global marketplace. It is estimated that while only about five percent of the U.S. workers are employed in STEM fields, these workers have accounted for more than 50 percent of the nation's sustained economic growth (Babco, 2004). The Business Roundtable (2005) predicted that if this trend remained steady, it would be likely that over 90 percent of the world's future scientists and engineers will reside in Asia.

Research investigating how to avert this trend with remedial strategies such as peer tutoring is limited. According to Bahr (2008), there are very few large-scale, methodologically sound studies that have evaluated the effectiveness of college remedial programs focusing on mathematics. The author also noted that almost the entire body of small-scale studies evaluating college remedial

programs were flawed and contained “findings of questionable value” (p.421). Bahr goes on to state that mathematics is the area in which students typically need the most remediation.

Peer tutoring is one type of remedial strategy that could be potentially beneficial for college students struggling in the area of mathematics. Lee (1988) surveyed 93 colleges and made a comparative analysis of remedial programs that were aimed at reducing drop out rates and increasing retention. Lee found that peer tutoring proved to be one of the more effective methods of remediation and was also one of the most cost effective. Topping (1996) identified 18 studies conducted between the years 1984 and 1994 that looked into peer tutoring delivered by upper year undergraduates to lower year undergraduates. He noted that the majority of these studies only collected subjective feedback. Three of the studies were able to demonstrate that peer tutoring was associated with a reduction in the dropout rate. Five of the studies were able to demonstrate improved academic achievement. However, Topping only considered two of the 18 studies to be “good quality studies” (p. 327).

The bulk of the peer-tutoring research conducted over the past 20 years has been outside of the domain of college

mathematics; much has been investigated with primary and secondary students in various areas. It has been demonstrated to be an effective intervention in reading (e.g., Bagley & Mallick, 1996; Harris, Marchand-Martella, & Martella, 2000; Kettmann-Klingner & Vaughn,1996). Peer tutoring has also been demonstrated to be an effective intervention in regard to improving the behavior of students with emotional and behavioral disorders (Presley & Hughes, 2000). There are also studies that have identified peer tutoring as an effective intervention when used with students that possess moderate to severe disabilities (e.g., Martella, Marchand-Martella, Young, & Macfarlane, 1995; McDonnell, Mathot-Buckner, Thorson, & Fister, 2001). Roswal et al. (1995) even demonstrated that peer tutoring reduced dropout rates among at-risk urban middle school students.

In light of the body of research that shows the potential benefits of peer tutoring interventions, it may be important to examine what might drive a student to seek out this type of help at the college level. Students in primary and secondary schools will typically be subjected to academic interventions and remedial strategies via their teacher or other school staff. At the post-secondary level, it is the responsibility of the student to obtain academic

assistance. For example, a college or university may provide various forms of peer tutoring, yet it is up to the student to access them. Getting students to utilize these academic interventions may be a challenge for some colleges and universities. Understanding student motivational profiles may help predict which students may be more likely to seek help and why. This could lead universities to devise new ways to reach these particular students and inform them about assistance that may be available.

This study adds to the sparse literature on peer tutoring and its impact on student achievement in college mathematics. There are few studies in general that investigate peer tutoring in mathematics at any grade level and there is a particular lack at the college level. In addition, there are no published research studies at the college/university level that have examined peer-tutoring effectiveness in mathematics while examining the role motivation for learning plays in those students who seek out peer-tutoring assistance. As previously noted, 40 percent of STEM majors change their major or fail to earn a degree at all. Offering peer-tutoring services to students having difficulty in these areas and understanding their motivation to use these services may serve to reduce overall student attrition in these essential fields of

study. College algebra was the focus of the current study due to the generalizability of the course material with lower level college mathematics classes and high school mathematics. As a practicing school psychologist who works with high school students, I was also interested to see if the results of this study could benefit high school students. If peer tutoring is a successful academic intervention at the college level with the material taught in this course it might be feasible to implement similar interventions with high school students that are struggling in mathematics.

The research questions and sub-questions addressed in this study are as follows:

1. Do students' final course grades differ according to whether they used peer tutoring at the university tutoring center?
    a. Is there a significant association between frequency of use of the university tutoring center and final course grade in college algebra?
    b. Do any of the variables outside of tutoring center usage, which include high school GPA, SAT Quantitative and Verbal scores, ethnicity, gender, and full-time versus part-time

enrollment have significant associations with final course grades in college algebra?

2. Is there a significant difference between the students who used the tutoring center and the students who did not in any of the six areas of motivation measured by the Motivated Strategies for Learning Questionnaire?
    a. Do any of the six motivational areas measured by the MSLQ predict student usage of the tutoring center above and beyond predictions based on ethnicity, gender, age, year in school, and living arrangement?
    b. Does ethnicity, gender, age, year in school, or living arrangement significantly predict how often a student used the tutoring center?

# CHAPTER 2

# REVIEW OF THE LITERATURE

## Peer Tutoring In Mathematics At The College Level

The following is an overview of the peer reviewed studies conducted from the year 2000 through the year 2014 concerning the implementation, effectiveness, and attitudes towards peer tutoring in mathematics at the university level. Much of the research in this area has been focused on qualitative experience of tutors and tutees. Only a small amount of the research on peer tutoring at the university level in mathematics has focused on its association with academic achievement. The following studies have been included in this chapter to provide a backdrop for what research has been done in this area and to demonstrate that some studies have shown that peer tutoring in mathematics at the university level can improve academic achievement among students enrolled in college math courses.

Halcrow and Iiams (2011) conducted a study in which they examined the effect peer tutoring, provided by an on campus center, had on student achievement across four freshman level math courses (college algebra, pre-calculus, applied calculus, and calculus I) at the University of North Dakota. In addition, the investigators took a

qualitative look into how some of the students felt about their time in the tutoring center. The quantitative portion of the study compared control group and experimental groups who were equally matched as far as prior mathematical knowledge (based on ACT scores). Only the control and experimental groups composed of college algebra students had statistically significant differences in prior mathematical knowledge. The control groups were given information about the campus tutoring center (Mathematics Learning Center) and were encouraged to use its services, but were not required to attend. The experimental groups were given the same information regarding the center, but they were required to attend tutoring at a minimum of one hour per week. This attendance also constituted five percent of their final grade. The students in these groups would receive a zero for that portion of their grade if they did not meet the attendance requirement. Results indicated that there were positive correlations between average time spent at the tutoring center and final course grade across all experimental groups. However, this was not the case for the control groups. There was no correlation between average time spent in the tutoring center and final course grade among those students. In addition, no

significant difference in final course grades was found between any of the control and experimental groups.

The qualitative portion of the study included 13 of the student participants from the overall sample of the study. These students were interviewed in order to better understand their experiences and opinions of the tutoring center. Two prominent themes were noted when interviewing the participants. First, students believed that utilizing the free tutoring services helped them to better understand the course material and eventually helped them improve their overall performance in the class. Secondly, students indicated consistently that they would not have used tutoring services had it not been included in their final course grade despite the common perception that the tutoring was beneficial. It was noted that this was due in part to many of the students fearing that their peers would have perceived them as weak math students. Additional contributing factors in student reluctance to utilize tutoring services was an uneasiness about working with new people in an unfamiliar environment as well as working with the tutors who were more accomplished in mathematics than they were. These findings are relevant to the current study because they provided insight into the impact of peer tutoring on final course grades in college math courses.

The qualitative information garnered from this study is also important to the current study since it provides a look at some of the potential barriers to student help-seeking behavior.

Duah, Croft, and Inglis (2014) assessed the effectiveness of peer assisted learning (PAL) on academic achievement in second year undergraduate math students. PAL in the context of this study consisted of a formal scheme in which one or more students would help other students in their understanding of course material and development of useful study skills that would enable them to ultimately succeed in the course. The key component to PAL is that it is discussion based and that student peers as opposed to course instructors facilitate these discussions. This particular study looked at the impact PAL had on achievement in a course on vector spaces, which is considered a higher-level undergraduate math course. Variables examined included achievement in a previous linear algebra course, lecture attendance (with course instructor), and PAL utilization. The findings indicated that prior linear algebra achievement, lecture attendance, and PAL utilization were all significantly correlated with achievement in the vector spaces course. When the researchers controlled for prior linear algebra achievement

and lecture attendance, they still found that PAL utilization had a significant positive correlation with achievement in the course. Multiple regression analysis resulted in a regression coefficient of $b$ = 1.182, which indicated that each time a student attended a PAL session, they could expect a 1.2% boost to their final grade in the vector spaces course. The findings here are relevant to the current study because it supports the hypothesis that peer tutoring may be beneficial to students enrolled in college level math courses.

Khazanov (2011) investigated the effects of implementing a peer-mentoring program utilizing peer tutors that were selected from advanced math classes to help students at risk of failing an elementary algebra course at an urban community college. Each at-risk student was assigned an individual mentor/tutor. The mentors attended the same college and volunteered for the program. All mentors chosen to participate in the study were enrolled in advanced math courses. The mentors were trained in general remedial math strategies and were given an overview of the elementary algebra course for which they would be providing help. The mentor/tutor program was implemented in two sections of the elementary algebra course in which the principal investigator was the instructor. Eighteen

students across the two sections of elementary algebra volunteered to take part in the study and work with mentors. The students began meeting with their mentors two weeks into the semester. These meetings occurred one to three times per week. The tutoring sessions focused on improving study skills, improving time management, and working on material from the elementary Algebra Course. The results of the investigation indicated that eight of the 18 (44%) at-risk students involved in the study passed the elementary algebra course. Nine of the 18 students did not pass the course (50%) and one student (5.5%) stopped attending the course altogether. Of the students who did not take part in the mentoring program 14 of 30 (46.7%) passed the course. Seven of 30 (23.3%) did not pass the course and nine (30%) students stopped attending the course altogether. Students who passed the course final examination were required to take a computer based adaptive test. Eight of eight (100%) of the study participants passed the computer-based exam. Fourteen of 14 (100%) of the non-participants passed the computer based exam as well.

Khazanov described the mentoring/tutoring program as partially successful, citing a similar pass rate for the course between the two groups; 44% pass rate for

participants of the study versus 46.7% pass rate for non-participants of the study enrolled in the same course. The most notable difference was the rate of attrition between the two groups. Study participants were much less likely to stop attending the elementary algebra course than non-participants. Of the study participants that did not pass the course, most did not attend their tutoring sessions regularly and often cancelled appointments. The findings support the hypothesis that tutoring services at the college level may improve academic performance for students who may otherwise fail or drop a course altogether.

Young (2011) investigated the effects of providing a peer-tutoring program for pre-service elementary school teachers enrolled in three college math courses. Reasons for non-attendance, preference for onsite peer tutoring versus college tutoring centers, and general perception of effectiveness were examined. Data were collected over six semesters at the onsite peer-tutoring program. The course, course section, number of students utilizing the tutoring services, and the length of the tutoring sessions were recorded. Students who utilized the tutoring services were also administered online surveys asking them to evaluate their peer tutors and how they felt about the effectiveness of the overall program in general. Two peer tutors from the

principal investigator's classes were selected to participate in the study. Onsite peer tutoring services commenced in October of the 2006 fall semester. These services were provided to two course sections taught by the principal investigator.

During the fall semester of 2007, 386 students enrolled in the pre-service teacher program were sent online surveys for the purpose of gathering qualitative information regarding their experiences with the peer tutoring program. Sixty-six (14.1%) of the students responded to the survey. The respondents were broken into three groups, tutee, non-tutee, and tutor. The tutees consisted of 18 females and two male students who attended at least two tutoring sessions each and as many as ten or more sessions. Preparation for a quiz or exam was the number one reason for seeking tutoring amongst this group. Additional common reasons included receiving help with completing assignments, help understanding completed homework, help using manipulatives, help with a new math concept, help with vocabulary, help with computations, and help with word problems. When asked to rate their experiences from very negative to very positive, three of the tutees indicated a neutral feeling towards the tutoring

experience, nine indicated a positive experience and eight indicated a very positive experience.

