EXAMINING THE RELATIONSHIP OF ETHNICITY, GENDER AND SOCIAL COGNITIVE FACTORS WITH THE ACADEMIC ACHIEVEMENT OF FIRST-YEAR ENGINEERING STUDENTS

Dissertation
Submitted To
The School of Education and Allied Professions
THE UNIVERSITY OF DAYTON

In Partial Fulfillment of the Requirements for
The Degree
Doctor of Philosophy in Educational Leadership
Bruce Henry Carr, B.S., M.Ed.

THE UNIVERSITY OF DAYTON
Dayton, Ohio
August 2012
EXAMINING THE RELATIONSHIP OF ETHNICITY, GENDER AND SOCIAL COGNITIVE FACTORS WITH THE ACADEMIC ACHIEVEMENT OF FIRST-YEAR ENGINEERING STUDENTS

Carr, Bruce Henry

APPROVED BY:

Charles J. Russo, J. D., Ed. D.  Committee Chair  Date

A. William, Place, Ph.D.  Committee Member  Date

C. Daniel Raisch, Ph.D.  Committee Member  Date

Lloyd D. Martin, Ph.D.  Committee Member  Date

Kevin R. Kelly, Ph.D.  Dean  Date
ABSTRACT

EXAMINING THE RELATIONSHIP OF ETHNICITY, GENDER AND SOCIAL COGNITIVE FACTORS WITH THE ACADEMIC ACHIEVEMENT OF FIRST-YEAR ENGINEERING STUDENTS

Name: Carr, Bruce Henry
University of Dayton
Advisor: Dr. Charles J. Russo

The purpose of the study was to examine the relationships of social cognitive factors and their influence on the academic performance of first-year engineering students. The nine social cognitive variables identified were under the groupings of personal support, occupational self-efficacy, academic self-efficacy, vocational interests, coping, encouragement, discouragement, outcome expectations, and perceived stress.

The primary student participants in this study were first-year engineering students from underrepresented groups which include African American, Hispanic American students and women. With this in mind, the researcher sought to examine the interactive influence of race/ethnicity and gender based on the aforementioned social cognitive factors.
The Engineering Occupational Self-Efficacy questionnaire was used and an online survey was utilized with questions designed to solicit student participant self-assessments in order to examine possible relationships between and among these constructs.

Data was collected and analyzed on relationships and measures of the nine identified social cognitive factors as they relate to the academic achievement of first year underrepresented engineering students.

This study included a convenience sample of 203 participants ($n = 203$). The sample consisted of first-year engineering majors who enrolled in the fall of 2010. In addition, in order to increase the opportunity for an adequate response rate, the participation of students from more than one university was solicited.

The universities that participated in this study were the University of Akron, Cedarville University, Central State University, University of Cincinnati, the University of Dayton, Miami University, Ohio University, The Ohio State University, University of Toledo, Wilberforce University, and Wright State University.

The findings in this study were analyzed by utilizing an ANOVA in order to examine the data and determine the differences between groups on the nine identified social cognitive variables. The study employed Pearson correlation to investigate the relationships between and among the nine social cognitive variables.

Differences in academic performance (university GPA of first-year undergraduate engineering students) were analyzed by ethnicity and gender. There was a main effect for ethnicity only. Gender was found not to be significant. Hispanics were not found to be
significantly different in their GPAs than Whites but Blacks were found to have lower GPAs than Whites.

Also, Pearson correlation coefficients were used to examine the relationship between and among the nine identified social cognitive variables. The data from the analysis uncovered ten significant correlations which were as follows: occupational self-efficacy and academic self-efficacy, occupational self-efficacy and vocational interest, occupational self-efficacy and perceived stress, academic self-efficacy and encouragement, academic self-efficacy and outcome expectations, academic self-efficacy and perceived stress, vocational interest and outcome expectations, discouragement and encouragement, coping and perceived stress, outcome expectations and perceived stress.

In addition, an ANOVA was used to evaluate whether a significant difference existed for each of the nine identified social cognitive variables based on ethnicity and gender. The analysis of variance indicated that ethnicity was found to be significant for academic self-efficacy.

Next, a Pearson correlation coefficient was utilized to examine the relationship between academic performance (college GPA) of first-year undergraduate engineering students and the nine identified social cognitive variables. The data analysis revealed three significant correlations which were as follows academic performance and occupational self-efficacy, academic performance and academic self-efficacy, and academic performance and encouragement.

Finally, a Pearson correlation coefficient was used to examine the relationship between high school GPA and the nine identified social cognitive variables. The Pearson
correlational coefficient indicated that there was one statistically significant correlation which was high school GPA and academic self-efficacy.

Recommendations for further study included (a) future research involving investigations that compare a variety of institutions in different regions of the country; (b) further investigations utilizing open-ended responses from engineering students based on interviews; (c) a replicated study in 5 to 10 years to evaluate whether differences emerged relating to ethnicity and gender due to possible societal or cultural changes; and (d) a study involving a pretest and posttest of students’ self-efficacy beliefs.

Finally, the researcher recommends a qualitative study specifically involving interview questions aimed at students with moderate level grades and SAT scores who exhibited above average academic performance.
To my wife Faith for her support and encouragement throughout this learning experience,
and special thanks to our children Drew, Sarah, and Hannah. I would also like to acknowledge my late mother, Helen V. Carr who provided me with a good foundation and the opportunities necessary for this achievement.
ACKNOWLEDGMENTS

I express sincere appreciation to Dr. Charles J. Russo, my committee chair, for working diligently with me to complete this study; and Dr. Place for his continual guidance throughout this process also Dr. Raisch and Dr. Martin for serving as my committee members.
# TABLE OF CONTENTS

ABSTRACT .................................................................................................................................................. iii

DEDICATION ............................................................................................................................................... vii

ACKNOWLEDGMENTS .......................................................................................................................... viii

LIST OF TABLES .................................................................................................................................. xi

CHAPTER

I. INTRODUCTION ......................................................................................................................................... 1
   Theoretical Framework .................................................................................................................. 3
   Significance of the Problem ........................................................................................................ 5
   Research Questions ..................................................................................................................... 8
   Introduction to Methodology ...................................................................................................... 10
   Delimitations and Limitations ................................................................................................... 11
   Operational Definitions ............................................................................................................ 13
   Nine Social Cognitive Factors ................................................................................................. 14
   Significance of the Study ........................................................................................................... 15
   Organization of the Study .............................................................................................................. 21

II. REVIEW OF RELATED RESEARCH AND LITERATURE .......................................................... 22
   Introduction to Related Literature ........................................................................................... 22
   Social Cognitive Theory ............................................................................................................ 24
   Self-Efficacy Theory .................................................................................................................. 27
   Sources of Self-Efficacy ............................................................................................................ 28
   Academic Self-Efficacy Theory ................................................................................................. 32
   Academic Self-Efficacy and Academic Self-Confidence ......................................................... 34
   Student Attitudes and Academic Self-Efficacy ........................................................................ 35
   Outcome Expectancy Models ...................................................................................................... 37
   Self-Efficacy, Ethnicity and Gender ............................................................................................ 40
   Occupational Self-Efficacy .......................................................................................................... 41
   Predicting Academic Performance ............................................................................................. 42
   Stress and Social Support ............................................................................................................. 43
   Summary ...................................................................................................................................... 46
III. METHODOLOGY ................................................................................................48
   Selection of Participants ..................................................................................48
   Data collection ................................................................................................50
   Instrumentation ................................................................................................51
   Demographic Information ..............................................................................52
   Validity and Reliability ..................................................................................52
   Hypothesis ......................................................................................................53
   Subscales ........................................................................................................54
   The Science and Engineering Careers Section .............................................54
   The Support Questionnaire ............................................................................61
   Data Analysis ..................................................................................................62
   Academic Performance ...................................................................................64
   Summary .........................................................................................................64

IV. ANALYSIS OF THE DATA ..............................................................................66
   Introduction .....................................................................................................66
   Internal Consistency and Reliability .............................................................72
   Hypothesis ......................................................................................................73
   Summary .........................................................................................................93

V. SUMMARY OF FINDINGS CONCLUSIONS, AND RECOMMENDATIONS 96
   Organization of the Chapter .........................................................................98
   Summary of the Findings ...............................................................................98
   Conclusions ..................................................................................................106
   Recommendations for Practice ....................................................................117
   Recommendations for Further Study ..........................................................120
   Summary .......................................................................................................122

REFERENCES ......................................................................................................124

APPENDICES ......................................................................................................139
   A-Participating Universities ..........................................................................139
   B- Institutional Review Board Approval Letter ............................................140
   C- Informed Consent of Participants ..............................................................141
   D- Engineering Occupational Self-Efficacy Approval Letter .......................142
   E- Engineering Self-Efficacy Questionnaire ...............................................143
   F-Central State University Approval Letter ...............................................153
   G-University of Cincinnati Approval Letter ...............................................154
   H-University of Toledo Approval Letter .....................................................155
   I-Wright State University Approval Letter ...............................................156
LIST OF TABLES

1. Academic Achievement Table of Student Participants .........................................68
2. Participating Colleges ............................................................................................69
3. Gender ....................................................................................................................70
4. Ethnicity .................................................................................................................71
5. Educational Background ........................................................................................72
6. Analysis of Variance for the Dependent Variable College GPA .........................76
7. Pearson Correlational Coefficient Matrix Between 9 Social Cognitive Variables .................................................................77
8. Analysis of Variance for the Dependent Variable Personal Support .................80
9. Analysis of Variance for the Dependent Variable Occupational .......................81
10. Analysis of Variance for the Dependent Variable Academic Self-Efficacy .......82
11. Analysis of Variance for the Dependent Variable Vocational Interest ............83
12. Analysis of Variance for the Dependent Variable Coping ...............................84
13. Analysis of Variance for the Dependent Variable Encouragement ..................85
14. Analysis of Variance for the Dependent Variable Discouragement ...............86
15. Analysis of Variance for the Dependent Variable Outcome Expectations .......87
16. Analysis of Variance for the Dependent Variable Perceived Stress ...............88
17. Pearson Correlational Matrix University GPA with 9 Social Cognitive Variables ...................................................................................................................90
18. Pearson Correlational Coefficient Matrix High School GPA with 9 Social Cognitive Variables ...................................................................................................................92
CHAPTER I
INTRODUCTION

Self-efficacy, the belief that one can complete a specific task effectively, is of crucial importance for all students, including those studying engineering. Self-efficacy has been researched extensively and is accepted as a motivational construct for academic achievement (Locke, Frederick, Lee, & Bobko, 1984). Self-efficacy can be defined as “people’s judgments of their capabilities to organize and execute courses of action required to attain designated types of performances” (Bandura, 1986, p. 391).