The non-tutees consisted of 40 female and six male students. When asked about their attitudes towards attending peer tutoring sessions 19 responded neutrally, 16 responded positively, four responded very positively, five responded negatively, and one non-tutee responded very negatively. Non-tutees who responded negatively or very negatively indicated that they either did not need tutoring, had childcare responsibilities, had scheduling conflicts, or they felt that the tutors would not be able to help them adequately.

Four of the tutors involved in the study responded to the questionnaire. All four tutors indicated previously utilizing peer tutoring services themselves. All indicated very positive feelings regarding peer tutoring. Tutors pointed to particular negative aspects of on-site peer tutoring which included students attempting to just obtain the answers for their homework and students who would not attempt the work on their own. Tutors also commented that certain course instructors preferred their course material to be explained in a particular manner and it was difficult for the tutors to determine instructor preferences without adequate communication with them. This study highlights the

need for my current study because it is one of several studies conducted in this area that does not include any type of quantifiable data that can be used to determine the impact of peer tutoring on academic performance. This study does, however, provide insight into why students might seek out peer tutoring and why they might avoid it, a central component to my study.

Carmody and Wood (2009) conducted a study in which they examined the experience of peer tutors involved in a peer tutoring program implemented with students taking university mathematics and statistics classes. The study was conducted at the University of Technology in Sydney Australia. In 2005, the University of Technology began utilizing a volunteer tutoring service at its Mathematics and Information and Communications Technology Center (MICTSC). The tutors involved in this study consisted of one paid doctoral student, three paid honor students, one unpaid fulltime staff member, and 18 volunteer third year university students. All tutors were math or science majors.

At the end of an unspecified semester, the peer tutors were asked to complete a questionnaire intended to gain insights into their experiences as peer tutors and their views concerning learning and teaching introductory

mathematics. Out the total 22 tutors working at the center, 12 responded to the questionnaire. The 12 consisted of nine third year volunteers and three paid honor students. The questionnaire consisted of the following questions (summary of tutor responses are provided under each question):

1. Why did you originally volunteer or sign on for peer tutoring?

Tutors indicated a combination of extrinsic and intrinsic reasons for volunteering to tutor at the center. Extrinsic reasons included gaining the opportunity to help other students, to help relieve the stress of other tutors by easing the ratio of tutee to tutor, and being able to contribute to the math department at the university. Intrinsic reasons included giving themselves something to do between classes, gaining experience in teaching, added to their resumes, crystallizing their knowledge of the material, improving their interpersonal skills, meeting new people, increasing self-confidence, and experiencing the fulfillment that teaching others brings.

2. How do you go about teaching mathematics in the mathematics study center?

Tutor responses varied the most in regard to this question. Some tutors preferred to explain the theories and concepts in regard to particular questions provided by tutees. Some

tutors preferred to utilize examples and explained each step required to solve a particular problem. Some tutors based they way they helped tutees answer questions around how well they felt the tutee understood the material.

3. What are your views of mathematics and how have they changed since tutoring?

The authors considered the tutors to have a mid to high level of understanding of mathematics. The tutors viewed mathematics as something that goes deeper than just tool for calculation. The tutors viewed mathematics as something that "relates to life in a modeling sense, and analytically how it starts to relates to itself, as an abstract language" (p. 23).

4. What are your views on learning mathematics and how have they changed since tutoring?

Most of the tutors indicated that they felt learning mathematics is challenging. Some of the tutors indicated that they found some areas of mathematics to be boring.

5. What sense of accomplishment do you feel you have gained through peer tutoring?

Sense of accomplishment was divided between extrinsic and intrinsic. Extrinsic sense of accomplishment gained from tutoring at the center generally involved feeling good about helping other students understand the material and

inspiring tutees to work harder in their future courses. Intrinsic sense of accomplishment included establishing new friendships, greater sense of responsibility, increasing their mathematical knowledge and interpersonal skills, and increasing their self-confidence in themselves and their mathematical ability. This study further demonstrates the need for research in this area to explore the impact of peer tutoring on academic achievement using quantitative data as opposed to only gathering and analyzing qualitative data obtained from users of peer tutoring, or in this instance, the tutors.

Patel and Little (2006) conducted a study which investigated the effectiveness of providing diagnostic assessments, individualized learning programs, and peer tutoring in mathematics for undergraduate engineering majors. The study was conducted at Robert Gordon University in Scotland and including engineering students enrolled during the years 1999 through 2000 and 2001 through 2003. The combination of supports, which included peer tutoring, was labeled Math and Statistics Support (MSS) by the authors.

The results of the study demonstrated that 92% (*N*=2012) of students who utilized MSS passed the math diagnostic test as opposed to an 88.1% (*N*=16012) pass rate

of students who did not use MSS. The difference in pass rates between the two groups was determined to be significant at the 0.01 level. An independent samples *t*-test indicated that the mean scores of students who utilized MSS were greater than the mean scores of students who did not utilize MSS. The authors concluded that this combination of support was a successful intervention for students and as well as a measure that could be taken to decrease degree program attrition. The authors also concluded that students would likely benefit from being provided a quiet, relaxing study area, supported by peer tutors, that is separate from the general class environment. The authors believed that this practice could reduce overall anxiety regarding mathematics, help students to establish rapport with peers and tutors alike, and could improve their ability to increase their mathematical skills and help them generalize those skills to their engineering course work. This study is one of the few in prior literature that provided quantitative data demonstrating the positive impact of peer tutoring on academic achievement in college mathematics; in this instance, data showing a significant difference in pass rates between students utilizing peer tutoring and those students who did not. The success of the peer tutoring as an academic

intervention in this study highlights the utility of further study into this domain.

Evans et al. (2001) investigated the effectiveness peer tutoring had with college students within two mathematics classes at the University College of Chichester. The study sample consisted of a total 30 students. Eighteen of the students were enrolled in a college math course, which was part of a four-year training program for mathematics specialists, and 12 students were enrolled in a college math course that was part of a two year accelerated program that would result in students gaining Qualified Teacher Status. One tutor was assigned to each course. The tutoring intervention spanned three semesters and was implemented during weeks two, three, seven, and eight of each term. The tutors taught their assigned class during the final hour of class during weeks and two and seven and during the first hour of class during weeks three and eight. During weeks three and eight, the first two hours of class were dedicated to peer tutoring. During the first hour of the peer tutoring portion of the study, students in class A would teach the students in class B. During the second hour of the peer tutoring portion of the study, class B would teach class A. Two students from the two-year course were paired up with three

students from the four-year course. This ratio was utilized due to the size difference between the two courses. The students were instructed to prepare notes and complete examples and references for when they were performing the role of tutor; the students were not given instructions on a specific method of teaching the material to their tutees. At the conclusion of the peer tutoring intervention all of the students involved completed questionnaires in order to evaluate their experience. The results of the questionnaires indicated that all but two of the students enjoyed the experience and would be interested in repeating it during the following semester. Results also indicated that the preferred number of peer tutors in a group was two. More than two tutors within a group appeared to complicate the presentation of the material to the tutees. The students were also asked to indicate how much time they would like dedicated to typical instruction, tutor lead instruction, and peer tutoring within a 36-hour course. The students indicated that they would typically dedicate 25 hours to traditional course instruction, eight hours to peer tutoring and three hours to tutor lead instruction. Another qualitative observation made by the authors demonstrated that the same amount of course material was delivered and completed faster by the peer tutoring groups

as opposed to traditional instruction. The investigators concluded that students generally enjoy peer tutoring and that it was a preferable way to vary instruction. It also facilitated the forming of study groups between students. The authors' further state that the peer tutoring method incorporated in their study likely facilitated the learning of the course material and also facilitated communication. Although this study provided valuable insight into student preferences regarding peer tutoring, which could be used to encourage increased usage, this study joins the majority of studies in this area that do not provide any quantitative demonstrating the impact of peer tutoring on academic achievement. This strengthens the rationale for the need of my study, which includes a large sample size and quantitative data that provides insight into the effectiveness of this academic intervention.

As previously mentioned in chapter one, Topping (1996) identified only 18 studies that had been conducted between the years 1984 and 1994 that investigated peer tutoring in college level mathematics, and he only considered two of them to be of high quality. The review of the literature in this area dating back to the year 2000 demonstrates a similar dearth of research. The few studies carried out during this period that did include quantitative analyses

of their data were able to indicate varying levels of the positive impact peer tutoring had on the academic performance of students enrolled in college/university level math courses. If peer tutoring is to be used continually as an academic accommodation or intervention at colleges and universities, further research into its efficacy appears to be warranted. As hypothesized in chapter one, it may be useful to better understand the motivational profiles of college students who seek out peer tutoring assistance if peer tutoring is found to be a useful academic intervention. The following sections in chapter two discuss the model of motivation that is the foundation for this study and also provides an overview of the literature that links the motivational constructs within this model to academic achievement in college level math courses.

## Paul Pintrich's Model Of Motivation

Paul Pintrich's model of motivation provided the framework for the second study in which participants completed the six motivation subscales of the MSLQ in order to provide insight into their motivational profiles. Below is a description of the model.

Paul R. Pintrich's model of motivation and learning is regarded as a major contribution to our understanding of

the factors that affect student achievement and is an outgrowth of research showing that numerous factors, not just the learners' skills and abilities, determine why some students succeed and some fail. Pintrich proposed that self-regulatory behaviors mediate the relationship between learners and their environment and thus, their academic success or failure (Pintrich, 2000; Pintrich & Zusho, 2002). Pintrich emphasized the importance of motivational processes to self-regulation and attempted to clarify the way in which motivational variables interacted with cognitive, behavioral, and contextual factors to impact self-regulation, which in turn, impacted achievement (Pintrich, Marx, & Boyle, 1993). This inclusion of motivational factors sets Pintrich's model apart from many other self-regulation models, which stress only cognitive or behavioral factors (Zimmerman & Schunk, 2001).

Pintrich developed the Motivated Strategies for Learning Questionnaire (MSLQ) to measure the constructs delineated in his model of self-regulated learning. The MSLQ is a Likert-scaled self-report questionnaire designed to measure college students' motivational attributes as well as use of various learning strategies and thus, includes a motivation section and a learning strategies section. The instrument may be used in a modular fashion

and allows for these two components, motivation and learning strategies, to be measured separately or together to meet the needs of the researcher. For the purpose of this current study, discussion will be limited to the relationship between motivation and achievement as conceptualized in Pintrich's model; learning strategies will not be addressed as they are outside the purview of this study.

Pintrich identified three primary types of motivational constructs that interact with academic achievement: value, expectancy, and affect, each of which can be measured by the MSLQ (Pintrich, Smith, Garcia, & McKeachie, 1991). The value components focus on why subjects engage in an academic task. Three subscales are included in the value component: intrinsic goal motivation, extrinsic goal motivation and task value beliefs. Intrinsic motivation is the student's perception of the importance and value of the task to be learned. Students with greater interest in a topic or who view the topic as important are more likely to engage in effective learning behaviors, such as help seeking (Pintrich & Zusho, 2002). Extrinsic motivation refers to elements such as getting good grades and gaining approval from others. The expectancy component includes two subscales measuring perception of self-

efficacy and control of learning beliefs. Self-efficacy refers to one's beliefs regarding their ability to learn or engage in actions at designated levels (Bandura, 1986). The third motivational construct, affect, refers to test anxiety. Its corresponding subscale examines the student's worry and concern regarding taking exams. This model predicts that an individual's motivation for learning may be a significant predictor of self-regulatory behaviors that will increase academic success, such as help-seeking behavior (i.e., seeking on campus tutoring services).

## Motivation And Achievement In College Mathematics

The following studies represent the bulk of the previous research dating back to the year 2000 that had focused on the motivational areas outlined in the Pintrich model in the domain of mathematics.

Cardetti and McKenna (2011) investigated what motivated college students to learn mathematics. To do this, the researchers conducted an analysis of student journal writings concerning the subject. Student thoughts were labeled, coded, and organized into groups to prevent overlap. Six themes regarding student motivations for learning mathematics emerged once the data were analyzed. The researchers labeled them, intrinsic satisfaction,

bribery, competition, fear and adrenaline surge, learning through sharing, and approval from family and peers.

No quantitative analysis was computed based on the results of the study, but each of the six themes was explored in a qualitative manner. Students participating in the study demonstrated overlap in regard to what motivated them, though exact numbers were not provided. Students motivated by intrinsic satisfaction noted a feeling of accomplishment when they were able to answer a problem they deemed difficult or challenging. Students motivated by what the researchers labeled “bribery” were motivated by things like getting a good grade in the class which would enable them to obtain a high paying job. Students motivated by competition wanted to learn the material in part because they wanted to demonstrate superiority over peers in the course. Students motivated by what the researchers labeled “fear and adrenaline surge” noted anxiety-inducing stressors such as upcoming exams and deadlines. Students motivated to learn through sharing cited that helping others learn the material provided them with satisfaction and motivation to improve their own math achievement. Many of the students involved in the study noted that they were motivated by approval from their family and peers. Not wanting to disappoint parents was mentioned prominently in

this category. These themes can be categorized according to the Pintrich model of motivation. Intrinsic satisfaction may be a component of intrinsic goal orientation. Bribery, competition, and approval from family and peers may fit under extrinsic goal orientation. Fear and adrenaline surge could potentially fall under test anxiety.

Husman et al. (2004) conducted a study in which they utilized the MSLQ task value and intrinsic motivation subscales to determine if these areas of motivation were related to the amount of time college students enrolled in a human development course spent studying. Two hundred seven students completed a packet of self-report questionnaires including the subscales from the MSLQ at the end of the semester. Results indicated a significant difference in intrinsic motivation between students who report studying zero to one hour per week and students who reported studying three and a half to four hours per week. Significant differences in intrinsic motivation were also revealed between students who reported two and a half to three hours per week and students who reported studying three and a half to four hours per week. Intrinsic motivation was positively correlated with time spent studying. In regard to task value, no significant

differences were found in relationship to time spent studying.

Lynch (2010) conducted a study that sought to determine if the academic performance of college level physics students was associated with the areas of Pintrich's model of motivation as measured by the MSLQ. Seventy-six students enrolled in a physics course at a New England university completed the MSLQ near the end of the fall semester; access to their final semester grades and lab grades was granted to the investigator. A correlation analysis revealed significant associations between motivational areas such as self-efficacy, intrinsic goal orientation, extrinsic goal orientation, and task value, and final semester grades. No significant relationship was found between semester grades and control of learning beliefs or test anxiety. When a deeper analysis split gender, it was discovered that extrinsic goal orientation and self-efficacy was still significantly associated with the final grade performance of female students, but none of the motivational areas were significantly associated with the semester grades of the male students. Results were different when looking at the student's final lab grades. Extrinsic goal orientation was the only area of motivation that appeared to have a significant link to final lab

grades. An analysis was conducted to determine if there were significant differences between how the male and female students rated themselves on the MSLQ. The analysis found significant differences in the areas of self-efficacy and test anxiety: the male students were noted to have scored significantly higher in the area of self-efficacy, while the female students scored significantly higher in the area of test anxiety.

Lynch (2006) investigated the relationship between Pintrich's five areas of motivation as represented by the MSLQ motivation subscales and academic achievement amongst 501 college students enrolled at a mid-Atlantic private university. Two hundred sixty-four freshman students and 237 upper level students completed the MSLQ near the midpoint of the semester. The sample covered 28 different courses taught by 26 different professors. Results indicated that self-efficacy was the motivational factor most significantly correlated with achievement among both the freshman and upper level students. Test anxiety had a significant negative correlation with academic achievement for the upper level students, but was not a significant factor for freshman students. Intrinsic goal orientation, task value, and control of learning beliefs also had significant positive correlations to achievement in both

groups of students. Extrinsic motivation did not turn up as significant for either freshman or upper level students. A stepwise multiple regression used to determine the combination of variables that might predict course grades revealed that the upper level students grades were predicted by self-efficacy and freshman grades were predicted by self-efficacy and extrinsic motivation.

Bong (2001) attempted to determine if self-efficacy and task value, two motivational areas of the Pintrich model, could predict academic performance as well as what courses students might decide to enroll in the future. One hundred sixty-eight female undergraduate students enrolled in a women's university in Seoul, Korea, took part in the study. The students were all enrolled in an instructional methods and technology course. The students completed surveys that measured the following areas: perceived value of the course, self-efficacy for self-regulated learning, self-efficacy for academic achievement, self-efficacy for the course, and self-efficacy for representative course contents. Data were collected four times over the course of the semester because the investigator hypothesized that student performance over the course of the semester might change their ratings in these areas. Results indicated that out of all the areas of self-efficacy examined, only

problem specific self-efficacy was significantly correlated (positive correlation) with student academic performance, midterm grades specifically. Problem specific self-efficacy was measured by presenting the students with an overhead projection of a set of 15 problem pairs taken from the course midterm. The problems were shown long enough for the students to understand the types of problems and how they might approach solving them, but they were not shown long enough for the students to actually solve the problems outright. After being shown the problems, the students were asked to rate their confidence in regard to their ability to solve the types of problems that were presented to them. Students rating themselves higher in problem-specific self-efficacy were more likely to perform better on the midterm examination; however, there was no significant relationship to performance on the final examination.

Peters (2013) conducted a study, which in part looked at the relationship between self-efficacy and academic performance in undergraduate mathematics students. College algebra students (n=326) attending four different universities across the United States completed the Mathematics Self-Efficacy Scale Revised in order to measure their perception of their competence at completing a variety of math related procedures. Results indicated that

self-efficacy was significantly correlated with the students' final course grades in college algebra. A statistically significant difference between male and female students was noted, with males rating themselves higher for self-efficacy; gender was not found to have a significant correlation with final course grades.

Acee and Weinstein (2010) conducted a study in which they implemented a value-reappraisal intervention using a sample of 82 undergraduate statistics students with the purpose of increasing their task value and to determine if increased task value positively impacted their motivation and course grades. The intervention involved providing students with messages concerning the importance of statistics in academia and professional life, the importance of being able to understand and utilize statistics in everyday life, and the intrinsic satisfaction associated within learning statistics. Students were spread across four sections of the course taught by two instructors (A and B) and were randomly assigned to either a control group or an experimental group that received the intervention. The investigators used the MSLQ task value subscale to measure task value amongst the participants. Self-efficacy was measured through the use of The Perceived Academic Competence Scale developed by Kaplan and Midgley

(1997). Results indicated a positive correlation between task value and self-efficacy ($r = .38$, $p < .01$). Task value increased significantly amongst those in the experimental group; no significant increase was detected in the control group. However, only one of the experimental groups that were taught by instructor B performed significantly better on a post intervention examination when compared to the control group. Further analysis revealed a significant instructor interaction effect making it difficult to determine if an increase in task value had indeed improved the students' exam performance. Students that demonstrated significant gains in task value were found to be more likely to engage in behavior such as accessing statistics websites outside of course requirements.

Mattern and Shaw's (2010) study investigated the relationship between self-efficacy in math, help seeking behavior, and a variety of academic outcomes amongst college students. The study used a sample of 107,453 students from 110 different universities from across the United States. Self-efficacy was measured by how students answered the "self-estimate of math ability" on the SAT questionnaire. Students could rate themselves to be within one of four categories: highest 10% of math ability, above average, average, and below average. Help seeking behavior

was also measured by the SAT questionnaire. Students were required to answer a question concerning their likelihood to seek help in improving math skills, writing skills, or skills in any additional academic area. Results in relation to self-efficacy in math indicated that students who rated themselves highly had higher high school GPAs, SAT critical reading scores, SAT math scores, SAT writing scores, first year college GPAs, and second year college retention rates than students who rated themselves within the below average range for self-efficacy in math. Of the 107,453 students, 33.5% of the sample rated themselves within the highest 10 percent of math ability, 42.3% rated themselves within the above average range, 23% rated themselves within the average range, and 1.2% rated themselves within the below average range. Related to help seeking behavior, 6.6% of the students who rated themselves within the top 10% of math ability stated that they would seek out help at college for math, as opposed to 16% of the above average group, and 38.4% of the average group. By far the largest percentage of students from any group that would seek help was the students who thought that they fell within the below average range in math ability. Sixty-five percent of them stated that they would be more likely to seek out help in college for math. Overall, help seeking in mathematics

appears to be negatively correlated with self-efficacy in mathematics.

Hodges and Kim (2010) looked at the relationship between self-efficacy and achievement in 103 college students who were enrolled in an online math course. The primary focus of the study was to determine if an intervention designed to improve self-efficacy and self-regulation would be effective. Self-efficacy was measured by using the MSLQ self-efficacy subscale, one of the five motivation scales. The investigators found that their intervention did not significantly increase the participants' self-efficacy or self-regulation. However, when analyzing the relationship between self-efficacy, self-regulation, and achievement, self-efficacy was found to be a significant predictor of academic achievement.

Spence and Ellen's (2007) study looked at the relationship between self-efficacy and achievement among a sample of 164 students enrolled an undergraduate remedial algebra course at a two-year college in the southeastern United States. Students engaged in the study were split between taking the course in a traditional classroom setting and taking the course online where students had access to the instructor via email, phone, or in-person appointments. Various areas of self-efficacy were measured

through self-report questionnaires. These areas included: computer self-efficacy, self-efficacy for self-regulated learning, and mathematics grade self-efficacy. Results indicated that in both learning environments mathematics grade self-efficacy and self-efficacy for self-regulation were positively correlated with math achievement in the course. Regression analysis revealed that of all the areas examined only age and mathematics grade self-efficacy were found to be significant predictors of math achievement, together accounting for 30% of the total variance. The researchers concluded that their results supported their initial hypothesis that mathematics self-efficacy is one of the most significant predictors of achievement in math.

Wadsworth et al. (2007) looked at the effect of self-efficacy and various learning strategies on math achievement in an online developmental mathematics course. Eighty-nine students enrolled at a large University in the Southeastern United States were involved in the study. The students completed the Learning Strategies Inventory (LASSI) which is a standardized instrument with the following subscales: test strategies, self-testing, use of support/materials, selecting the main idea, information processing, concentration, anxiety, time management, motivation, and attitude. Self-efficacy was measured by

having the students mark on a zero to ten scale how they felt about their ability to complete different types of math problems that they would have previously encountered on placement exams or would encounter in their math course. Multiple regression analysis was used to determine if self-efficacy and various learning strategies were significant predictors of final course grade. The results indicated that self-efficacy along with motivation, concentration, information processing, and self-testing strategies were significant predictors of the student's final grade in the course.

Kesici and Erdogan (2009) used the MSLQ to determine if any of Pintrich's areas of motivation represented by the five motivation subscales on the MSLQ were a significant predictor of math anxiety in college students. Math anxiety was measured using the Mathematics Anxiety Rating Scale (MARS) developed by Richardson and Suinn (1972). One hundred eighty-three students enrolled in a general mathematics course at a university located in Konya, Turkey, completed the MSLQ and the MARS. Regression analysis revealed self-efficacy and test anxiety were significant predictors of math anxiety. Approximately 18% of the variance in math anxiety was explained by test anxiety. Test anxiety and self-efficacy together explained

approximately 22% of the variance. Self-efficacy was negatively correlated with math anxiety as the investigators noted they had expected. These findings are relevant to the current study because it further establishes the MSLQ as an instrument that is useful for measuring the facets of motivation in college students and areas such as self-efficacy and test anxiety may be predictors of help seeking behavior amongst college math students.