Against this brief background, it is important to note that engineering students often do not persist to graduation or achieve their potential academically due to a lack of self-confidence in their abilities to complete the core requirements in undergraduate engineering programs (Lent, Brown, & Larkin, 1984). In other words, researchers assert that low self-efficacy may be associated with poor academic performance (Pajares & Schunk, 2002). Correspondingly, researchers have reported the vital role associated with an individual’s domain specific self-efficacy and their level of accomplishment (Lent, Brown, & Larkin, 1986). Further, research on self-efficacy suggests that it is a useful construct for predicting student academic achievement and persistence toward graduation (Lent et al., 1986). In the same way, researchers have reported evidence suggesting that self-efficacy, in combination with other social cognitive variables, was considered to be the most helpful psychological constructs among factors influencing student academic performance and persistence (Bandura, Adams, & Beyer 1977).
Lent, Brown, and Larkin (1989) asserted that strong self-efficacy beliefs are particularly important to students with moderate academic ability as compared to those possessing high academic ability. For instance, students with high academic ability are less likely to encounter academic setbacks while those of moderate academic ability and high self-efficacy beliefs will sustain their efforts and recover their sense of efficacy after the greater likelihood of experiencing failures or setbacks when faced with difficult academic tasks (Bandura, 1995). In addition, these researchers discovered that strong self-efficacy expectations are predictive of academic performance and persistence to graduation for science, mathematics, engineering, and technology students (Lent, Brown & Larkin, 1989). These researchers maintained that self-efficacy theory, a derivative of social cognitive theory, provides counselors and academic advisors with prescriptive interventions for engineering students.

In light of the importance of self-efficacy, this study examined differences in academic performance determined by grade point average of first year undergraduate engineering students based on ethnicity and gender. This study also assessed the degree to which nine social cognitive factors correlated with each other based on student responses and considered whether a significant difference exists based on ethnicity and gender. In other words, the researcher examined the degree in which the nine social cognitive variables correlated with each other. Additionally, this study sought to discover whether a relationship exists between and among the nine identified social cognitive variables and academic performance, as measured by college grade point average of first year underrepresented engineering students. At the same time, this study was designed to uncover a possible correlation between the nine identified social cognitive variables and
high school grade point average. More specifically, the researcher sought to examine the role of social cognitive variables in the prediction of the academic achievement of first year underrepresented engineering students. The researcher conducted this study based on earlier work conducted by Hackett, Betz, Casas, and Rocha-Singh (1992) who described academic self-efficacy as the strongest predictor of academic performance in undergraduate engineering students.

**Theoretical Framework**

Social cognitive career theory and self-efficacy theory provided the theoretical framework underlying this study. This study utilized each of the nine social cognitive factors to help determine students’ levels of motivation and as a means of predicting their ability to complete the educational requirements of their academic programs. The study is also designed to provide counselors and advisors with information that could be used in effort to change individual student’s academic self-efficacy beliefs.

Bandura’s social cognitive theory (SCT) is a psychological construct that provides the theoretical framework for understanding how people’s self-efficacious beliefs can be used to both explore and identify methods that allow students to control their actions that are associated with their academic learning environments while producing desirable outcomes (Bandura, 1986). Lent, Brown, and Hackett (1996) expanded Bandura’s social cognitive theory to include academic performance by introducing social cognitive career theory (SCCT).

Social cognitive career theory is derived from SCT and is considered a useful construct contributing to improved academic performance and occupational career guidance through personal determinants such as self-reflection (Lent et al., 1996). In
addition, social cognitive career theory can be used to guide the development and implementation of interventions for the target group of this study toward successfully completing the academic rigors of this science and mathematics based major and profession.

According to Bandura (1995), “in social cognitive theory, people must develop skills in regulating the motivational, affective, and social determinants of their intellectual functioning as well as the cognitive aspects. This involves bringing self-influence to bear on every aspect of the learning process” (p. 18). For example, self-regulatory skills require perseverance in the face of adversity and self-efficacy theorists Lent and Brow (2005) have found the more efficacious students have the ability to regulate their personal motivation in regard to overcoming difficulties connected with mastering academic subjects. Moreover, academic self-efficacy raises students levels of effective self-regulation linked to successful academic performance.

The SCT framework suggests that educators, through teaching practices, can influence their students self-efficacy beliefs, emotional states and motivation to become driving forces proactively engaged in their own academic achievement and development. To this end, students are able to improve their academic performance through self-regulatory behaviors Bandura (1986). As such, perceived self-efficacy involves self-regulatory mechanisms associated with perseverant effort needed for student academic success. Bandura (2001) introduced the concept of self-efficacy as a part of a self-regulatory behavior, and research has that shown self-regulatory behavior to be correlated with academic achievement. Zimmerman (1989) explained that the self-regulated learners are those who are motivated and active participants in their own learning process. With
this in mind, the framework of social cognitive theory suggests that in order to be considered a self-regulated learner, a student must exhibit self-efficacy perceptions in their abilities to perform the task of achieving their academic goals Zimmerman (1989).

Significance of the Problem

Since 1972, a national effort to increase the number of minorities and women in engineering has experienced limited success. Despite the increase in participation of minorities and women in science and engineering in the decades of the 1980s and 1990s, African Americans and Hispanic Americans continue to be underrepresented in the science and engineering workforce (National Action Council for Minorities in Engineering, [NACME], 2002). More recent data suggest the United States is experiencing a shortfall of high school and college students prepared to meet the demand for science, mathematics and engineering majors in regard to our domestic citizenship (U.S. Department of Education, 2009).

For this reason, predicted shortages for engineers in corporate America have created a need to increase the number of underrepresented minorities with the technical skills needed to fill the labor demand (Zeldin, Britner, & Pajares, 2008). Therefore, America’s increasingly technical economy mandates the need for successfully educating minority engineering students in order to increase our international competitiveness (Bruner, 2000).

One of the realities confronting corporate America is that as few as one half of all students in the United States who enroll in engineering persist to graduation (Hayes, 2007). The graduation rates of historically underrepresented minority students in engineering are even more alarming. Therefore, workforce projections and changing
demographics suggest that we must increase the number of well-equipped minority engineering students in order for the United States to remain a world economic leader (Engineering Workforce Commission, 2004). Consequently, self-efficacy learning strategies have been found to be associated with successful academic performance and retention (Bandura, 1986).

Students that are nationally recognized as underrepresented in engineering include African Americans, Hispanic Americans, and Native Americans. In fact, in the decade of the 1980s, only one out of three minority first-year students in engineering persisted to graduation (NACME, 2002). Similarly, according to NACME (2011, p. 3), retention rates for Euro-Americans in engineering school were 33% percent higher than the retention rates for African Americans and 11.4% higher than Hispanic Americans. These disparities existed despite similar standardized test scores and academic standing (Landis, 1991). Studies have shown that these disparities exist due to lack of role models, peer support, and low faculty expectations which may lead to discouragement (Landis, 1991).

In 1974, the Alfred P. Sloan Foundation in a seminal study published the report *Minorities in Engineering: A Blue Print for Action*, discussing the need to develop support systems for minority engineering students (Padulo, 1974). These support systems, the study suggested, should be designed to assist students in negotiating the rigors of the undergraduate curriculum while ultimately preparing them to meet the predicted demand for America’s technological workforce.

Most research on the prediction of undergraduate minority engineering student persistence and academic performance pertaining to social cognitive variables, outcome expectations and academic self-efficacy perceptions has focused on gender differences
(Pintrich & Schunk, 1996). Therefore, there is a need for more research examining minority engineering students and their achievement motivation (Graham, 1994).

Research also reports that women and men of color are disproportionately underrepresented in science, technology, engineering, and mathematics (STEM) occupations Bayer Corporation (2012). Moreover, research on engineering labor force employment percentages reveals that 7.1% of employed engineers are African American, 5.2% are Hispanic and 80% Caucasian (United States Department of Labor, 2011, p. 17). A closer look at the national pipeline for minorities in engineering reveals B.S. completion percentages for African American engineering students were 31.2% while 52.3% were completed by Hispanics and 63.7% by Caucasian students (NACME, 2011, p. 3).

United States Bureau of Labor Statistics data from 2011 also report that African American students are more underrepresented than Hispanic students. In fact, African American students are graduating at about one-half the rate of all engineering students while Hispanics were graduating at approximately three-fourths the rate of all engineering students; and the graduation rate for Native American students is considered too low to derive reliable data. In addition, previous research reveals that the attrition rates for minority undergraduate engineering students were approximately 50% compared to 30% for white students, (Landis, 1991).

The graduation rates for minority engineering students are low. However, these statistics indicate an improvement since the minority engineering effort began in 1974 (NACME, 2002). More recently, the African American engineering students represented 3% of all B.S. degrees in engineering, while Hispanic students accounted for 4.4% of all

With this in mind, the under-attainment of students of color in engineering is a national concern. To this end, more academic progress is necessary for underrepresented students to achieve parity toward improving America’s economic future in the twenty-first century global economy since much of it is driven by technology. Therefore, the retention and academic achievement of underrepresented engineering students is a top priority in order for America to remain a strong global technological power.

In order to fill the country’s needs for engineers, students must be able to meet the academic requirements of undergraduate engineering programs. In addition, social cognitive factors may be useful in predicting the academic achievement and persistence of high school and college students (Lent, Lopez, & Bieschke, 1991). Research in the area of self-efficacy has shown that social cognitive factors such as achievement motivation, social support, and familial and faculty encouragement can positively impact student the retention and persistence to graduation of minority students enrolled in engineering (Zimmerman, 1989). Consequently, this researcher choose to investigate factors predicting academic success that may influence the self-efficacy beliefs of underrepresented engineering students regarding their capabilities to perform the specific academic tasks necessary to accomplish a desired academic outcome.

Research Questions

This study sought to examine the relationship between social cognitive factors and their correlation to academic performance of first year underrepresented
undergraduate engineering and engineering technology students. The questions were selected in order to uncover helpful information for advisors.

As previously mentioned, the information obtained in this study may be used in providing a counseling tool for advisors to implement strategies to increase the self-efficacious beliefs of undergraduate engineering students in the completion of their degrees. In other words, using social cognitive theory constructs can provide educators with a means of determining the factors that contribute to student success and may provide specific insights for psychological counseling interventions. Likewise, social cognitive theory can be useful in developing interventions to increase the academic self-efficacy beliefs of underrepresented engineering students. More specifically, this study sought to answer the following questions:

First, are there differences in academic performance determined by grade point average of first year undergraduate engineering students based on ethnicity and gender?

Second, is there a relationship between and among the nine social cognitive factors identified: (a) personal support, (b) occupational self-efficacy, (c) academic self-efficacy, (d) vocational interests, (e) coping, (f) encouragement, (g) discouragement, (h) outcome expectations, and (i) perceived stress?

Third, for each of the nine social cognitive factors identified, is there a significant difference based on ethnicity and gender?

Fourth, is there a relationship between the academic performance (college grade point average) of first year undergraduate engineering students and the nine identified social cognitive factors?
Fifth, is there a relationship between high school GPA and each of the nine social cognitive factors identified?

**Introduction to Methodology**

The researcher sought to collect and analyze data on relationships and measures of occupational and academic self-efficacy, vocational interests, outcome expectations, perceived stress, support, and coping as they relate to the academic achievement of first year underrepresented engineering students. In this study, participants rate their levels of confidence for completing each academic or affective domain using a 10-point rating system. The scores ranged from high to low according to the level of self-efficacy or confidence rate for each specific factor. In brief, the higher the score the participant selects the higher the level of self-efficacy.