Zientek and Thompson (2010) investigated the impact that self-efficacy and mathematics anxiety has on math achievement by conducting a meta-analysis of previously completed research on those constructs. The researchers compared the results from various studies that looked at how math anxiety and self-efficacy affected achievement in mathematics and computed secondary analyses on the results including multiple regression and commonality analyses. The combined the different age groups across the studies, which spanned elementary school to college students. Results of the analysis demonstrated that self-efficacy was the number one predictor of academic success in mathematics. Self-efficacy accounted for 3.88% to 16.44% of the variance across the five studies that were looked at. When prior achievement was added, the two variables accounted for 11%

to 14% of the variance. In regard to math anxiety, the results demonstrated that it did not account for a significant amount of the variance that explained math achievement.

Hodges (2008) tried to determine if an increase in student self-efficacy would lead to higher achievement amongst students enrolled in a college algebra and trigonometry course. The study included 196 students enrolled at a large university in South Eastern United States. Students were given the Self-efficacy for Learning Math Asynchronously (SELMA) survey at the outset of the study and again at five weeks and 14 weeks in order to determine their level of self-efficacy and whether it changed over the course of the semester. Participants were assigned to either a control or experimental group. The experimental group received motivational emails aimed at increasing self-efficacy. The control group also received the emails, but at the much lower frequency of once per week. Final exam grades were used as the outcome measure for the study. Results indicated that there was no significant difference in self-efficacy between experimental and control group after the email condition was implemented. However, a significant increase in self-efficacy across both groups was demonstrated between the

first and second SELMA administrations. In regard to math achievement, a significant positive relationship, although weak, was found between self-efficacy and final exam grades.

The above studies support the use of Pintrich's model of motivation to predict student achievement. Self-efficacy was shown to be a significantly associated with higher academic achievement in mathematics in several studies. Studies utilizing regression analysis consistently found self-efficacy to be a significant predictor of math achievement as well. Several of these studies also demonstrated significant positive associations between academic achievement in college mathematics and additional areas of the Pintrich model such as intrinsic goal orientation, extrinsic goal orientation, task value, and control of learning beliefs. Intrinsic motivation and task value were also found to be significantly associated with positive academic behaviors such as increased time studying and seeking additional educational materials outside of the ones provided by the course instructor. Test anxiety was the only domain in the model found to be negatively associated with academic achievement in mathematics.

## Rationale For Current Study

Based on previous research it appears that peer tutoring interventions at the college level in mathematics may improve academic achievement and may also reduce attrition. This study seeks to add to that body of literature to determine if this intervention is an effective way of raising academic performance. This study will join the minority of research in this area that has utilized a large sample size and quantitative data to demonstrate the impact of peer tutoring on academic achievement.

If peer tutoring is proven to be an efficacious intervention at the college level, it may be important to understand what motivates a student to seek out this intervention. This portion of my research is what makes the current study unique. Using the Pintrich model of motivation I am seeking to identify the particular motivational variables that influence help-seeking behavior in college math students. No previous study has utilized this model as a framework to identify the specific motivational profile of an individual that might seek out peer tutoring. If a particular motivational profile is identified, colleges and universities may be better able to

devise more effective methods of delivering these services to the students who need them.

# CHAPTER 3

# METHODOLOGY

## Setting

Participants utilized a tutoring center located in a large urban university in the northeastern United States. Tutoring services were provided in a large, well-lit, open laboratory environment. Tables were provided for students so that they could engage in their coursework and receive tutoring assistance. Each table sat up to approximately four students. Tutors were provided with their own table where they waited to be assigned to students awaiting tutoring. One to two supervisors (graduate students) ran the laboratory at any given time. The supervisors assigned tutors to specific tutees and monitored tutoring session length. Students who used the university tutoring center received 20-minute one-on-one tutoring sessions with a tutor. Once the session ended, the tutee was permitted to sign up for another 20-minute tutoring session. Students were able to request as many tutoring sessions as they felt they needed in one visit. On occasion students were asked to be tutored in groups with other students who were also working on the same material; this practice was due to the high number of student users attending the tutoring center at a given time. Students being tutored in groups would

still receive the assistance of one tutor, but they would receive less one-to-one attention. The students were expected to have already attempted any work they had brought with them independently before requesting the aid of a tutor. Students received assistance with problems that they were unable to answer independently.

Tutors hired by the university tutoring center were deemed to be highly proficient in the courses they were hired to tutor. Each tutor must have received an A grade in the courses they were to tutor and must have passed a proficiency exam to demonstrate their ability before they were hired. All tutors were current graduate or undergraduate students at the university.

In order to study the effects of motivation on utilization of the tutoring center and its effectiveness in improving grades in college math, two studies were conducted. The first study evaluated the effectiveness of the tutoring center in improving grades in college math. The second study, with a sample drawn from the same population, evaluated the motivational components affecting help-seeking behavior.

## Study One Sample

One thousand one hundred twenty-four college students attending a large urban university in the northeastern

United States who were enrolled in college algebra during the 2008 fall semester were included in this study. Descriptive statistics of this sample are provided in tables 4.1 through 4.3 in chapter four.

## Measures

### *Usage Of Tutoring Center*

The use of the tutoring center was defined as the number of visits each student within the sample had made to the university tutoring center during the fall semester of 2008. Students had to visit the tutoring center a minimum of one time to be considered a user of the center.

### *Final Course Grade Point Average*

The final course grade point average for the college algebra course for each student within the sample population was provided.

### *SAT Verbal and Quantitative Scores*

Mattern, Patterson, Shaw, Kobrin, and Barbuti (2008) reviewed the psychometric quality of the SAT. The SAT is composed of three sections; critical reading, mathematics, and writing. Scores in each section range from 200 to 800. The investigators conducted a study in which they analyzed the SAT scores from 151,316 students across 726 four-year colleges and universities that had received a minimum of 200 SAT score reports in the year 2005. The researchers

were provided with the gender, race/ethnicity, best language, and high school grade point average of each participant in their sample. The first-year grade point average of all participants within the sample was also provided. The investigators computed the correlation between SAT scores and the students' first year grade point average. A correlation was computed for each subgroup (i.e., gender, race/ethnicity, and best language). Results of the analysis revealed that the SAT is more predictive of first year grade point average for females. Correlations were computed for each of the three sections of the SAT as well as overall SAT score with first year grade point average. The correlations ranged from 0.52 to 0.58. For the male participants the correlations ranged from 0.44 to 0.50. As for race and ethnicity, the SAT was shown to be the most predictive for Caucasian participants. The correlations with first year grade point average for this subgroup ranged from 0.46 to 0.51. The results indicated that the SAT is less predictive for minority students. Correlations for African American, Asian, and Hispanic students ranged from 0.40 to 0.46. In regard to language, students who indicated English as their best language had the highest correlations to first year grade point average (0.47 to 0.54). Students who indicated that English and a

second language were both their best had correlations ranging from 0.41 to 0.50. The predictive validity for students whose best language was one other than English was much lower, ranging from 0.28 to 0.42.

The investigators concluded that the SAT over-predicts male performance while under-predicting female performance. African American, Hispanic, and Native American students were found to be over-predicted while Caucasian and Asian students were found to be accurately predicted to slightly under-predicted. Students whose best language is English were considered accurately predicted while students whose best language was one other than English were under-predicted by the critical reading and writing sections of the SAT; however, those students were accurately predicted by the mathematics section of the SAT. Students who listed English and another language as their best, were over-predicted.

*High School GPA*

Mattern et al. (2008) also looked at the predictive validity of high school grade point average (HSGPA) concerning first-year grade point average in college. According to the results of the study, HSGPA under-predicted females, correlating at 0.54, and over-predicted males, correlating at 0.52. HSGPA was most highly

correlated with first-year grade point average in Caucasian students at 0.56. HSGPA had a much lower correlation with first-year grade point average with minority students (Asian 0.47; African American 0.44; Hispanic/Latino 0.46; American Indian or Alaskan Native 0.49; students who indicated "other" ethnicity 0.45). HSGPA correlations to first-year grade point average was higher in students who indicated English as their best language (0.55) and was much lower for students who indicated that another language than English was their best language (0.35).

## Procedures

The investigator was given access to an extant data set for a sample of 1124 students who were enrolled in college algebra during the 2008 fall semester. The data set included the following information for each student within the sample: gender, ethnicity, enrollment status, high school grade point average, SAT verbal and quantitative scores, final course grade for college algebra for the fall 2008 semester, and their level of usage (number of visits) of the university tutoring center. The participants fell into two groups: those who used the tutoring center during the fall 2008 semester and those who did not use the tutoring center during the fall 2008 semester. Results were analyzed to determine if any of the variables included in

this study were significantly associated with final course grade. The data were also examined to determine if there were any significant differences between users and non-users of the tutoring center.

## Study Two Sample

The 1124 students from study one who were enrolled in college algebra during the fall semester of 2008 were solicited to take part in the second part of the study. Two hundred fifty-four students (22.6%) from the study one sample volunteered to participate. Descriptive statistics of this sample are provided in tables 4.16 through 4.21 in chapter four.

## Measures

The Motivated Strategies for Learning Questionnaire (Pintrich, Smith, Garcia, & McKeachie, 1991) is a self-report survey intended to gauge motivation in college students. The MSLQ is composed of 15 subscales; nine scales focus on various learning strategies and six scales focus on academic motivation. The nine learning strategy scales are as follows: Rehearsal, Elaboration, Organization, Critical Thinking, Self-Regulation, Time and Study Environment, Effort Regulation, Peer Learning, and Help Seeking. The motivation scales, which were utilized in this study, include Intrinsic Goal Orientation, Extrinsic Goal

Orientation, Task Value, Control of Learning Benefits, Self-Efficacy for Learning and Performance, and Test Anxiety. The motivation section and its six subscales mentioned above consist of 31 questions in total. The intercorrelation matrix for the subscales is in Appendix B and the rotated component matrix for test items is provided in Appendix C. Scale scores are derived from the mean of the scores from the test items within each subscale. The scales were meant to be used either together or separately in order to fit the needs of the researcher incorporating the MSLQ into a given study. Burlison, Murphy, and Dwyer (2009) indicated that the MSLQ had been utilized in previous research approximately 129 times, with the complete questionnaire being implemented 14 times. Only seven of the 14 studies using all the subscales of the MSLQ were done so in the context of an academic setting in which academic outcomes were a focus of the study.

Pintrich et al. (1993) conducted a study using the MSLQ in order to establish the instrument's internal consistency, reliability, and predictive validity. The study involved 380 college students from the Midwestern United States, most of whom were attending four-year universities. Thirty-seven college classes were sampled in the study. They spanned fourteen different college subjects

which included chemistry, computer science, economics, education, ecology, history microbiology, English, geography, philosophy, physical education, sociology, Spanish, and psychology. Approximately 10 students from each of the 14 subjects volunteered to participate. Demographic information was provided by 280 of the 380 subjects. Of those who provided their demographic information, 34% were male and 66% were female. Ninety percent of these students indicated that they were Caucasian, 5% indicated they were African American, 3.2% indicated they were Asian American, and 1.5% indicated they were Hispanic or Spanish speaking. For the purposes of this study the results for the internal consistency, reliability, and predictive validity for the motivational items of the MSLQ will be discussed. Coefficient alphas for each motivation scale are shown below in table 1.

Table 1.

*Coefficient Alphas For MSLQ Motivation Scales*

| Motivation Scale | Coefficient Alpha |
|---|---|
| Intrinsic Goal Orientation | .74 |
| Extrinsic Goal Orientation | .62 |
| Task Value | .90 |
| Control of Learning Beliefs | .68 |
| Self-Efficacy for Learning and Performance | .93 |
| Test Anxiety | .80 |

Predictive validity of the MSLQ motivation scales with the outcome measure of final course grade are presented below in table 2. Correlations of .13 and above were considered to be significant at an alpha of .05.