This study used the Science and Engineering Educational Plans, Stress, and Support Questionnaire developed by Hackett, Betz, Casas and Roche-Singh (1992). The questionnaire included five parts: Demographic Information, The Science and Engineering Careers Questionnaire, Occupational Interest Scale, The Outcome Expectations Questionnaire, The Stress Inventory, and the Support Questionnaire. The stress and support inventory was incorporated as a modified version of Mendoza inventory (Mendoza, 1981); modifications were made by Hackett et al. (1992).

The study employed descriptive statistics for the indicators of academic self-efficacy vocational interests, outcome expectations and other social cognitive factors. In the same way, support questionnaires included the degree of personal support participants felt they received from faculty, family members, and friends. The researcher did not manipulate the variables in this study, and there is no cause and effect. Instead, the
researcher sought to analyze the factors in the study in order to predict student achievement in their engineering programs. Further, the researcher utilized regression analysis in order to produce a multiple correlation for the purpose of the predictions.

**Delimitations and Limitations**

This section identifies the possible weaknesses of this study that confound the ability to generalize beyond the actual participants (Creswell, 1994).

First, this study was limited to the small sample size consisting of students enrolled at each participating engineering program. Therefore, the small sample size lessens the statistical power which is the likelihood of making a Type II error.

Second, the generalizability of the results of this study is limited since the sample population only consists of first-year African American, Caucasian, and Hispanic engineering students from seven Ohio public universities and three private. Each institution is made up of predominately Euro American students with the exceptions of Central State University and Wilberforce University. As such, the findings are primarily applicable to like institutions with similar populations. Therefore, valid generalizations to universities in other parts of the country with more diverse student populations may not apply to the findings of this study.

Third, the results of this study cannot be generalized to all underrepresented engineering students based on gender and ethnicity. Even so, the results do add to the knowledge base insofar as the findings provide more information for future research.

Fourth, this study was limited with regard to its instrumentation. This is so, particularly because it was not feasible to sample the whole array of topics that could be
considered in ascertaining the social cognitive factors predicting the academic achievement of first-year underrepresented students in engineering.

Fifth, this study was limited with regard to procedures. The researcher distributed the questionnaires via email using E-Survey Pro to all faculty members or minority engineering program directors of participating universities in Ohio at both public and private institutions. As such, this study is limited by the method used for selecting the educators and students for participation in this study. More specifically, this study may be limited due to the fact that only self-assessment measurements were used in order to elicit student responses.

Sixth, the study did not take the student’s socioeconomic status into consideration. According to the United States Department of Education (2002), socioeconomic information derived from college student inventories along with standardized test scores helps to explain college retention because students from lower socioeconomic groups tend to have lower standardized test scores and lower retention rates in college.

There are four underlying assumptions for these research questions. First, the researcher assumed the Science and Engineering Educational Plans, Support, and Stress Questionnaire adapted by Hackett, et al. (1992) precisely measured responses in regard to self-accessed self-efficacy beliefs, vocational interests and other social cognitive factors predicting academic performance.

Second, the researcher assumed the students participating in the study would respond honestly to the questionnaire.
Third, the researcher assumed the acceptance of self-efficacy theory along with the theoretical framework supporting social cognitive theory. In addition, recognition of the usefulness of the specific psychological constructs including self-regulatory mechanisms, expectancy, and locus of control have considerable implications for improving student performance.

Fourth, this present study was limited due to date and time when administered.

**Operational Definitions**

The operational definitions provided in this section describe the characteristics of each term within the context of this present study.

Self-Efficacy: refers to the beliefs in one’s capabilities to accomplish a domain specific task or organize and execute the courses of action required to manage perspective situations (Bandura, 1977).

Underrepresented Engineering Students: those who are considered disproportionately less or under-represented in engineering schools and occupations based on the percentage of the population of the United States of America (Engineering Workforce Commission, 2004).

Self-Assessment: information that the participants provide about themselves that describes the confidence that they have in their abilities to accomplish specific academic tasks or a description of their affective states (Blanche & Merino, 1994).

Academic performance: student grade point average (GPA) based on a 4.0 scale. Most schools consider a GPA of 3.0 good academic performances for first-year engineering students.
Nine Social Cognitive Factors

The following list provides definitions for the nine social cognitive variables:

1. **Personal Support**: Part F contains the construct of Personal Support which refers to the degree of encouragement that students” have received from various sources such as parents, peers, and faculty members.

2. **Occupational Self-Efficacy**: An indication of students” level of confidence in their abilities relative to each occupation. This social cognitive factor is operationally defined in Part I, Section B of the Engineering Occupational Self-Efficacy Scale (EOSES) and determines how efficacious students consider themselves to be in meeting the educational or training requirements of eighteen science and engineering occupations.

3. **Academic Self-Efficacy**: The self-accessed level of confidence in students” ability to complete the core requirements in an engineering program. This social cognitive factor is identified in section B part two of the EOSES and is based on the assumption that students are motivated to put forth their best efforts academically.

4. **Vocational Interests**: This social cognitive factor is operationalized to reflect a student”s level of interest in eighteen engineering and engineering associated occupations identified in Part C of the EOSES.

5. **Coping**: This factor is operationally defined in part two of the EOSES stress inventory subscale and describes the extent to which the situations or events encountered interfered with student”s ability to function as an engineering student.

6. **Encouragement**: This is one of the two constructs.

7. **Discouragement**: Section F part II operationalizes two constructs which are
used to access the degree of faculty support perceived by students.

8. Outcome expectations: An assessment of a student’s perception of the outcomes that would accrue if they successfully completed an undergraduate degree in engineering. These social cognitive factors are operationally defined in section D of the EOSES.

9. Perceived stress: A social cognitive factor that has been operationalized to access students’ perceptions of stress from academic, familial, and interpersonal sources. The stress inventory scale is found in part E of the EOSES.

Significance of the Study

According to the U.S. Department of Labor (2011), the participation of minorities and women in science and engineering careers is disproportionate to that of Euro American males and Asians. In fact, the U.S. Department of Education (2000) reported that African Americans accounted for only 7.7% of the Science and Engineering workforce. More recently, few published studies have investigated social cognitive factors predicting the academic achievement of first year underrepresented students in engineering (Lent, Singley, Sheu, & Schmidt, 2007). Consequently, research from a social cognitive perspective is needed to predict academic achievement, since this may provide insights into underrepresentation of minorities in engineering.

At the same time, research has demonstrated that the under-representation of men and women of color in engineering may be due to the low self-efficacy expectations they perceive in their capabilities to produce the specific levels of performance necessary for success as an engineering student (Betz & Schifano, 2000). Research on the core construct of Bandura’s (1986) social cognitive theory is self-efficacy which maintains
that people are more likely to engage and persist in tasks they believe that they are capable of successfully completing. Likewise, according to Bandura (1986), people tend to avoid tasks they feel less confident in performing.

Research has demonstrated that a racial achievement gap exists among students who have chosen to major in science, technology, engineering and mathematics (STEM). For this reason, social cognitive constructs such as academic self-efficacy beliefs, outcome expectations, and vocational interest may allow counselors and other educators to gain insights by providing them with the theoretical framework needed to intervene and raise students’ self-efficacy expectations (Betz & Hackett 1981; Lent & Hackett, 1987).

Therefore, the researcher choose to examine the relationship of social cognitive factors in regard to predicting the academic performance of under-represented first-year engineering students. The measurable parameters used by the researcher to predict first-year engineering students’ academic achievement included a wide variety of variables including occupational and academic self-efficacy, vocational interests; outcome expectations, perceived stress, support, and coping as well as gender and ethnicity.

The researcher selected students of color for this study due to the fact that they continue to be underrepresented in science, technology, engineering, and math professions. In this way, the applicability of Bandura’s self-efficacy theory (1986), which is derived from social cognitive theory and other motivational constructs, provides a theoretical framework for counselors and advisors to increase their understanding of social cognitive factors which may affect students’ academic achievement in addition to
providing intervention techniques designed to strengthen efficacy expectations (Betz, & Hackett 1981).

As previously mentioned, the information gained from this study is expected to uncover findings to facilitate advisor and counselor effectiveness by developing student’s efficacious self-beliefs. For example, these improvements may include the amount of scholastic effort exerted by the student; persistence in the face of adversity, meeting academic challenges, along with motivation to overcome personal, social and academic challenges (Bandura, 1997). Consequently, advisors, counselors, teachers and school administrators could benefit by developing a better understanding of self-efficacy and other social cognitive factors that increase the academic success of underrepresented first-year engineering students.

Therefore, the results of SCT investigations can be used for implementing additional academic support when needed. (Fouad & Guillen, 2006). Further, student responses to each of the social cognitive factors may capture differences based on ethnicity and gender that may reveal the strength of respondents’ self-efficacy beliefs and goal commitments to earn an undergraduate degree in engineering. With this in mind, question one of the study looked into the possibility that there may be differences in academic performance based on grade point average of first-year undergraduate engineering students based on ethnicity and gender.

As addressed in question two, the next goal of this study was to examine the relationship between personal support, occupational self-efficacy, and academic self-efficacy, vocational interest, coping, encouragement, discouragement, outcome expectations, and perceived stress. Also, as referenced in question three, this study
reviewed the interactive effect of gender and ethnicity on academic self-efficacy as well as other social cognitive variables such as stress and support (Hackett, Betz, Casas & Rocha-Singh, 1992). In addition, question four examines the relationship of (a) personal support; (b) occupational self-efficacy; (c) academic self-efficacy; (d) vocational interest; (e) coping; (f) encouragement; (g) discouragement; (h) outcome expectations; and (i) perceived stress, to academic achievement of first-year underrepresented engineering majors (Hackett, et al.,1992).

According to Sells (1980), self-efficacy beliefs act as mental filters and may influence the specific academic courses that students persist in, through effort or lack of effort. Further, the use of self-efficacy and other social cognitive factors to predict the academic performance will be used to extend the research of Hackett, et al, (1992). Therefore, the information gained from this study is likely to provide useful information for educators, school counselors, advisors and faculty member effectiveness in assisting students in completing their undergraduate degree programs in engineering due to improved self-efficacy beliefs.

This study also found underlying factors contributing to self-efficacy beliefs or attitudes held by students prior to beginning their engineering studies. In so doing, this study analyzed student’s self-accessed beliefs concerning their personal capabilities to manage the academic demands placed on them as engineering students. Further, the researcher found it important to ask questions that would uncover the social cognitive factors that positively affected a student’s self-efficacy beliefs and overall attitudes towards the study of engineering in college. Lent et al. (1984) theorized that the more self-efficacious college students are in their academic self-efficacy beliefs and have
expectancy for positive outcome expectations, the more likely they are to persist in pursuing their degree when encountering adversity.

In essence, the study sought to identify a pattern of encouraging results that positively influenced student’s attitudes and levels of confidence. For example, what factors add to students perceptions of their abilities to succeed in engineering? Thus, the research was designed to increase the understanding of students underlying self-efficacy beliefs about engineering which were partly influenced and acquired during high school before the students begin their engineering studies in college. The findings can be shared with K-12 educators in effort to prepare current and future college students entering engineering.