Table 2.

*Correlation Of MSLQ Scales With Final Course Grades*

| Motivation Scale | Correlation Coefficient with Final Course Grade |
|---|---|
| Intrinsic Goal Orientation | .25 |
| Extrinsic Goal Orientation | .02 |
| Task Value | .22 |
| Control of Learning Beliefs | .12 |
| Self-Efficacy for Learning and Performance | .41 |
| Test Anxiety | -.27 |

The results indicated that intrinsic goal orientation, task value, self-efficacy for learning and performance were significantly correlated with the final course grade. Extrinsic value and control of learning beliefs were not significantly correlated with final course grade. Test anxiety was negatively correlated with the final course grade. Pintrich et al. (1993) indicated that these outcomes were expected which added validity to the MSLQ motivation scales.

## Procedures

Student participants within this sample volunteered to complete the six motivation subscales of MSLQ midway through the fall 2008 semester. Participants also provided

the following information: gender, ethnicity, age, year in school, living arrangement (on-campus or off-campus), and usage of the campus tutoring center. The survey was administered to students through the website Survey Monkey. Students were invited to complete the survey via an email that was distributed by the university. If students chose to complete the survey, they were redirected to a website where the survey was posted for them to complete.

# CHAPTER 4

# RESULTS

## Study One

A sample of 1,124 students enrolled in a college algebra course at a large urban university in the North Eastern United States during the fall semester of 2008 served as the subjects for the first part of this research investigation. Descriptive data on the subjects are contained in Table 3, 4 and 5.

Table 3.

*Gender*

| Gender | N | Percent |
|---|---|---|
| Female | 644 | 57.3 |
| Male | 480 | 42.7 |

Table 4.

*Ethnicity*

| Ethnicity | N | Percent |
|---|---|---|
| African American | 235 | 20.9 |
| Asian | 135 | 12.0 |
| Hispanic | 71 | 6.3 |
| Caucasian | 567 | 50.4 |
| Other | 116 | 10.3 |

Table 5.

*Level Of Enrollment*

| Level of Enrollment | N | Percent |
|---|---|---|
| Full Time | 1077 | 95.8 |
| Part Time | 35 | 3.1 |
| Unknown | 12 | 1.1 |

As shown in Tables 3, 4 and 5 the sample consisted of primarily Caucasian students who were attending the university on a full-time basis. The sample was also more female than male. While the gender distribution is similar to the data for the student body as a whole, the ethnic distribution is weighted more heavily toward minority students in general, and African American students in particular.

As shown in Table 6, approximately 20% of the students enrolled in the course visited the tutoring center during the academic period used for the research.

Table 6.

*Number Of Students That Visited Tutoring Center*

| Tutoring Center Visits | N | Percent |
|---|---|---|
| Visited Tutoring Center | 196 | 18.9 |
| Did Not Visit | 842 | 81.1 |

Data on the SAT scores, high school grade point average and final course grade are contained in Table 7.

Table 7.

*SAT Verbal & Quantitative Scores, High School GPA, & Final Course Grade*

| Variable | *N* | Mean | Std. Deviation |
|---|---|---|---|
| High School GPA | 872 | 3.03 | .42 |
| SATQ | 995 | 522.56 | 65.87 |
| SATV | 995 | 518.00 | 73.20 |
| Final Course Grade | 1038 | 2.03 | 1.20 |

*Section 1.01 Research Question One*

Research Question One is as follows: Do students' final course grades differ according to whether they used peer tutoring at the university tutoring center? The means and standard deviations of the final course grade for users and non-users are contained in Table 8.

Table 8.

*Means And Standard Deviations Of Final Grade By Center Usage*

| | Used Center | Did not Use Center |
|---|---|---|
| N | 196 | 842 |
| Mean | 1.96 | 2.05 |
| Std. Deviation | 1.15 | 1.22 |

The means for the two groups were compared by a univariate analysis of variance (ANOVA). These results are presented in Table 9.

Table 9.

*ANOVA Results For Using Versus Not Using Center*

| | Sum of Squares | df | Mean Square | F | Sig. | Partial eta Squared |
|---|---|---|---|---|---|---|
| Between Groups | 1.16 | 1 | 1.16 | .802 | .371 | .001 |
| Within Groups | 1502.97 | 1036 | 1.451 | | | |
| Total | 5776.96 | 1037 | | | | |

As shown in Table 9 the difference in the final grade between students who used the Center and those who did not was not statistically significant.

*Research Question One, Sub-question One*

The first sub-question to research question one is as follows: Is there a significant association between frequency of use of the university tutoring center and final course grade in college algebra? Specifically, this analysis uses the actual number of times a student used the center rather than simply dividing the sample into users versus non-users. The average number of times the Center was used across the entire sample was .82. However, taking only those students who visited the Center at least once, the mean was 4.18 with a range of 1 to 48 times. Two Pearson correlations were computed between number of visits and final course grade: the first including those students who did not visit the center and the second including only students who visited the Center at least once. The correlation with all students included was -.007 and the correlation with only students who visited the Center was -.018; neither correlation was significant. The results did not demonstrate a significant association with any particular frequency of usage indicating that no matter how

few or how many times students utilized the tutoring center, it did not impact their final grade for the course.

*Research Question One, Sub-question Two*

The second sub-question to research question one is as follows: Do any of the variables outside of tutoring center usage, which include high school GPA, SAT Quantitative and Verbal scores, ethnicity, gender, and full-time versus part-time enrollment have significant associations with final course grades in college algebra? To answer this question, Pearson correlations were computed with the interval scale variables. These correlations are presented in Table 10.

Table 10.

*Pearson Correlations Of Interval Variables With Course Grade*

| Predictor Variable | Pearson Correlation |
|---|---|
| High School GPA | .329** |
| SATQ | .287** |
| SATV | .082* |

*Correlation is significant at the .05 level (2-tailed)
** Correlation is significant at the .01 level (2-tailed)

As shown in Table 10, all three variables correlate significantly with course grade with the strongest correlation being High School GPA. As would be expected, SATQ correlates more strongly than SATV.

Secondly, two univariate ANOVAs were computed for gender and ethnicity. The data for ethnicity are presented in Table 11.

Table 11.

*Final Course Grades By Ethnicity*

| Ethnicity | N | Mean | Std. Deviation |
|---|---|---|---|
| African American | 215 | 1.53 | 1.09 |
| Asian | 130 | 2.21 | 1.18 |
| Hispanic | 69 | 1.94 | 1.32 |
| Caucasian | 526 | 2.18 | 1.19 |
| Other | 98 | 2.13 | 1.17 |
| Total | 1038 | 2.02 | 1.20 |

The ANOVA results are presented in Table 12.

Table 12.

*ANOVA Results For Ethnicity*

| | Sum of Squares | Df | Mean Square | F | Sig. | Partial eta Squared |
|---|---|---|---|---|---|---|
| Between Groups | 69.74 | 4 | 17.44 | 12.56 | .000 | .046 |
| Within Groups | 1434.39 | 1033 | 1.39 | | | |
| Total | 1504.13 | 1037 | | | | |

As shown in Table 12 there was a significant difference as a function of ethnicity with a small effect size. These results were followed by a Tukey post hoc test. This showed that African American students had a significantly lower average course grade as compared to all others groups except Hispanic students, which approached significance ($p = .086$). No other comparison was significant.

The results for gender are presented in Tables 13 and 14.

Table 13.

*Final Course Grades By Gender*

| Gender | N | Mean | Std. Deviation |
|---|---|---|---|
| Males | 595 | 1.86 | 1.20 |
| Females | 443 | 2.15 | 1.19 |

Table 14.

*ANOVA Results For Gender*

| | Sum of Squares | Df | Mean Square | F | Sig. | Partial eta Squared |
|---|---|---|---|---|---|---|
| Between Groups | 20.98 | 1 | 20.98 | 14.65 | .000 | .014 |
| Within Groups | 1483.15 | 1036 | 1.43 | | | |
| Total | 5776.96 | 1038 | | | | |

As shown in Tables 13 and 14, females had a significantly higher average final grade. The effect size, however, is small. As a follow-up analysis, a two-way ANOVA was computed with ethnicity and gender as the factors. The interaction was not significant. Data for enrollment status are presented in Tables 15 and 16.

Table 15.

*Course Grade By Enrollment Status*

| FT or PT | N | Mean | Std. Deviation |
|---|---|---|---|
| Full-Time Student | 995 | 2.05 | 1.19 |
| Part-Time Student | 32 | 1.42 | 1.08 |

Table 16.

*ANOVA Results For Enrollment Status*

| | Sum of Squares | df | Mean Square | F | Sig. | Partial eta Squared |
|---|---|---|---|---|---|---|
| Between Groups | 12.33 | 1 | 12.33 | 8.61 | .000 | .008 |
| Within Groups | 1467.35 | 1025 | 1.43 | | | |
| Total | 5701.78 | 1027 | | | | |

As shown in Tables 15 and 16, part-time students have significantly lower course grades. The effect, however, is very small.

Finally, an ordinary least squares (OLS) regression was computed in order to determine the combined effect of the variables listed above on final course grade. To enable ethnicity to be entered into the regression equation, the sample was dichotomized into African American and Other. The results of this analysis are contained in Table 17.

Table 17.

*OLS Regression Results*

| Predictor | Beta | t-test | *p* |
|---|---|---|---|
| HGPA | .312 | 9.376 | .000 |
| SATQ | .292 | 7.669 | .000 |
| Gender | .106 | 3.126 | .002 |
| Ethnicity | .098 | 2.863 | .004 |
| Enrollment | -.065 | -2.033 | .042 |
| SATV | -.066 | -1.843 | .066 |
| # of Visits | .036 | 1.125 | .261 |

The multiple $R^2$ = .449, adjusted $R^2$ = .195. As shown in Table 4.15 the strongest predictors of final course grade,

in order of strength, were high school GPA, SAT quantitative scores, gender (female), ethnicity, and enrollment. Visits to the tutoring center and SAT verbal scores did not enter significantly into the regression equation.

## Study Two

A sub-sample of 254 of the college algebra students from the sample used in study one volunteered to complete the six motivation subscales of the Motivated Strategies for Learning Questionnaire via an online survey that was distributed by email to all students who were enrolled in college algebra during the fall semester of 2008. The MSLQ subscales completed were as follows: Intrinsic Goal Orientation, Extrinsic Goal Orientation, Task Value, Self-Efficacy for Learning and Performance, Test Anxiety, and Control of Learning Beliefs. The participants also shared their ethnicity, gender, age, year in school, whether they lived on or off campus, if they used the tutoring center and how often. Descriptive data on these students are contained in Tables 18 to 23.

Table 18.

*Gender Of Students In Study Two*

| Gender | N | Percent |
|---|---|---|
| Female | 151 | 59.4 |
| Male | 86 | 33.6 |
| Missing | 17 | 7 |

Table 19.

*Ethnicity Of Students In Study Two*

| Ethnicity | N | Percent |
|---|---|---|
| African American | 34 | 13.4 |
| Asian | 27 | 10.6 |
| Hispanic | 18 | 7.1 |
| Caucasian | 140 | 55.1 |
| Other | 35 | 13.8 |

Table 20.

*Living Arrangement Of Students In Study Two*

| Living Arrangement | N | Percent |
|---|---|---|
| On Campus | 131 | 51.6 |
| Off Campus | 105 | 41.3 |
| Missing | 18 | 7.1 |

Table 21.

*Year In School Of Students In Study Two*

| Year in School | N | Percent |
|---|---|---|
| Freshman | 154 | 60.6 |
| Sophomore | 56 | 22.0 |
| Junior | 21 | 8.3 |
| Senior | 5 | 2.0 |
| Missing | 18 | 7.1 |

Table 22.

*Age Of Students In Study Two*

| Age | N | Percent |
|---|---|---|
| 16 | 1 | .4 |
| 17 | 3 | 1.2 |
| 18 | 124 | 48.8 |
| 19 | 60 | 23.6 |
| 20 | 18 | 7.1 |
| 21 | 5 | 2.0 |
| 22 | 10 | 3.9 |
| 23 | 1 | .4 |
| 24 | 3 | 1.2 |
| 25 | 1 | .4 |
| 26 | 1 | .4 |
| 27 | 1 | .4 |

Table 22.

*Continued*

| Age | N | Percent |
|---|---|---|
| 35 | 1 | .4 |
| 36 | 1 | .4 |
| 40 | 1 | .4 |
| 42 | 1 | .4 |
| Missing | 22 | 8.66 |

Table 23.

*Use Of Tutoring Center By Students In Study Two*

| Use of Tutor Ctr | N | Percent |
|---|---|---|
| Did Not Use | 144 | 56.7 |
| One Time | 33 | 13.0 |
| Occasionally | 55 | 21.7 |
| Regularly | 15 | 5.9 |
| Frequently | 7 | 2.8 |

As shown in the above tables, the subjects in Study 2 were primarily freshmen females who lived on campus. The ethnic distribution is more similar to the total University than the distribution for Study 1. The percentage of students who used the Center is higher than the percentage reported for Study 1.

*Research Question Two*

The second research question in this study is as follows: Is there a significant difference between the students who used the tutoring center and the students who did not in any of the six areas of motivation measured by the MSLQ? The means and standard deviations of the six

scales for students who used or who did not use the Center are contained in Table 24.

Table 24.

*Means Of Motivational Subscales*

| | Used Center (n = 115) | | Did not Use Center (n = 122) | |
|---|---|---|---|---|
| MSLQ Scale | Mean | sd | Mean | sd |
| Intrinsic | 4.08 | 1.23 | 4.39 | 1.31 |
| Extrinsic | 5.63 | 1.22 | 5.65 | 1.18 |
| Task Value | 4.41 | 1.38 | 4.64 | 1.41 |
| Self-Efficacy | 4.19 | 1.46 | 5.21 | 1.42 |
| Test Anxiety | 4.34 | 1.43 | 4.00 | 1.64 |
| Control Learning Beh. | 4.26 | 1.35 | 5.01 | 1.37 |

A multivariate analysis of variance was computed on the data in Table 4.22. The omnibus Wilks' Lambda was significant with a medium effect size (Wilk's Lambda = .848, p = .000, partial eta squared = .152). The univariate results are presented in Table 25.

Table 25.

*MANOVA Results For Enrollment Status*

| MSLQ Scales | Mean Square | F | p | Partial Eta Squared |
|---|---|---|---|---|
| Intrinsic | 5.57 | 3.44 | .065 | .014 |
| Extrinsic | .018 | .012 | .912 | .000 |
| Task Value | 3.38 | 1.74 | .189 | .007 |
| Self-Efficacy | 61.46 | 29.56 | .000 | .112 |
| Text Anxiety | 6.82 | 2.86 | .092 | .012 |
| Control Learning Beliefs | 33.99 | 18.35 | .000 | .072 |

As shown in Table 25 there was a significant difference between the two groups in the motivational areas

of self-efficacy for learning and performance and control of learning beliefs. Students who used the tutoring center scored significantly lower in these two motivational areas than those students who did not use the tutoring center.

*Research Question Two, Sub-Question One*

The first sub-question for research question two in this study is as follows: Do any of the six motivational areas measured by the MSLQ predict student usage of the tutoring center above and beyond predictions based on ethnicity, gender, age, year in school, and living arrangement? To answer this question, a binary logistic regression was computed using the six areas of motivation measured by the MSLQ along with ethnicity, gender, year in school, age, and living arrangement. For this analysis, ethnicity was analyzed as shown in Table 4.17. The overall Nagelkerke R Squared = .222. The results of this analysis are contained in Table 26.

Table 26.

*Binary Logistic Regression With Motivational Domains And Demographic Variables Predicting Use Or Non-Use Of The Tutoring Center*

| Variable | Beta | Wald | df | p | Exp(B) |
|---|---|---|---|---|---|
| Intrinsic | .042 | .057 | 1 | .811 | 1.042 |
| Extrinsic | .192 | 1.527 | 1 | .217 | 1.212 |
| Task Value | .322 | 3.708 | 1 | .054 | 1.38 |
| Self-Efficacy | -.704 | 14.662 | 1 | .000 | .494 |
| Test Anxiety | -.235 | 3.296 | 1 | .069 | .790 |
| Control of Learning Beliefs | -.176 | 1.624 | 1 | .203 | .838 |

Table 26.

*Continued*

| Variable | Beta | Wald | df | p | Exp(B) |
|---|---|---|---|---|---|
| Gender | -.278 | .838 | 1 | .360 | .758 |
| Ethnicity (a) | .037 | 1.322 | 4 | .858 | 1.03 |
| Age | -.039 | .435 | 1 | .509 | .962 |
| Year in School | .311 | .237 | 1 | .189 | 1.365 |
| Living Arrangement | .213 | .380 | 1 | .538 | 1.24 |

(a) Using African American as the comparison group

As shown in Table 26, self-efficacy for learning was the only significant predictor of tutoring center usage, with students who used the center reporting lower self-efficacy. None of the other areas of motivation or demographic variables significantly predicted this behavior among this sample of students

*Research Question Two, Sub-question Two*

The second sub-question to research question two is as follows: Do any of the previously mentioned variables significantly predict how often a student used the tutoring center? An ordinary least square (OLS) regression was computed in order to answer this question. For this analysis, ethnicity was dichotomized into Caucasian versus other. The Adjusted $R^2$ = .171, $p$ = .000. The results of this analysis are contained in Table 27.

Table 27.

*OLS Regression With Motivational Domains And Demographic Variables Predicting The Amount Of Usage Of The Tutoring Center*

| Variable | Beta | *p* |
|---|---|---|
| Self-Efficacy | -.432 | .000 |
| Task Value | .203 | .030 |
| Year in School | .153 | .045 |
| Test Anxiety | -.150 | .048 |
| Control of Learning Beliefs | -.151 | .066 |
| Gender | -.103 | .100 |
| Extrinsic | -.103 | .184 |
| Living Arrangement | .074 | .302 |
| Ethnicity | .062 | .336 |
| Age | .055 | .442 |
| Intrinsic | -.017 | .850 |

In order of strength, the significant predictors of how often students used the tutoring center were low self-efficacy for learning, higher task value, higher year in school, and lower test anxiety. Only self-efficacy, however, was more than marginally significant. As before, the results indicated that students who rated themselves lower in self-efficacy were more likely to use the tutoring center more often.

*Research Question Two, Sub-Question Three*

This question is actually an alternative analysis to the analysis presented immediately above. For Study 2, frequency of use was coded on a five-point scale as follows:

Table 28.

*Frequency Of Center Use For Study Two*

| Freq. of Center Use | N | % |
|---|---|---|
| Did not Use | 144 | 56.7 |
| One Time | 33 | 13.0 |
| Occasionally | 55 | 21.7 |
| Regularly | 15 | 5.9 |
| Frequently | 7 | 2.8 |

Since this variable is ordinal rather than interval, the OLS regression presented above is somewhat questionable. As a consequence, frequency of use was analyzed as shown in Table 28 through a one-way MANOVA. The means for the variables are contained in Table 29.

Table 29.

*Means For Frequency Of Use*

| Variable | Did not Use | One Time | Occasionally | Regularly | Freq |
|---|---|---|---|---|---|
| Intrinsic | 4.38 | 4.21 | 4.18 | 3.83 | 3.00 |
| Extrinsic | 5.64 | 5.69 | 5.65 | 5.96 | 4.28 |
| Task Value | 5.53 | 4.41 | 4.56 | 4.41 | 3.14 |
| Self-Efficacy | 5.18 | 4.54 | 4.28 | 3.35 | 3.39 |
| Test Anxiety | 4.01 | 4.26 | 4.35 | 4.76 | 3.91 |
| Control Learning Beh | 4.99 | 4.58 | 4.32 | 4.05 | 2.71 |
| Age | 19.06 | 18.57 | 19.19 | 18.80 | 25.00 |
| Year in School | 1.39 | 1.31 | 1.54 | 1.93 | 2.14 |
| Living Arrangement | 1.55 | 1.75 | 1.51. | 1.53 | 1.29 |

The omnibus Wilk's Lambda was highly significant with a medium effect size (Wilk's Lambda = .114, p = .000, partial

eta squared = .114). The univariate results are presented in Table 30.

Table 30.

*MANOVA Results For Frequency Of Use*

| Variable | Mean Square | F | p | Partial Eta Squared |
|---|---|---|---|---|
| Intrinsic | 2.665 | 1.66 | .161 | .029 |
| Extrinsic | 1.379 | 1.01 | .401 | .018 |
| Task Value | 3.081 | 1.58 | .180 | .027 |
| Self-Efficacy | 18.067 | 8.71 | .000 | .134 |
| Text Anxiety | 2.33 | .983 | .418 | .017 |
| Control Learning Blf | 10.879 | 6.09 | .000 | .098 |
| Gender | .194 | .829 | .508 | .015 |
| Ethnicity | .319 | 1.329 | .260 | .023 |
| Age | 54.639 | 6.91 | .000 | .109 |
| Year in School | 1.955 | 3.62 | .007 | .060 |
| Living Arrangement | .468 | 1.92 | .108 | .033 |

As shown in Table 30, Self-Efficacy, Control of Learning Beliefs, age, and year in school are statistically significant. What is evident from the means is that the group that used the Center “frequently” is distinctly different from the other groups. Specifically, they have a much lower level of self-efficacy, have a far lower score on Control of Learning Beliefs, and they are older and more typically juniors and seniors. While this group is small, these results help to clarify the regression results presented earlier.

# CHAPTER 5

# DISCUSSION

## Overview

The purpose of this study was to determine if there were viable interventions for helping students perform better in college math courses. One of the original hypotheses that formed the foundation of this study was that peer tutoring offered in the form of on campus tutoring centers would be one of those viable interventions. Leading with that hypothesis, it appeared that understanding what drove students to seek out this type of intervention would be equally important. In other words, if utilizing campus tutoring centers can improve academic achievement and perhaps even reduce student attrition, it may be beneficial to investigate how to encourage more students to use them. However, the results did not support the first hypothesis that use of the tutoring center in this study would be significantly associated with student's final grade for the course. Analyses of the data revealed that there was no significant difference between users of the tutoring center and non-users when it came to final course grade. When investigating whether frequency of use of the tutoring center could be associated with final course grades, the

correlation with the number of visits to the tutoring center was found to be nonsignificant. The frequency of visits ranged anywhere from one visit to 48 visits for a single student. The mean number of visitations for users of the tutoring center was approximately four visits for the semester. High School GPA, SAT quantitative scores, and gender (female) turned out to be the only significant predictors of final course grade amongst this sample of students. It appears that if students did not perform well in high school or on the quantitative section of the SAT and they were male, using the campus tutoring center would not be enough to help improve their final course grade no matter how many times they went.

Though there were no significant associations with tutoring center usage and final course grade the fact that there was no significant difference between final course grades between the users and non-users is interesting. It is possible that in this particular sample, using the tutoring center helped users keep pace with non-users despite having lower SAT quantitative scores and lower high school GPAs. It should also be noted that mean final course grades in college algebra for both groups were not strong. Non-users had a mean GPA of 2.05 while users had a mean GPA of 1.96.