Researchers have generally agreed that major predictors of academic performance in college are formed before students enter college (Besterfield-Sacre, Atman, & Shuman, 1997). Therefore, all students could benefit from investigations that contribute to increased knowledge and understanding of factors related to retention, preparation and overall academic performance in engineering. In fact, previous research has shown that students begin their first year of college with a broad range of attitudes and academic self-beliefs prior to beginning their engineering studies (Besterfield-Sacre et al., 1997).

It is important then, that K-12 and post-secondary educators are aware of which factors may contribute to certain attitudes and self-perceived capabilities. These factors can best predict student success, so initiatives can be put in place to improve students” graduation rates as they enter college. Correspondingly, a study at the University of Pittsburgh found that attitudes held by freshman, even before they begin their engineering studies, provide useful information for predicting retention (Besterfield-Sacre et al.,
1997). This information is especially important for minority students majoring in engineering for retention initiatives.

Based on Besterfield-Sacre, et al. (1997) findings the student’s initial confidence levels and self-efficacy could affect their rate of persistence and retention. The notion of confidence levels as predictors to student persistence holds true for all students particularly during the period of adjustment from high school to college (Allen, 1999).

Unfortunately, research still indicates that traditionally underrepresented engineering students face unique barriers to academic achievement than their majority counterparts. For instance, research shows that African American students often feel a sense of ethnic isolation and a lack of peer support (Delphin & Rollock, 1995).

According to Tinto (1994), students are unsuccessful in completing their college degrees in any major for two primary reasons: intention and commitment. As an educator and former director of a minority engineering program, the researcher finds that it is important to work with K-12 schools, and consider areas of collaboration that would promote increased persistence, and strengthen commitment as students matriculate to colleges and universities.

Little is known about the influence of social cognitive variables which include (a) personal support, (b) occupational self-efficacy, (c) academic self-efficacy, (d) vocational interests, (e) coping, (f) faculty encouragement, (g) discouragement, or (h) outcome expectations, along with measures of (i) perceived stress, and relevant to academic achievement for students of color majoring in engineering. Most research investigating social cognitive factors predicting the academic achievement of engineering students has focused on predominately Euro-American student samples (Betz & Hackett,
1981). More specifically, previous studies focused primarily on occupational self-efficacy investigating the career options of predominately Euro-American students. Therefore, Betz and Hackett (1981) suggest that research is needed on social cognitive factors that predict the academic achievement of students from other ethnicities who are underrepresented in engineering. Likewise, Lent, et al. (2007) reported that research examining self-efficacy has moved from common occupational self-efficacy toward more complex investigations of self-efficacy relative to academic progress and educational achievement. For this reason, it is important to understand the impact of personal support, occupational self-efficacy, academic self-efficacy, vocational interests, coping, encouragement, discouragement, outcome expectations, and perceived stress, on underrepresented minorities in engineering.

**Organization of the Study**

The remainder of this study is organized into four chapters: Chapter 2 contains the literature review that serves as the theoretical background for this study. Chapter 3 reviews the procedures and methodologies with regard to data collection and analyses. These methods include identification of the participants and sampling procedures along with introducing the analysis of the data. In addition, Chapter 4 presents an analysis of the data. Lastly, Chapter 5 contains the summary of the study along with the results and implications for future research.
CHAPTER II

REVIEW OF RELATED RESEARCH AND LITERATURE

Introduction to Related Literature

A review of the literature reveals that for more than two decades Bandura’s self-efficacy theory (1986), a core component of social cognitive theory, has been used as a conceptual framework to address experiences that may influence students’ academic achievement, performance, motivation, persistence and confidence. Bandura (1997) found that students’ academic achievements are affected by their self-efficacy beliefs.

According to Bandura (1986), the construct of self-efficacy beliefs are “people’s judgments of their capabilities to organize and execute courses of action required to attain designated types of performances” (p. 391). For example, positive self-efficacy beliefs towards engineering and computer science technology resulted in improved academic performance of students studying these academic disciplines (Lent, Brown & Larkin, 1989). Further, Bandura (1986) proposed that “efficacy beliefs affect thought processes, the level of persistency of motivation, and affective states; all of which contribute importantly to the types of performances that are realized” (p. 31).

With this in mind, this review is divided into twelve major sections examining the relationship between nine social cognitive factors such as personal support, occupational self-efficacy, academic self-efficacy, vocational interest, coping, encouragement, discouragement, outcome expectations (positive and negative), and perceived stress as a
predictor of academic achievement of underrepresented first-year engineering students, (Bandura, 1986). The purpose of this investigation was to discover whether there is a statistically significant correlation between a first-year students’s perceived academic self-efficacy in combination with the aforementioned social cognitive factors in prediction of academic achievement based on students response to stress, coping mechanisms, personal support, and faculty support. In addition, the present study examined self-efficacy and social cognitive factors and the influence of ethnicity and gender in the academic achievement of students in engineering (Hackett, Betz, Casas, and Rocha-Singh, 1992).

As noted, this study examined nine social cognitive factors that may contribute to the success of underrepresented first-year engineering students. These social cognitive factors are personal support, occupational self-efficacy, academic self-efficacy, vocational interest, coping, encouragement, discouragement, outcome expectations, and perceived stress. Further, this present study examined the differences in the academic performance determined by grade point average of first year undergraduate engineering students based on ethnicity and gender. The researcher investigated the relationship among the nine social cognitive factors identified. Next, this study sought to identify any statistically significant difference that may exist among the nine identified social cognitive variables based on ethnicity and gender. In addition, this study examined the relationship between the academic performance (college GPA) of first-year undergraduate engineering students and the nine identified social cognitive factors. Finally, this study examined the relationship between high school GPA and each of the nine identified social cognitive factors.
Social Cognitive Theory

Bandura (1986) maintains that social cognitive theory is based on the beliefs individuals have about their capabilities to improve their performance or master specific tasks. Consequently, Bandura asserts that how people perform academically in the future can often be predicted by the beliefs that they hold with regard to their own capabilities to perform specific tasks. In other words, the self-accessed beliefs people have about their capabilities to perform academic tasks successfully may strongly influence their actual performance. As a result, Bandura’s social cognitive theory provides a framework for understanding, predicting, and changing human behavior.

Researchers have studied the role of students’ self-efficacy beliefs in relation to their academic performance and researchers assert that self-efficacy expectations may contribute to the prediction of grades, academic performance, and student persistence in the face of adversity (Lent, Brown & Larkin, 1986; Pajares & Schunk, 2002). Moreover, these researchers found that low self-efficacy beliefs may be associated with academic attrition, low academic performance, and ineffective study habits. Bandura, Caprara, Barbranelli, Pastorelli, and Regalia (2001) examined the affective influences of self-efficacy beliefs among high school students and found similar results. These researchers discovered the self-efficacy beliefs among high school mathematics and science students were positively correlated with their ability to learn and played a vital role in their academic achievement. Self-efficacy is thus part of the theoretical framework of Bandura’s (1986) social cognitive theory. This theory provides evidence that performance accomplishments such as academic achievement are based on an
individual’s interactions with their own beliefs, personal reflections, and the measure of control they have over their thoughts, emotions, and actions.

In his research on social cognitive theory, Bandura (1986) posits that behavior modifications can be accomplished through an individual’s self-regulatory function. The capacities of individuals to analyze their personal experiences make it possible for them to self-regulate their own behavior. This self-regulatory ability is also known as self-reflection. Therefore, as people reflect on their personal experiences, they may learn more about their own behavior and environment which may result in an improvement of future behaviors (Bandura, 1986). Consequently, students who engage in self-regulated learning have the ability to analyze their learning experiences and alter their thinking in order to meet the academic demands placed upon them (Bandura, 1991).

Bandura’s social cognitive theory views individuals as agents who are proactively involved with their own cognitive development. Therefore, according to Bandura, “what people think, believe, and feel affects how they behave” (Bandura, 1986, p. 25). Bandura asserts that individuals possess personal determinants that enable them to evaluate their own experiences through symbolizing, forethought, self-reflection, and vicarious observations. Similarly, these personal determinants enable people to exercise a conscious measure of control over their thoughts, emotional states, motivations, and actions. He explains that “social cognitive theory subscribes to a model of emergent interactive agency. Persons are neither autonomous agents nor simply mechanical conveyers of animating environmental influences” (Bandura, 2001, p. 4). Rather, Bandura stipulates that “they make causal contribution to their own motivation and action within a system of triadic reciprocal causation” (Bandura, 1989, p. 1175).
Bandura (1986) describes his model of triadic reciprocally as the interaction between personal factors, behavior, and the environment. In this model, the relationship between personal factors and the environment entails human beliefs and cognitive competencies that are developed and changed by cultural and social influences within the individual’s existing surroundings. Next, the person’s behavior or actions may be influenced by the level of the self-efficacious thoughts the individual is experiencing. Finally, the interaction between the person’s existing surroundings and behavior may influence a change in their behavior and personal characteristics due to environmental conditions. For example, Jones (1989) states:

the fact that behavior varies from situation to situation may not necessarily mean that behavior is controlled by situations but rather that the person is constructing the situations differently and thus the same set of stimuli may provoke different responses from different people or from the same person at different times. (p. 23)

As first-year engineering students experience triadic reciprocal interactions through experiences involving their personal cognitive attributes, behavior, and first year college experience or environment, social cognitive theory may be useful in predicting their probability of persisting along with their expected academic performances. Social cognitive theory and self-efficacy may, then, be useful for predicting and understanding the academic performance of first-year underrepresented engineering students. Social cognitive theory may also assist in the identification and implementation of psychological counseling methods designed to modify or change low academic self-efficacy beliefs to contribute a more positive level of efficacious thinking.
Little is known about the influence of social cognitive variables which include outcome expectations, along with measures of academic, and career self-efficacy, vocational interests, perceived stress, social support, and coping relevant to academic achievement for students of color majoring in engineering. Most research investigating social cognitive factors predicting the academic achievement of engineering students has focused on predominately Euro-American student samples (Betz & Hackett, 1981). To this end, this study expects to contribute to the process of providing an application of social cognitive theory and self-efficacy as academic and career counseling tools to be used by advisors for underrepresented first-year engineering students.

**Self-Efficacy Theory**

The academic achievement and retention of undergraduate engineering students has been positively linked to their personal beliefs that they have the capabilities to perform successfully the required tasks Betz and Hackett (1983). These beliefs are part of a social cognitive construct known as self-efficacy. Self-efficacy refers to persons’ belief concerning their personal capability to accomplish a domain specific task (Bandura, 1977).

In other words, self-efficacy is defined in terms of an individual’s self-perception of possessing the competence to successfully achieve specific kinds of accomplishments and attain specific outcomes (Pajares, 1996). According to Bandura (1986), positive self-efficacy beliefs are associated with the ability of individuals to achieve situation specific goals. Yet, Lent and Hackett (1993) indicate that domain specificity should not reduce self-efficacy assessments for application to only extreme microscopic proportions. Instead, self-efficacy assessment can be used broadly enough for application to
reasonably specific domains and still remain predictive of academic performance. Bandura (1997) states self-efficacy “refers to the beliefs in one’s capabilities to organize and execute the courses of action required to produce given attainments” (p. 3). Other research studies have reported that self-efficacy influences academic achievement, motivation and learning complex subject matter (Pajares, 1996; Schunk, 1995). Thus, interventions designed to enhance the academic self-efficacy of first year engineering students should be implemented in order to contribute to students’ academic success.