Knowing that the first hypothesis that tutoring center usage would be significantly associated with final course grades did not turn out to be true, it was left to be determined if the results from the second part of the study could still be useful in regard to helping improve academic achievement among college math students. During part two of the study, a sample of students from the larger part one sample volunteered to complete the six motivation scales of the MSLQ. The purpose was to determine if there was a significant difference between users and non-users of the on campus tutoring center in any of the six areas of motivation measured by the MSLQ. An analysis of the survey results did in fact reveal significant differences between the two groups. When just analyzing the six motivational areas, results demonstrated that students who used the tutoring center possessed significantly lower self-efficacy for learning and performance and significantly lower control of learning beliefs than those students who did not use the tutoring center. It was determined that self-efficacy for learning and performance was the sole predictor of tutoring center usage above and beyond the other five motivational areas as well as gender, ethnicity, age, year in school, and living arrangement (on or off campus). A deeper analysis was completed in order to

determine what characterized students who used the tutoring center more frequently than others. The results revealed that students who use the tutoring center more often have lower self-efficacy, lower control of learning beliefs, are older and tend to be juniors or seniors. This finding was especially evident for students who indicated “frequent” use of the tutoring center.

It may not be too surprising to find that students who seek out tutoring help have lower self-efficacy and control of learning beliefs (i.e., the belief that your effort can impact your outcome) than those who did not. These students are less apt to believe that they can succeed independently, therefore seeking outside help from peers, via the tutoring center, who have already proven themselves to be proficient in the subject in question seems to be almost a natural reaction for someone who has little faith in their own ability. In my own two-year experience as a tutoring supervisor in the university tutoring center mentioned in this study, I had many interactions with both tutors and users of the center. Many students used the center for help with homework that they felt they could not complete on their own. There were great surges in center usage prior to midterm and final examinations in which students sat through long queues in order to see a tutor.

Once the allotted 20-minute period with the tutor had expired, many students would rush to my supervisor's station in order to sign up for another tutoring session and once again sit through a long queue. Tutors often reported that students using the center did not have a firm grasp of the material. Many times the tutors would have to walk the tutee through every step of a particular problem repeatedly, at times going through entire homework assignments or practice examinations. It appeared that the more often students used the center the more they depended on the tutors to help them get through the work. The results of the study confirm that the most frequent users of the center believed in themselves the least.

The findings also indicated that students most likely to use the tutoring center frequently were typically in their junior or senior year. As college algebra is a lower level math course, it is possible that these students have either failed this course previously or they were putting off taking the course due to perceived weakness in mathematics. This could explain this group's low scores in self-efficacy for learning and performance.

## Novel Contribution Of Findings Relative To Previous Research

The body of research in the area of peer tutoring as an effective intervention in college level mathematics is quite thin. Recent studies (Duah et al., 2011; Halcrow & Iiams, 2014) demonstrated that peer tutoring for college math courses has been found to have significant positive associations with final course grades. The findings from the current study demonstrate otherwise. This may be due to the fact that Halcrow and Liams(2014) investigated several math course including higher level course (college algebra, pre-calculus, applied calculus, and calculus I) with only first year students; the tutoring was required of the experimental group and accounted for five percent of the final grade. Duah et al.(2011) utilized a structured method of peer tutoring called peer assisted learning (PAL) in their study and it did not take place in a tutoring center. The study only looked at students enrolled in a course on vector spaces, which is considered a higher-level math course. Regardless of the current results, any contribution to this area of study would appear to be useful given the small number of previous studies. Universities are continually looking for ways to reduce student failure and attrition in the areas of science, technology, engineering,

and mathematics (STEM). Offering campus tutoring services in these fields of study is not uncommon and therefore examining their effectiveness is warranted. Once a fuller body of research in this particular area has been developed, colleges and universities may be able to make more informed decisions in terms of how to allocate finite resources to different initiatives geared at helping STEM students.

In addition to adding to the body of research in regard to this particular academic intervention, frequency of tutoring center usage and its association with final grades was also investigated. Little previous research exists that looks into the specific number of visits to an on campus tutoring center and how that number may impact final grades in a college math course. Although the current study demonstrated no significant effect on final grade regardless of number of visits, it nonetheless adds new and potentially useful information to a thin body of research.

Prior to the current study, there have been little to no studies completed that looked at these specific motivational factors and how they might predict help-seeking behavior (i.e., seeking out tutoring at an on campus center) in college math students. This study

provides insight into how these students feel about themselves in relation to academics. A number of previous studies have demonstrated that self-efficacy, one of the six components of Pintrich's model of motivation for learning, has significant associations with math achievement at the college level. Here we can see that self-efficacy, or a lack thereof, has a significant association with help-seeking behavior as well. This adds a new component to the previous research that has yet to be fully explored and gives insight into how students with low self-efficacy may present (i.e., lower high school GPA; lower SAT scores; more likely to seek academic help if it is available).

## Study Limitations

### *Limitations of Part One*

A limitation of part one of this study is that the results may not generalize to a much larger population. The students that made up the sample of the study were all enrolled in a lower level math course indicating that they may not intend to become mathematics majors. Students with stronger math skills upon entering college typically start with higher-level course work than college algebra; for example, pre-calculus or calculus one. The course grade for all students in this sample ranged from 1.96 to 2.05 out of

a possible 4.0, which implies that the majority of the students in the sample were not strong in mathematics and they may have been overrepresented in the sample since stronger math students are likely to be in higher level courses.

Another aspect of the study that may weaken the generalizability of the results is that only one university tutoring center was investigated. There are a multitude of colleges and universities across the United States that provide mathematics tutoring for their students in the form of on campus centers. Results from a similar study investigating the effectiveness of those tutoring centers could very well be different from the results of this study.

Frequency of tutoring center usage was analyzed in this study. Information regarding how often students visited the tutoring (down to the exact number of visits) was obtained for all the students enrolled in college algebra during the fall 2008 semester, but there were limitations to the data. First, we do not know how long each visit lasted. In my experience working in this particular center, a student visit could consist of one 20 minute session with a tutor or it could consist of several 20 minute sessions with one or more tutors, sometimes

resulting in the student receiving one or more hours of individual tutoring in one visit. Although, less commonly, some students just used the tutoring center as a place to study and did not request a tutor at all. Secondly, the results of this study cannot account for the effect of the individual tutors themselves. It is possible that some tutors were more effective than others at helping students in college algebra and that may have played a role in the seemingly dampened impact of using the center on final course grades.

Finally, the number of courses studied is a limitation in itself. The center serves several math courses all the way up to calculus three, which is substantially more difficult and more likely to have STEM majors than the single course, college algebra, that was analyzed in this study. It is possible that if more courses were analyzed in the same way college algebra was analyzed, some significant associations with using the tutoring center and final course grades might be found.

### *Limitations of Part Two*

Not being able to match the survey responses with individual students from part one of the study is a major limitation of the second portion of the study. Being able to link final course grades from part one of this study

with the motivational areas examined in part two would have allowed for additional analyses that could have bolstered the overall findings. It would have been possible to determine if any of the six motivational variables were significantly associated with final course grade above and beyond other variables such as ethnicity, gender, SAT performance, high school GPA, as well as other demographic variables included in the two sections of the study. Students who used the tutoring center among the sample in study one were more likely to have lower high school GPA and lower SAT scores than those who did not use the tutoring center. Study two's sample is a subset of the study one sample. The tutoring center users in the subset sample possessed significantly lower self-efficacy than non-users. These results imply that self-efficacy would be associated with final course grade as it has been demonstrated in previous research, but there are no hard data from the current study that could confirm this assumption due to the two samples not being linked.

The question of generalizability of results comes up again in the second part of this study. The subset sample of students from part one's larger sample who completed surveys for part two was a much smaller group in which the demographics such as ethnicity and gender did not match the

main sample. Females and Caucasians appear to be overrepresented in the part two sample. In turn minority groups and males were slightly underrepresented, thus potentially reducing the overall validity of the findings in terms of generalization to the larger group.

Finally, now that it is known that students who used the tutoring center have significantly lower self-efficacy than those who did not use the tutoring center, the reason why is still unknown. Users are more likely to have lower high school GPAs and lower SAT scores than non-users. It is feasible to infer that a history of weakness in mathematics could lead to low self-efficacy for learning and performance in this area. However, there may be a litany of additional factors that were not examined in the current study that could potentially lead to low self-efficacy for learning and performance in this particular academic area as well.

## Implications of Findings for New Research

The implications of this study question the efficacy of peer tutoring in an on-campus center as an intervention for college math students who may not exactly be high achievers to begin with. Future research could focus on different groups of students enrolled in higher-level math courses to determine if this type of intervention may be

more effective with those particular students. Future research involving multiple tutoring centers across different universities may also yield significant results as well.

Further research into how the six motivational areas analyzed in this study predict help-seeking behavior in students taking other college math courses, or in additional areas such as science, technology, and engineering courses may be useful as well. If what drives students to seek out effective academic interventions can be predicted, colleges and universities may be able to find ways to better deliver these services to students who are more likely to use them. It may also help institutions of higher learning encourage students who are less likely to seek help on their own to do so.

Finally, the current study helps confirm the role that self-efficacy plays in achievement in mathematics. It may be useful to target future research on interventions geared at increasing self-efficacy in college math students, as well as other STEM majors.

REFERENCES CITED

Acee, T.W. & Weinstein, C.E. (2010) Effects of a value-reappraisal intervention on statistics students' motivation and performance. *The journal of Experimental Education, 78,* 487-512.

Babco, E. (2004) Skills for the innovation economy: what the 21st century workforce needs and hot to provide it. Washington, DC: Commission on Professionals in Science and Technology.

Bahr, P. R. (2008). Does mathematics remediation work?: A comparative analysis of academic attainment among community college students. *Research In Higher Education, 49* (5), 420-450.

Bagley, C. & Mallick, K. (1996) Towards achievement of reading skill potential
through peer tutoring in mainstreamed 13-year-olds. *Disability & Society, 11* (1), 83-89.

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice Hall.

Bong, M. (2001) Roles of self-efficacy and task value in predicting college students' course performance and future enrollment intentions. *Contemporary Educational Psychology, 26*, 553-570.

Bound, J. & Turner, S. (2011) Dropouts and diplomas: The divergence in collegiate outcomes. In E. Hanushek, S. Machin, & L. Woessmann (Eds.), Handbook of the Economics of Education, Vol. 4 (573-613). Amsterdam: Elsevier Science.

Burlison, J.D, Murphy, C.S., & Dwyer, W.O. (2009) Evaluation of the motivated strategies for learning questionnaire for predicting academic performance in college students of varying scholastic aptitude. *College Student Journal, 43*(4), 1313-1323.

Business Roundtable (2005) Tapping America's potential: the education for innovation initiative. Washington DC: Business Roundtable

Cardetti, F. & McKenna, P.J (2011) In their own words: getting pumped for calculus. *PRIMUS*, *21*(4), 351–363.

Cooper, E. (2010) Tutoring center effectiveness: The effect of drop in tutoring. *Journal of College Reading & Learning, 40*(2), 21-34.

Daempfle, P. A. (2004) An analysis of the high attrition rates among first year college science, math, and engineering majors. *Journal of College Student Retention, 5* (1), 37-52.

Dill, F. (2009) Action research on context, process and product variables in a tutoring lab. *AURCO Journal, 15*, 87-96.

Duah, F., Croft, T., & Inglis, M. (2014) Can peer assisted learning be effective in undergraduate mathematics?, *International Journal of Mathematical Education in Science and Technology, 45*(4), 552-565.

Eccles, J.S.; Adler, T.F.; Futterman, R.; Goff, S.B.; Kaczala, C.M.; Meece, J.L.; & Midgley, C. (1983). Expectancies, values, and academic behaviors. In J.T. Spence (Ed.), *Achievement and Motivation* (pp. 75-146) San Fransisco, CA: W.H. Freeman.

Evans, W.; Flower, J.; & Holton, D. (2001). Peer tutoring in first-year undergraduate mathematics. *International Journal Of Mathematical Education In Science & Technology, 32* (2), 161-173.

Halcrow, C. & Iiams, M. (2011) You can build it, but will they come? *Primus, 21*(4), 323-337.

Harris, R.E.; Marchand-Martella, N.; & Martella, R.C. (2000) Effects of a peer-delivered corrective reading program. *Journal of Behavioral Education, 10* (1), 21-36.

Hodges, C.B. (2008) Self-efficacy, motivational email, and achievement in an asynchronous math course. *Journal of Computers in Mathematics and Science Teaching, 27*(3), 265-285.

Hodges, C.B. & Kim, C. (2010) Email, self-regulation, self-efficacy, and achievement in a college online mathematics course. *Journal of Educational Computing Research, 43*(2), 207-223.

Husman, J.; Derryberry, W.P.; Crowson, H.M.; & Lomax, R. (2004)Instrumentality, task value, and intrinsic motivation: making sense of their independent interdependence.*Contemporary Educational Psychology 29.* 63—76.

Kaplan, A., & Midgley, C. (1997). The effect of achievement goals: Does level of perceived academic-competence make a difference? *Contemporary Educational Psychology*, *22*, 415—435.

Kesici, S. & Erdogan, A. (2009) Predicting college students' mathematics anxiety by motivational beliefs and self-regulated learning strategies. *College Student Journal, 43*(2), 631-642.

Kettmann-Klingner, J. & Vaughn, S. (1996) Reciprocal teaching of reading comprehension strategies for students with learning disabilities who use English as a second language. *The Elementary School Journa, 96* (3), 275-293.

Khazanov, L. (2011). Mentoring at-risk students in a remedial mathematics course. *Mathematics and Computer Education, 45* (2), 106-118.

Lynch, D. (2010) Motivational beliefs and learning strategies as predictors of academic performance in college physics. *College Student Journal, 44*(4), 920-927.

Lynch, D. J. (2006) Motivational factors, learning strategies, and resources management as predictors of course grades. *The College Student Journal, 40*(2), 423-428.

Martella, R.C.; Marchand-Martella, N.E.; Young, K.R.; & Macfarlane, C.A. (1995) Determining the collateral effects of peer tutoring training on a student with severe disabilities. *Behavior Modification, 19* (2), 170-191.

Mattern, K.D.; Patterson, B.F.; Shaw, E.J.; Kobrin, J.L.; & Barbuti, S.M. (2008) Differential validity and prediction of SAT. New York, NY: The College Board.

Mattern, K.D. & Shaw, E.J. (2010) A look beyond the cognitive predictors of academic success: understanding the relationship between academic self-benefits and outcomes. *Journal of College Student Development, 51*(6), 665-678.

McDonnell, J.; Mathot-Buckner, C.; Thorson, N.; & Fister, S. (2001) Supporting the inclusion of students with moderate to severe disabilities in junior high school education classes: the effects of classwide peer tutoring, multi-element curriculum and accommodations. *Education and Treatment of Children, 24* (2), 141-160.

Patel, C. & Little, J. (2006). Measuring maths study support. *Teaching Mathematics And Its Applications: An International Journal Of The IMA, 25* (3), 131-138.

Peters, M.L. (2013) Examining the relationships among classroom climate, self-efficacy, and achievement in undergraduate mathematics: a multi-level analysis. *International Journal of Science and Mathematics Education, 11*, 459-480.

Pintrich, P. R., Marx, R., & Boyle, R. (1993). Beyond cold conceptual change: The role of motivational beliefs and classroom contextual factors in the process of conceptual change. Review of Educational Research, 63, 167—199.

Pintrich, P.R.; Smith, D.A.F.; Garica, T; & McKeachie, W.J (1991) *A manual for the use of the motivated strategies for learning questionnaire (MSLQ).* Ann Arbor, Michigan. The Regents of the University of Michigan.

Pintrich, P. R., Smith, D. A. R, Garcia, T., & McKeachie, W.J. (1993). Reliability and predictive validity of the motivated strategies for learning questionnaire (MSLQ). *Educational and Psychological Me asurement, 53,* 801-813.

Pintrich, P. R. (2000) The role of goal orientation in self-regulated learning. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), Handbook of self-regulation (pp. 451—502). San Diego, CA: Academic.

Pintrich, P. R., & Zusho, A. (2002). The development of academic self-regulation: The role of cognitive and motivational factors. In A. Wigfield & J. S. Eccles (Eds.), Development of achievement motivation (pp. 249—284). San Diego, CA: Academic.

Presley, J.A. & Hughes, C. (2000) Peers as teachers of anger management to high school students with behavioral disorders. *Behavioral Disorders, 25* (2), 114-130.

Richardson, F.C., & Suin, R.M. (1972). The mathematics anxiety rating scale: Psychometric data. *Journal of Counseling Psychology, 19,* 551-554.

Spence, D.J. & Ellen, U.L. (2007) Engagement with mathematics courseware in traditional and online remedial learning environments: relationship to self-efficacy and achievement. *Journal of Educational Computing Research, 37*(3), 267-288.

Topping, K.J. (1996) The effectiveness of peer tutoring in further and higher education: a typology and review of the liturature. *Higher Education, 32* (3), 321-345.

Urban Institute for US Department of Labor (1999) An overview of economic, social, and demographic trends affecting the US labor market. Washington, DC: Lerman, R.I. & Schmidt, S.R.

United States Congress Joint Economic Committee (2012) STEM education: preparing for the jobs of the future. Retrieved from http://www.jec.senate.gov/public/index.cfm?a=Files.Serve&File_id=6aaa7e1f-9586-47be-82e7-326f47658320

United States Department of Labor (2014) Employment status of the civilian population 25 years and over by educational attainment (data file). Retrieved from http://www.bls.gov/news.release/empsit.t04.htm.

United States Department of Education, National Center for Education Statistics (2014) Income of young adults (data file). Retrieved from http://nces.ed.gov/fastfacts/display.asp?id=77

Wadsworth, L.M., Husman, J., Duggan, M.A., & Pennington, M.N. (2007) Online mathematics achievement: effects of learning strategies and self-efficacy. *Journal of Developmental Education, 30*(3), 6-14.

Yi-Guang Lin, Wilbert J. McKeachie, & Yung Che Kim (2003) College student intrinsic and/or extrinsic motivation and learning. *Learning and Individual Differences, 13,* 251–258.

Young, E. (2011). Onsite peer tutoring in mathematics content courses for pre-service teachers. *Issues In The Undergraduate Mathematics Preparation Of School Teachers, 3*, 1-8.

Zientek, L.R. & Thompson, B. (2010) Using commonality, analysis to quantify contributions that self-efficacy and motivational factors make in mathematics performance. *Research in The Schools, 17*(1), 1-11.

Zimmerman, B. J., & Schunk, D. H. (Eds.). (2001). Self-regulated learning and academic achievement: Theoretical perspectives (2nd ed.). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

## APPENDIX A

## STUDY TWO SURVEY

DIRECTIONS:
Please choose the most appropriate choice or fill in the blank space provided when necessary. This survey is anonymous. Please do not write your name on this survey.

1. What is your gender? Male Female

2. What is your ethnicity?

   a. Native American/Alaskan Native
   b. African Decent
   c. Asian
   d. Hispanic/Latino
   e. Caucasian
   f. Other

3. I live_____.

   a. on campus
   b. off campus

4. Please list your age _____.

5. I am a _____.

   a. freshman
   b. sophomore
   c. junior
   d. senior

6. Have you used the Math and Science Resource Center located on campus for help with the material in this course?

Yes No

7. How often have you used the Math and Science Resource Center this semester?

   a. one time
   b. occasionally
   c. regularly (at least once per week)
   d. frequently (twice per week or more)

The following questions ask about your motivation for and attitudes about this class. Remember there are no right or wrong answers. Just answer as accurately as possible. Use the scale below to answer the questions. If you think the statement is very true of you, circle 7; if a statement is not at all true of you, circle 1. If the statement is more or less true of you, find the number between 1 and 7 that best describes you.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Not at all true of me | | | | | | Very True of me |

1. In a class like this, I prefer course material that really challenges me so I can learn new things.

2. If I study in appropriate ways, then I will be able to learn the material in this course.

3. When I take a test I think about how poorly I am doing compared to with other students.

4. I think I will be bale to use what I learn in this course in other courses.

5. I believe I will receive an excellent grade in this class.

6. I'm certain I can understand the most difficult material presented for this course.

7. Getting a good grade in this class is the most satisfying thing for me right now.

8. When I take a test I think about items on other parts of the test I can't answer.

9. It is my own fault if I don't learn the material in this course.

10. It is important for me to learn the course material in this class.

11. The most important thing for me right now is improving my overall grade point average, so my main concern in this class is getting a good grade.

12. I'm confident I can learn the basic concepts taught in this course.

13. If I can, I want to get better grades in this class than most of the other students.

14. When I take tests I think of the consequences of failing.

15. I'm confident I can understand the most complex material presented by the instructor in this course.

16. In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.

17. I am very interested in the content area of this course.

18. If I try hard enough, then I will understand the course material.

19. I have an uneasy, upset feeling when I take an exam.

20. I'm confident I can do an excellent job on the assignments and tests in this course.

21. I expect to do well in this class.

22. The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible.

23. I think the course material in this class is useful for me to learn.

24. When I have the opportunity in this class, I choose course assignments that I can learn from even if they don't guarantee a good grade.

25. If I don't understand the course material, it is because I didn't try hard enough.

26. I like the subject matter of this course.

27. Understanding the subject matter of this course is very important to me.

28. I feel my heart beating fast when I take an exam.

29. I'm certain I can master the skills being taught in this class.

30. I want to do well in this class because it is important to show my ability to my family, friends, employer, or others.

31. Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.

APPENDIX B

INTERCORRELATION MATRIX FOR THE MSLQ

| Factor | Intr Goal | Extr Goal | Task Value | Self Eff | Test Anx | Control LB |
|---|---|---|---|---|---|---|
| Intr Goal | 1 | .488** | .686** | .547** | -.042 | .393** |
| Extr Goal | .488** | 1 | .442** | .299** | .219** | .222** |
| Task Value | .686** | .442** | 1 | .563** | -.087 | .402** |
| Self Eff | .547** | .299** | .563** | 1 | -.489** | .642** |
| Test Anx | -.042 | .219** | -.087 | -.489** | 1 | -.220** |
| Control LB | .393** | .222** | .402** | .642** | -.220** | 1 |

** Correlation is significant at the 0.01 level (2-tailed).

APPENDIX C

ROTATED COMPONENT MATRIX FOR MSLQ ITEMS

| MSLQ Items | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 |
|---|---|---|---|---|---|---|
| Q36 | .822 | | | | | |
| Q30 | .800 | | | | | |
| Q39 | .737 | | | | | |
| Q40 | .693 | | | | | |
| Q17 | .684 | | | | | |
| Q35 | .674 | | | | | |
| Q23 | .539 | | | | | |
| Q37 | .496 | | | | | |
| Q38 | | .828 | | | | |
| Q31 | | .722 | | | | |
| Q22 | | .722 | | | | |
| Q15 | | .673 | | | | |
| Q28 | | .572 | | | | |
| Q33 | | .547 | | | | |
| Q44 | | .536 | | | | |
| Q25 | | .534 | | | | |
| Q19 | | .513 | | | | |
| Q18 | | .495 | | | | |
| Q42 | | .487 | | | | |
| Q32 | | | .809 | | | |
| Q16 | | | .769 | | | |
| Q41 | | | .724 | | | |
| Q21 | | | .718 | | | |
| Q27 | | | .695 | | | |
| Q26 | | | | .694 | | |
| Q43 | | | | .593 | | |
| Q34 | | | | .496 | | |
| Q29 | | | | | .855 | |
| Q14 | | | | | .657 | |
| Q24 | | | | | | .693 |
| Q20 | | | | | | .661 |

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.