**Sources of Self-Efficacy**

Bandura (1986) found that individuals’ efficacious beliefs can be developed and influenced by four types of information that he identified as performance accomplishments or mastery experiences, vicarious learning, emotional arousal, and verbal persuasion. This finding suggests that positive experiences in any of these areas influence students to become more highly self-efficacious in their academic self-efficacy beliefs, and therefore, contribute to improvement in specific types of academic performances and accomplishments.

Mastery experiences or performance accomplishments have been shown to exert the strongest influence on self-efficacy (Maddux & Stanley, 1986). Performance accomplishments present the most tangible proof that individuals have the ability, motivation, and perseverance necessary to succeed (Bandura, 1982, Brian & Wilson, 1981; Feltz, Landers, & Raeder, 1979; Gist, 1989). Accordingly, when people believe that they have the capability to succeed in an endeavor, they will persevere despite adversity. Further, highly efficacious people recover from setbacks and become stronger in overcoming obstacles through perseverant effort (Bandura, 1986).
Bandura states, “developing a sense of efficacy through mastery experiences is not a matter of adopting ready-made habits. Rather, self-efficacy involves acquiring the cognitive, behavioral and self-regulatory tools for creating and executing appropriate courses of action to manage ever-changing life circumstances” (Bandura, 1995, p. 80). This speaks of an internalized strength of thought that can be adapted to motivate and supply individuals with the perseverance needed to accomplish challenging circumstances that they encounter throughout life. Consequently, students can develop a strong self-efficacy towards academic pursuits once they begin to believe they have the capability to meet scholastic challenges even when faced with adversity.

Bandura’s (1977) mastery experiences have important implications for self-enhancement and academic achievement. The self-enhancement and academic achievement model emphasizes the promotion of students’ positive self-beliefs through verbal encouragement. However, social cognitive theorists maintain that most of the effort put forth by educators should be focused on raising students’ personal competence and confidence by creating opportunities for them to have successful experiences performing specific tasks. Therefore, interventions should be designed to support these kinds of initiatives (Pajares, 1996).

Vicarious learning is considered the next most powerful influence on the development of self-efficacy; this type of information is obtained through social model observations Bandura (1977). Vicarious learning is a model used by social learning theorists to describe how people learn by making observations of those around them. As an illustration, when students see their peers succeed in given tasks, they begin to believe that they have the capability to achieve similar accomplishments. In addition, vicarious
experiences are most effective when observers perceive that the persons modeling specific behaviors have attributes that are similar to their own. Consequently, the more similar they find the model to themselves the more convinced students are that they too can successfully achieve comparable tasks.

According to Brown and Inouye (1978), observers can be negatively influenced into thinking that they do not have the aptitude to accomplish tasks when observing a model with similar attributes fail when attempting specific undertakings. These research findings suggest that this is particularly true when the modeling influences exert a great deal of effort and yet remain unsuccessful in their endeavor. Brown and Inouye (1978) also found that although vicarious experiences are not as strong as mastery experiences, in certain circumstances their influence can diminish the effects of direct failure experiences. Bandura (1996) asserts that in this type of scenario competent models that successfully perform tasks are needed to improve observers” beliefs about their personal efficacy in domain specific-areas.

Bandura”s (1995) research indicates social models that are perseverant in the face of difficulties do more to strengthen observers” sense of self-efficacy than social modeling influences that only accomplish easy tasks. As a result, the same characteristics demonstrated by efficacious and perseverant social models can be transmitted to student observers. As a result, students who develop strong senses of self-efficacy are more apt to show the characteristic of perseverance as they encounter the academic challenges of a mathematics curriculum. This is important because higher level mathematics along with science which is mathematics based are subjects that are required in order for students to enter engineering curricula.
Pajares (2001) observed that people search for models with qualities for which they have a high regard and whose abilities they desire for themselves. Specifically, counselors in high schools, colleges, and universities can create learning environments where students have the opportunity to observe their peers as competent social models. In this way, vicarious learning can serve as a means to promote efficacy in mathematics, science, and technology among underrepresented students when teachers create competent social modeling scenarios within the classroom whenever possible.

Vicarious learning is an influential factor that suggests that classmates are motivated by seeing others of similar abilities successfully perform an academic task. Hence, teachers play a critical role in creating an environment where this type of learning can take place, especially in the areas of science, mathematics, and technology.

Individuals” self-efficacy beliefs may be influenced through verbal persuasions that they receive from others. Bandura (1977, 1986) considered verbal persuasions of others to be a weaker source of self-efficacy beliefs than mastery or vicarious experiences. Zeldin and Pajares (1997) examined the influence of vicarious experiences on students, finding that they are developed when individuals are exposed to verbal judgments expressed by others and can play an important role in the creation and development of a person’s self-beliefs. However, it is important to note that verbal persuasions should not be confused with empty praise Erikson (1980). Instead, positive verbal persuasion must be created by encouraging individuals” beliefs in their personal capabilities. For example, Bandura, Jeffrey, and Gajdos (1975) state that verbal persuasion that bolsters higher levels of self-efficacy beliefs is based on the “credibility of the persuaders, their prestige, trustworthiness, expertise, and assuredness” (p. 152). On
the other hand, negative appraisals which weaken self-efficacy are more easily transmitted and accepted; therefore, it requires less effort to lessen a person’s self-efficacy beliefs than it is to build them up through encouragement (Bandura, 1986).

Lastly, one”s physiological state is another factor that can influence the level of self-efficacy. Physiological states include emotional arousals, anxiety, stress, and fatigue and mood states. Bandura (1997) assert that persons have the capability of selecting their own thoughts; and when they are encountering anxiety or stress, that persons may dwell on the formidable aspects of the task at hand. Moreover, this state of apprehension can perpetuate aversive thoughts and fears of an individual”s own inadequacies which may decrease their belief that they have the capability to succeed. As a result, persons may experience impaired focus which may cause the individual to perform inadequately.

**Academic Self-Efficacy Theory**

Bandura”s social cognitive theory (1977, 1982) served as the theoretical foundation for the concept of academic self-efficacy. Academic self-efficacy refers to students’ beliefs in their capability to learn or master domain specific academic subjects and accomplish significant academic progress (Bandura, 1997). The theory of academic self-efficacy, then, provides a means of gaining better understanding of the process of academic achievement of minority students and women students enrolled in engineering programs.

By way of illustration, Bouffard-Bouchard, Parent, and Larivee (1991) reported links between academic self-efficacy beliefs to cognitive performances of mathematics students; the researchers also discovered self-regulatory processes that influence theses performances. The researchers discovered that those students in spite of their cognitive
ability, whether average or advanced performed according to their personal efficacy beliefs when solving conceptual math problems.

Put another way, students with a high sense of academic self-efficacy outperformed those students who were less self-efficacious even if the lower performing individuals were of equal or advanced cognitive ability. Further, students who perceived themselves as more academically self-efficacious were found to manage their time better, and work more persistently in the face of more difficult math problems. In addition, the students who were recognized as processing high self-perceived academic self-efficacy accomplished higher cognitive performances, showed greater skill toward utilizing strategic solutions for conceptual mathematics problems than those students who had less confidence in their ability and who were identified as being at the same cognitive level. Therefore, this research suggests that students’ perceived cognitive efficacy may significantly contribute to their motivation, scholastic performance, and ultimate academic achievement in courses that require conceptual mathematic ability such as engineering.

Bandura asserts that self-efficacy beliefs may influence the specific task individuals decide to pursue such as academic majors, the amount of effort they expend toward the tasks, and the persistence or coping ability that they show in the face of adversity, along with their personal level of achievement (Bandura 1997, Schunk, 1995). Consequently, underrepresented engineering students and women who perceive themselves as having a high sense of personal efficacy toward their engineering studies and who are likely to put forth more effort, show greater persistence in the face of adversity and accomplish greater levels of academic achievement (Pajares, 1996).
Academic Self-Efficacy and Academic Self-Confidence

Academic self-confidence and academic self-efficacy are two different constructs. Even so, these two constructs are nonetheless closely associated. For example, studies have demonstrated that both academic self-confidence and academic self-efficacy may influence students’ academic performance, persistence, motivation and achievement as an undergraduate student (Lent, Brown, & Larkin 1986; Pascarella & Terenzini, 1991).

DeMoulin’s (1993) research on academic self-confidence asserted that it is an antecedent of academic self-efficacy and is determined by the amount of an individual’s background knowledge and skills which are needed to accomplish a challenging task successfully. Other researchers have identified academic self-confidence as a concept that describes student’s self-accessed perceptions concerning his or her academic ability in individual academic courses such as mathematics or chemistry (Zimmerman, 1989). Academic self-confidence also describes the general perceptions that students have of their academic abilities on the whole (Astin, 1993).

Lent, Brown, and Larkin (1986), in a study addressing student persistence, identified academic self-efficacy as the self-accessed belief that individuals have regarding their knowledge and skill sets to accomplish specific educational goals. In addition, they described academic self-efficacy as the outcomes that individuals expect to experience once they have completed certain academic responsibilities. According to Bandura’s social cognitive theory, overall self-efficacy consists of expectations of personal capabilities to perform a task in addition to specific outcomes (Bandura, 1977, 1982). Thus, Hirsch, Jackson, & Kidd (2001) asserts those student attitudes, academic self-concept, and academic self-efficacy are very similar constructs.
Student Attitudes and Academic Self-Efficacy

Bandura’s self-efficacy theory is not based on the actual ability of individuals to accomplish specific tasks. Rather, this theory is grounded in the belief individuals have in their capability to accomplish given tasks successfully. More specifically, Bandura asserts “perceived self-efficacy is defined as personal judgments of one’s capabilities to organize and execute courses of action to attain designated types of educational performances” (Bandura, 1997, p. 3).

In like fashion, Besterfield-Sacre, Atman, and Shuman (1998) conducted research which was closely associated with academic self-efficacy theory based on the effects of a students’ initial attitudes towards engineering before beginning their engineering studies. The study also examined the impact of these attitudes on undergraduate student’s academic achievement during their first year of study. Besterfield-Sacre et al. states “A student’s initial level of confidence and subsequent changes, particularly during the first year, may affect his/her motivation, performance, and quite possibly retention in engineering” (1998, p. 2). As such, the attitudes and beliefs that students bring with them before beginning their studies may be major determinants to their success as engineering students.

Besterfield-Sacre, Atman, and Shuman (1998) utilized a closed form questionnaire known as the *Pittsburgh Freshman Engineering Attitude Survey* (PFEAS) in order to explain the differences in student academic achievement, persistence and attrition out of engineering after a students’ first year of study. These results confirmed that student attitudes are associated with their academic achievement and persistence in engineering. According to these researchers:
Finally, in investigating the nature of “attrition in engineering, several studies have indicated that retention in engineering is more linked to student’s attitudes” about the engineering field and about their own abilities to succeed than it is to their own academic credentials. (p. 2)

In other words, with all things being equal, Besterfield-Sacre et al. found that students who have greater confidence in their academic abilities and more interest in engineering were more likely to persist than those with lower confidence although they possess the same academic skills.

Additionally, in the PFEAS study the researchers operationalized or defined students’ attitudes towards engineering as their confidence in their skills to succeed in engineering, the level of confidence that they have in their preparatory knowledge, and their self-accessed capabilities to meet the requirements in an engineering program of study. Further, students’ attitudes toward their personal academic capabilities influenced their perceived ability to meet the requirements of the approaching educational experience as first-year engineering students (Besterfield-Sacre, et al., 1998).

In a more recent study, Hirsch, Gibbons, Kimmel, Rockland, and Bloom (2003) combined the work of Besterfield-Sacre and her colleagues on students’ initial attitudes toward engineering and Bandura’s academic self-efficacy theory. Hirsch et al. found the work of Besterfield-Sacre et al. and Bandura’s self-efficacy theories closely associated enough to develop an attitude self-efficacy scale. This scale was designed to measure high school students’ attitudes toward engineering, along with their academic self-efficacy, and interest in engineering. Moreover, the purpose of their investigation was to examine students’ self-efficacy for engineering related skills, and students’ levels of
confidence in the core academic subjects of chemistry, math and physics. Hirsch et al. (2003) borrowed attitude and self-efficacy variables from the PFEAS which was originally developed by Besterfield-Sacre and colleagues. In the same way, Hirsch and his colleagues recognized a similarity between academic self-efficacy and measurements of student attitudes found in the PFEAS. In this regard, Hirsch et al. research suggests that the PFEAS can be adapted for use in order to determine a students’ level of academic self-efficacy.

Bandura (1986) noted that self-efficacy theory has been used to examine human levels of motivation which include affective or emotional states that may influence human behavior such as academic achievement. According to Bandura (1986), the nature and function of efficacy beliefs are based more on what people believe than reality.

**Outcome Expectancy Models**

Self-efficacy is based on two theoretical constructs, efficacy expectations and outcome expectations. Both of these cognitive factors are considered types of expectances that are useful in understanding how individuals are motivated to perform an activity. More specifically, self-efficacy expectancy refers to the belief of individuals concerning their capability to perform specific tasks or behaviors (Bandura, 1977). In addition, levels of self-efficacy expectations exist in varying strengths based on the difficulty of the task the individual is considering. The strength of self-efficacy expectations is based on a person’s level of confidence to perform a given task.

At the same time, self-efficacy expectation (Bandura, 1977, 1986) may be a helpful construct for predicting whether or not an individual will attempt a particular task or exhibit a certain behavior. Additionally, self-efficacy expectation may provide insight
on the predicted amount of effort that individuals are willing to expend on tasks and if they are willing to continue to persist through adversity (Bandura, 1986).

Self-efficacy expectations are measured based on the three facets of magnitude, generality, and strength (Bandura, 1977, 1986). The magnitude of specific tasks refers to the level of effort required to accomplish them along with the self-efficacy expectation based on the level of difficulty. Thus, the magnitude of tasks can range from low levels of difficulty to higher levels of difficulty which would require great effort in order to accomplish. The generality of self-efficacy expectations refers to the transferability of self-efficacy beliefs to other tasks and behaviors. The strength of self-efficacy is based on the power of beliefs individuals have to accomplish particular tasks.

With this in mind, self-efficacy expectations serve as useful predictors of academic performance because the strength of self-efficacy expectations can be a determinant of future actions and effort exerted by an individual. Consequently, individuals with low self-efficacy expectations often do not develop enhanced self-efficacy beliefs when they experience threatening events and are unsuccessful in accomplishing a particular task. Conversely, individuals with high level self-efficacy expectations tend to persevere in the face of adverse circumstances. As a result, these individuals acquire new behaviors that may produce future success in related tasks. In addition, individuals who experience enhanced self-efficacy expectations are more inclined to overcome preoccupation with personal weakness with regard to accomplishing a specific task (Bandura, Adams & Beyer, 1977).

On the other hand, outcome expectancy refers to the belief that specified behaviors may result in particular outcomes (Bandura, 1986). Researchers report that
people act based on their beliefs about what they perceive will be the likely outcomes of their actions (Lent, Brown, & Larkin, 1986). The self-efficacious beliefs that students have of their personal capabilities to accomplish specific academic tasks influences their outcome expectations (Beck & Lund, 1981; Wheeler, 1983). In like manner, although certain behaviors when performed successfully have been shown to lead to certain outcomes, individuals are unlikely to pursue many activities if they doubt that they have the capability to succeed. For this reason, self-efficacy expectations are considered more influential than outcome expectancies for motivating persons to persevere in given tasks (Maddux & Stanley, 1986).

Additionally, Lent and Hackett (1987) posit that outcome expectations represent an often overlooked theoretical construct which is also useful in predicting and understanding persistence and achievement for science math, engineering and technology majors. Outcome expectations are personal beliefs about possible consequences of effort and actions taken toward a goal. In addition, outcome expectations have been found to affect interests and motivate behavior (Lent, Brown, and Hackett, 1996).

Lent, Lopez, and Bieschke (1991) report that outcome expectations and self-efficacy were highly correlated in studies involving the academic achievement and persistence of undergraduate engineering students. Similarly, Lent, Lopez, and Bieschke (1993) discovered outcome expectations and self-efficacy were useful in predicting engineering student’s interest and academic performance in mathematics. As such, outcome expectations play an important role in studies involving social cognitive theory research. However, although outcome expectations are useful in understanding interest
and motivation, these researchers suggest that self-efficacy has been found to be the best predictor of academic motivational and outcomes Lent and Hackett (1987).

**Self-Efficacy Ethnicity and Gender**

A variety of researchers have conducted studies on gender differences in interests and expectations regarding science, mathematics and engineering academic majors and occupations (Betz & Hackett 1983; Freedman, 1989; Gibbons, 2007). Hackett and Betz (1981) were the first researchers to apply self-efficacy theory derived from Bandura’s (1977, 1986) social cognitive theory to the career decisions and behavior of women. Hackett et al. (1992) viewed self-efficacy expectations as a construct that was useful in understanding of the career behavior of women. Yet, few researchers have focused on ethnically diverse men and women in engineering.

At the same time, Hackett and Betz (1981) were also the first researchers to apply self-efficacy theory to the career decisions of women. Self-efficacy expectations were used as a means of understanding gender role socialization differences. Hackett and Betz suggested that women were less likely than men to develop strong career-related self-efficacy in a non-traditional career field such as engineering. Hackett and Betz explain that the early socialization experiences of women provided them with less exposure to careers that are considered traditionally male. As a result, the career self-efficacy of women considering engineering may be significantly lower than that of men because they do not recognize their true capabilities to perform in a traditionally male dominated field.

In the same way, Hackett and Betz (1981) hypothesized that low level self-efficacy beliefs in women may restrict their career options and hinder them from entering professions which have been a traditionally male dominated. According to researchers the
lack of role models could be a primary factor for their underrepresentation in engineering (Ginorino, 2003; Nauta, Epperson, Douglas & Kahn 1998). Likewise, Morgan (1992) reports that a significant number of women considered engineering to be incompatible with their future roles as wives and mothers. Few studies have addressed career self-efficacy of minority women in science, mathematics, and engineering, professions. Also, researchers report that factors such as lack of exposure to vicarious role models, along with guidance to take advanced science and mathematics courses, may play a major role in the low self-efficacy of minority women (Hackett & Byars, 1996; Hackett & Lent, 1992).

**Occupational Self-Efficacy**

Previous studies focused primarily on occupational self-efficacy investigating the career options of predominately Euro-American students. Hackett and Betz (1981) suggest that research is needed on social cognitive factors designed to predict the academic achievement of students from other ethnicities who are underrepresented in engineering. Similarly, Hackett and Betz (1981) reported that research examining self-efficacy has moved from common occupational self-efficacy toward more complex investigations of self-efficacy relative to academic progress and educational achievement. For this reason, it is important to understand the impact of occupational and academic self-efficacy, vocational interests, outcome expectations, perceived stress, support and coping on underrepresented minorities in engineering.
Predicting Academic Performance

Previous research supports the utility of social cognitive constructs in understanding and predicting the academic achievement of engineering students with regard to ethnicity and gender (Lent & Hackett, 1993). High levels of self-efficacy are considered to be useful in predicting successful task performance of any kind (Bandura, 1977, 1986). More specifically, social cognitive theory, academic self-efficacy, outcome expectations, perceived stress and coping have been shown to be useful in predicting the academic achievement of college students enrolled in engineering (Lent, Brown, & Larkin, 1986).

Lent, Brown, and Larkin (1984, 1986) were the first to conduct studies on career and academic self-efficacy which uncovered a positive correlation between the two constructs in regard to academic progress of engineering, science, technology and math majors. However, their findings support the value of academic self-efficacy construct as the most accurate predictor of a student’s academic performance. Further, Lent suggests that “academic performance in high school was strongly related to academic self-efficacy” (Lent et al., 1986, p. 265). Accordingly, these findings suggest the strength of a first-year engineering student’s academic self-efficacy developed in high school may affect the strength of their academic self-efficacy toward the academic coursework required in college.

In another study, Lent, Brown and Larkin (1987) compared self-efficacy to two other social cognitive models including vocational interest or interest comparisons and outcome expectations or consequence thinking. They reported data suggesting that
academic self-efficacy is the most efficient predictor of engineering students’ academic achievement and persistence.

The academic performance and retention of underrepresented students in engineering needs to be improved. Even so, research indicates that improved retention rates are needed for majority students and women as well. Therefore, all students could benefit from investigations that contribute to increased knowledge and understanding of factors related to retention, preparation and overall academic performance in engineering (Singham, 2003).

Additionally, the core components of the PFEAS ask students to rate their self-perceived academic confidence in the academic preparation that they received in high school. Students are also asked to rate their overall perceptions of their ability to meet the academic requirements of their forthcoming engineering curricula. This information is needed in order to better uncover students’ efficacy to achieve and aspects of their motivation based on their individual beliefs. Due to the similarity of student attitudes toward engineering and their academic self-efficacy, Besterfield-Sacre et al. (1998) confirmed the usefulness of self-assessed self-efficacy beliefs for determining student academic performance.

**Stress and Social Support**

Research has identified stress, coping, and social support as factors that may be important to the academic performance, and career choice of undergraduate college students (Shields, 2001). In fact, Hackett et al. (1992) reported that these considerations may be especially significant for first-year underrepresented engineering students. Mendoza (1981) provided valuable insight when he collected data supporting the theory
that underrepresented engineering students, in particular women, encounter increased levels of stress and lower levels of support as compared to Euro-American students.

Greenfield, Holloway, and Remus (1982) report that undergraduate engineering programs require rigorous courses of study in science and mathematics which often brings to bear high levels of stress on students. For this reason, faculty, social, and familial support have been positively correlated with successful coping skills exhibited by students during their first two years of study (Cohen & Wills, 1985).

According to Landis (1991), underrepresented engineering students frequently experience a lack of social support and encounter feelings of insensitivity from faculty members while attending predominately white campuses. Freeman (1979) reports that lack of support or encouragement from engineering faculty members has been identified as a stressor that may negatively impact the academic performance of underrepresented engineering students and women. Freeman further refers to the lack of support from faculty members as the “null environment hypothesis” (p. 217) because it is a construct that represents the absence of encouragement and help that the students experience.

Hackett, Betz, Casas and Rocha-Singh (1992) report that there is also data suggesting that “Euro-American women and women and men of color may experience sources of stress over and above those experienced by Euro-American men in engineering programs, resulting from, for example, sexism, racism, and differential treatment by faculty and follow students” (p. 529). In further corroboration of this scenario, Nettles and Johnson (1987) examined the influence of ethnic status on faculty-student relations in addition to academic assimilation and social integration. Their study concluded that although faculty members are generally supportive of students, this
support has faltered when ethnic status was taken into consideration. In other words, Nettles and Johnson (1987) declared that students of color have encountered perceptions of estrangement with regard to faculty-student relationships which as a result may exert a negative influence on student’s academic and social integration.

Similarly, Bandura’s self-efficacy theory reveals that verbal support from faculty members provides a source of encouragement and is linked to higher levels of self-efficacy (1977, 1986). For example, Hackett, Betz, Casas and Rocha-Singh (1992) indicated that diminished levels of academic and career self-efficacy due to the academic stressors encountered by students in engineering programs has been inversely related to high levels of self-efficacy. Therefore, as previously mentioned, students possessing higher level coping skills along with efficacious outlooks may have greater abilities to manage stress and anxiety successfully.

On the basis of these findings, it may be that lack of verbal encouragement from faculty is one of the cardinal and mitigating factors against underrepresented students coping skills and academic performance. Thus, Bandura’s social cognitive theory and self-efficacy theory provide behavioral strategies that advisors and counselors can use in order to encourage students of color in engineering programs. These intervention strategies may promote higher levels of self-efficacy by generating and strengthening beliefs of an individual’s personal and academic competence (Bandura, 1977, 1982, 1986).

Causes of student stress concerning academic stressors are not associated with what Landis (1991) refers to as ethnic isolation, lack of peer support, and low faculty expectations of underrepresented engineering students. These factors include lack of
effort, dedication, and commitment to one’s academic studies Landis (1991). Yet, the research cited in this study is based on the fact that underrepresented engineering students must meet the same requirements and score within the same range on standardized test such as the Scholastic Aptitude Test (SAT) and the American College Test (ACT) tests to enter their perspective engineering programs (Landis, 1991). In addition, students must meet specified academic standards before they are admitted to their engineering programs. Consequently, researchers were operating under the belief that the majority of students enrolled in engineering programs are putting forth acceptable efforts to meet the academic demands.

With this in mind, some studies provide evidence that the self-efficacy construct is useful to high school counselors and college advisors because it provides the theoretical framework for understanding how positive self-efficacy beliefs can be developed in students (Hackett & Betz, 1981; Lent & Hackett, 1993). In the same way, Bandura’s (1977) self-efficacy construct has been useful for understanding and predicting the level of academic achievement and persistence of high school and college students.

Summary

This review of the literature presented information on the relationship between and among gender, ethnicity, and social cognitive factors on the academic achievement of first-year engineering students. This literature review also presented information on the impact and measures of students’ self-efficacy beliefs among the aforementioned social cognitive variables. The literature review provides evidence that social cognitive factors may have an influence on the academic achievement of first-year engineering students. For example, Hackett, Betz, Casas and Rocha-Singh (1992) presented findings on
interactions and correlations of the nine identified social cognitive variables in a similar study. The significant interactions and main effects reported in their study included occupational self-efficacy, academic self-efficacy, and vocational interest for ethnicity. A main effect was found for positive outcome expectations. Gender and ethnicity revealed a significant interaction and main effect with encouragement. On the other hand, no main effects or significant interactions were uncovered for gender and ethnicity for perceived stress, personal support and coping.

Occupational self-efficacy and academic self-efficacy were significantly correlated with university GPA measures. Perceived stress was significantly related to university GPA, coping was positively correlated with positive outcome expectations and university GPA, and coping was positively correlated with perceptions of encouragement. High school GPA was found to be significantly correlated with university GPA. Coping was found to be negatively correlated with negative outcome expectations and inversely correlated with discouragement.

No correlations were present between academic self-efficacy and outcome expectations, positive outcome expectations, and university GPA. These descriptive and inferential analyses were used to provide the basis for my study which examines the relationship between social cognitive factors, self-efficacy beliefs, and ethnicity and gender on the academic achievement of first-year engineering students.
CHAPTER III

METHODOLOGY

This chapter describes the procedures and quantitative methods that were used in this study along with the demographic characteristics of the participants. Moreover, this chapter includes descriptions of methods that the researcher used during data collection, analysis, and sampling procedures. Accordingly, the information in this study is presented in the following order: selection of participants; data collection procedures; instrumentation, including a description of the Likert scale, used to examine the relations of measures of personal support; occupational self-efficacy; academic self-efficacy; vocational interests; coping; encouragement; discouragement; outcome expectations; and perceived stress of first-year undergraduate engineering students’ research design; research setting; demographic characteristics of participants; validity and reliability; the analysis of collected data; and the hypotheses.

Selection of Participants

This study includes a convenience sample of 203 participants (N = 203). The sample included first-year engineering majors who enrolled in the fall of 2010. In addition, in order to increase the opportunity for an adequate response rate, the researcher decided to solicit the participation of students from more than one university. Also, the intended participants that the researcher targeted for this study are first year engineering students from universities in Ohio. Therefore, the participants in this study consisted of
first-year engineering students enrolled in engineering programs at one of eleven universities in Ohio.

The universities and their affiliations are in this study are the University of Akron (public, research university), Cedarville University (private, Baptist university), Central State University (public, historically black college/university), University of Cincinnati (urban, public research university), the University of Dayton (private, Roman Catholic), Miami University (public, state university), Ohio University (oldest public research university in the state of Ohio), The Ohio State University (comprehensive teaching and research university), University of Toledo, Wilberforce University (private, African Methodist Episcopal, [AME], historically black college/ university), and Wright State University (public, state university). Specific descriptions of the participating universities are located in Appendix A.

In order for the students to meet the criteria for the study, they had to be classified as having full-time status. Further, underrepresented students within the engineering major were the primary focus of the research. Underrepresentation of an ethnic group in engineering is based on low representation by a percentage of the population within the engineering major or profession (National Science Foundation, 1998). Yet, the total sample of participants included both majority and underrepresented ethnicities. Such an approach afforded the researcher the opportunity to complete a statistical test comparing the two groups in an effort to determine any statistically significant differences between the two groups.

For the purposes of this study, the underrepresented ethnicities that were included consisted of first-year African and Hispanic American students. Likewise, the majority
students in this study included first-year Caucasian or White engineering students. Therefore, the researcher identified universities in the state of Ohio that offer engineering and have minority engineering programs or are attended by underrepresented engineering students. As a result, the researcher identified the following universities as meeting the criteria for the population that will facilitate data collection in this study: the University of Akron, Cedarville University, Central State University, University of Cincinnati, the University of Dayton, Miami University, Ohio University, The Ohio State University, Wilberforce University and Wright State University. Participants are students who have been enrolled, for at least, the equivalent of one semester.

**Data collection**

After receiving Institutional Review Board approval from the University of Dayton (Appendix B), in the fall of 2010, consent forms were emailed to deans, minority engineering program administrators, and faculty members who agreed to administer the survey personally at the target universities. The email included a link to a web-based survey instrument known as the Engineering Occupational Self-Efficacy Scale. In addition, the researcher provided college faculty members with a letter that included the survey link via eSurvey Pro to email to their students. This letter described the purpose and scope of the study, asking participants to complete the Engineering Occupational Self-Efficacy Scale (EOSES). A copy of the letter is located in Appendix C. Moreover, the researcher provided instructions for filling in responses and once the questionnaires were completed, the results were collected in real time from each participating university and stored for analysis.
The researcher used web-based surveys to administer the survey and collect the participant’s responses during their core engineering courses or mandatory student meetings in order to help insure a good response rate. The researcher communicated with faculty members or administrative faculty requesting questionnaires be given to adequate numbers of underrepresented students and women.

**Instrumentation**

Prior to the collection of data, the researcher requested and received written permission from Dr. Nancy E. Betz, Professor of Counseling Psychology at The Ohio State University, to use the Occupational Self-Efficacy Scale (OSES) in this study. A copy of her permission letter is located in Appendix D.

Nancy Betz and Gail Hackett (1981) were the first to apply Bandura’s (1977) concept of self-efficacy to the areas of career psychology and counseling. As a result, Betz and Hackett (1986) developed a series of career and academic self-efficacy measures. These instruments included the Occupational Self-Efficacy Scale (OSES), which was designed to measure the perceptions that students have in their ability to successfully complete the specific tasks associated with the educational requirements of their academic course work leading to a profession.

In addition, Betz & Hackett, (1983), along with their colleagues, have developed other measures, which include the Mathematics Self-Efficacy Scale and the Career Decision Making Self-Efficacy Scale (Taylor & Betz, 1983), along with other colleagues, have extended the OSES to test the self-perceptions of students in science, mathematics and engineering (Hackett, Betz, Casas & Roche-Singh, 1992). For this reason, the researcher selected the Engineering Occupational Self-Efficacy Scale (Hackett, et al.
1992) in order to measure academic and occupational self-efficacy in this study. A copy of the survey instrument is located in Appendix E.

This instrument was designed to gather demographic information on variables such as ethnicity, gender, school year of the subject, and social cognitive factors such as parental support or discouragement. These items provide information on the impact of the subjects’ past experience, which, according to Bandura (1997), forms an individual’s domain specific self-efficacy. For example, repeated failures in science and math generally determine students’ perceptions of their ability to meet the academic requirements for this subject.

**Demographic Information**

The demographic data provided in this study consisted of: each participants year in school; gender, (question two) found in Part A of the EOSES questionnaire; age (question three); ethnicity (question four); engineering discipline; family educational background (question eight); residence (question ten); along with living conditions (question twelve).

Students were classified based on the underrepresentation of their ethnicities within the profession of engineering (National Science Foundation, 1998). As a result, the underrepresented, or minority group, included African American and Hispanic American students. The students in the majority category included Caucasian and Asian American students.

**Validity and Reliability**

According to Nunnally (1978), an alpha coefficient of $r = 0.80$ is required for research purposes in order to ensure reliable internal consistency relating to the data.
More recently, Streiner and Norman (2003) stated that the alpha coefficient should be above 0.7 but not higher than 0.9 for reliable internal consistency tests. According to Hackett et al. (1992), the coefficient alpha values for internal consistency and reliability of the various subscales found in the Engineering Educational Plans, Stress, and Support Questionnaire were all within the acceptable range for research. Therefore, this instrument was considered as having testing reliability within acceptable limits for this study. Alpha Cronbachs were run on this data and reported in chapter four.

**Hypothesis**

The researcher gathered data for the study to provide evidence about the research hypotheses which examined the relationship among nine social cognitive factors, ethnicity, gender, and the academic achievement of first-year students in engineering (Hackett et al., 1992).

The researcher investigated the following hypotheses:

1. Gender and ethnicity will account for a statistically significant portion of variance in the academic performance of first-year undergraduate engineering students determined by college grade point average. The study employed the use of a 2 X 3 analysis of variance to test hypothesis one.

2. The nine social cognitive variables identified: personal support, occupational self-efficacy, academic self-efficacy, vocational interests, coping, encouragement, discouragement, outcome expectations, perceived stress, will correlate with each other. Hypothesis two was tested by running eighty one correlations.
3. For each of the nine social cognitive variables identified, there is a statistically significant difference based on ethnicity and gender. Nine 2 X 3 ANOVA’s will be utilized to test hypothesis three.

4. There is a statistically significant relationship between the academic performance (college GPA) of first-year engineering students and the nine identified social cognitive factors. Nine Pearson Correlations will be used to test hypothesis four.

5. There is a statistically significant relationship among the nine identified social cognitive variables and high school grade point average (GPA) of first-year engineering students. Hypothesis five was also tested through the utilization of nine Pearson Correlations.

**Subscales**

The instrument also requested information for nine social cognitive variables found in four major subscales, which are science and engineering careers questionnaire, occupational interest scale, outcome expectations questionnaire, stress inventory and support questionnaire. The nine identified social cognitive variables were: personal support, occupational self-efficacy, academic self-efficacy, vocational interests, coping, encouragement, discouragement, outcome expectations, and perceived stress. These nine social cognitive variables were correlated with each other in order to see if a statistically significant relationship exists.

**The Science and Engineering Careers Section**

The following are descriptions of the Science and Engineering Careers section for this study.
The Occupational Self-efficacy Scale, found in section B part one of the engineering EOSES scale, was designed to evaluate how efficacious students perceive themselves in meeting the educational or training requirements for 18 science and engineering occupations. The scale measures the participants’ levels of self-efficacy by asking them to rate their levels of confidence to successfully meet the program requirements in addition to performing the professional tasks essential for science and engineering professionals. The scale incorporates a 10 point Likert scale ranging from (0) not at all confident to (9) completely confident, which denotes a superior level of self-efficacy. Hackett et al. (1992) applied the theoretical construct of Bandura’s self-efficacy theory to their instrument based on the belief that lower levels of occupational self-efficacy would likely result in a lack of persistence and contribute to attrition.

On the other hand, higher levels of occupational self-efficacy can result in greater perseverance in the presence of obstacles or academic setbacks and therefore, producing higher levels of academic performance and student achievement. Hackett et al. (1992) collected data that indicated internal consistency reliabilities or alpha scores of .95 for this occupational (science and engineering) self-efficacy subscale. Lent et al. (1986) found the occupational self-efficacy scale to have acceptable internal consistency reliability Cronbach’s alpha of .95 and a test retest internal consistency reliability of .89. Therefore, according to DeVellis (2003, pp. 95-96), this research scale is considered “very good” for internal consistency and reliability.

**Scoring of the Occupational Self-efficacy Scale**

In part one of this sub-scale, the first 18 items were designed to identify career self-efficacy of the participant and are scored cumulatively. In other words, the total
score can be used or the score can be divided by 18 to get the score back into the original response units. The score can then be interpreted in terms of the overall degree of confidence for the 18 careers. Further, there is no need to reverse the score on the self-efficacy items.

**The Academic Self-efficacy Scale.** Section B part two of the Science and Engineering Careers Questionnaire also contained the Academic Self-efficacy scale which was primarily based on Betz and Hackett’s (1983) Mathematics Self-efficacy college courses scale and was adapted for use in the OSES instrument located in Appendix E. The second portion of this subscale focused on academic self-efficacy and asked participants to rate the degree of confidence they have in their capability to meet mathematics and science and other core requirements in their engineering programs. The sum of the scores in the first part of this subscale revealed the participants’ level of self-efficacy in meeting the educational requirements. Moreover, this scale consisted of twelve items and is based on the assumption that students are motivated to put forth their best efforts academically. This measure was originally utilized by Lent et al. (1987), who reported an internal consistency reliability of .89 for this scale.

The strength of the students’ confidence was assessed by asking participants to rate their confidence on a 10 point scale ranging from not confident at all (0) points, to completely confident yielding a (9) point score. Finally, the overall strength of scores were calculated by totaling the sum and dividing by 12.

**Scoring of the science and engineering careers questionnaire:**
Part 2 of this subscale consist of the Lent et al. (1987) academic milestones self-efficacy scale. This part of the subscale is scored the same as the first section where the scores are summed and no reverse scoring is involved.

**The Occupational/Vocational Interest Scale.** Part C of the EOSEs contained the occupational interest scale which is a subscale of the engineering occupational self-efficacy scale (Hackett et al., 1992). This subscale also consists of 18 items which was used to access students’ occupational self-efficacy scores.

The Vocational Interest scale was originally designed by Lent et al. (1986) to ensure that participants distinguish between their level of interest and from their level of confidence in eighteen engineering and engineering associated occupations. Additionally, the same occupations were listed on the occupational self-efficacy scale, however, this scale was modified so that a participant with a higher score would indicate a greater satisfaction associated with a particular occupation; this subscale measured the level of interest students have in each occupation using a Likert scale. The 10 point Likert scale ranges from strongly dislike (0) score to strongly like (9) point score. Lent et al. (1986) reported internal consistency reliability alpha coefficients of .89 for the items on the subscale.

**Scoring**

In order to obtain an index of interest in science occupations, Part C was scored by taking the sum over the 18 items. As such, the participants’ interest ratings of each occupation were recorded on a 10 point Likert Scale ranging from strongly dislike (0) to strongly like (9). Lent et al. (1986) found an internal consistency coefficient Cronbach’s alpha of .79 for the Vocational Interest Scale. Therefore, the scale was considered to have had acceptable internal consistencies.
The Outcome Expectations Questionnaire Section D of the engineering EOSES consisted of the outcome expectations questionnaire. This subscale measured student perceptions as they envisioned the outcome of successfully completing the course work required to obtain an undergraduate degree in engineering. This scale was developed by Lent, Lopez and Bieschke (1991).

The researchers employed the use of a 10 point Likert-like scale to access the degree to which participants agreed or disagreed with the potential outcomes listed. The scale ranged from strongly disagree (0) to strongly agree (9). The scale listed 12 possible outcomes, including 3 negative outcomes and 9 positive. For example, in question one, part two, section D, students were asked if they agree or disagree with statements such as “A degree in engineering /science will allow me to obtain a well-paying job.”

Participants were also asked to respond to their degree of agreement or disagreement with negative scenarios such as, “I worry that employers will doubt my competence.” In this question, the researcher used reverse coding to calculate the scores. Here, higher scores indicated a stronger degree of positive or negative outcome expectations. In addition, the ratings from the positive and negative items were calculated separately. For example, the ratings for the positive and negative outcomes were summed individually and the totals were divided by the number of subscale items in order to obtain the average scores. Therefore, the outcome expectations subscale was treated as one variable; this was accomplished by totaling the scores of participants and then dividing them by 12, which represents the total number of items on the scale. Hackett et al. (1992) revealed the internal consistency reliability or Cronbach’s alpha score of .81 for the positive outcome scale and .77 for the negative outcomes scale.
The Stress Inventory

Part E, the stress inventory subscale was utilized to accesses student perceptions of stress. The stress inventory subscale is based on Hackett et al. (1992) and their adaptation of Mendoza’s stress coping inventory scale (Mendoza, 1981). The first two parts of this instrument were designed to uncover how the participants cope with stress by employing two rating scales and the last two sections of this subscale make use of two one item rating scales. The first part of the subscale consisted of 19 items, 16 of which were from Mendoza’s stress coping inventory scale (1981).

The stressors that were assessed in the scale include student perceptions of academic, familial, and interpersonal sources of stress. Hackett et al. (1992) included two additional items in order to uncover more specific antecedents that are related to the stressors associated with the engineering major along with familial pressures to measure in engineering.

Perceived Stress. In part one of this subscale, participants were asked to respond to each statement measuring the degree of stress on a five point scale ranging from not at all stressful (1) point to extremely stressful (5) points. On question number three, part one section E, participants were asked to rate an academic stressor such as: “How stressful have each of the following been to your not meeting personal expectations for academic achievement.”

In the same way, the subscale asked students the degree of stress associated with familial and interpersonal stressors. Moreover, this scale was designed to measure students’ subjective views of perceived stress or strain. For example, some common
stressors may include tests, grades, competition, time demands, professors and concerns about the job market (Mendoza, 1981).

The results of this subscale were taken from the mean ratings of the participants. Hackett et al. (1992) reported that the instrument has high internal consistency reliability, alpha coefficient of .86 for the stress inventory. Therefore, this instrument was found to be acceptable for internal consistencies and reliability.

**Scoring**

The scoring of part one of this subscale involves taking the sum of over the 19 items in order to obtain an index of stress in the participant’s environment.

**Coping.** Part two of the stress inventory subscale used a small 5-item scale to identify the extent to which the situations or events interfered with their ability to function effectively as an engineering student. This scale, in the original form, was taken from Mendoza’s (1981) stress coping inventory. The responses from this scale ranged from not at all (1) point to extreme with a rating of (5) points. Students were asked question 23, part two, section E, “Does the stress that you experience interfere with your ability to enjoy acquiring knowledge and growing intellectually at the university.” As in the other measures, mean scores are identified for each participant. Hackett et al. (1992) reported an acceptable internal consistency Cronbach’s alpha of .87 for this section of the subscale. As a result, this section of the survey instrument had a high reliability rating for data collection.

**Scoring.** Part two of the subscale was accomplished by summing the items scores over the number of items to find the degree to which stress is interfering with life.
Global Stress and Coping. Part three of the scale was adapted by Hackett et al. (1992) from Mendoza’s stress inventory scale (1981) and was designed to measure students’ overall or global level of stress and coping.

Scoring. Part three of the subscale was scored by obtaining the sum of two one-item measures, which called for participants to signify their global degree of stress and coping.

The Support Questionnaire

Personal Support

Part F, contains the support questionnaire, subscale and asked participants to indicate the degree of support or encouragement they have received from a variety of sources such as parents, peers, and faculty members. Subjects were asked to indicate the degree of support or encouragement that they received on a 5 point scale with higher scores indicating more support. Hackett et al. (1992) reported the internal consistency of .88 for this scale.

Scoring

Part F was designed to acquire an index of social support from the participants and the scores can be calculated from this subscale by adding items 1 through 11 for part one.

Faculty Encouragement /Discouragement Scale. The researcher used the second part of the questionnaire, adapted from Freeman’s (1979) null environment hypothesis, to assess the degree of faculty support perceived by students.

This part of the engineering occupational self-efficacy instrument required participants to indicate their perceptions of the amount of support they received from faculty by responding to a 3 point scale. This subscale asked for responses ranging from
no one with a score of (0) to yes two or more faculty with a score of (2). For example, the questionnaire asked students about encounters such as what faculty member has given
you the impression that … “You are not well-suited for engineering /scientific fields.”
The questionnaire consists of a total of 10 items, with four of the items measuring positive faculty support and 6 measuring discouragement or negative faculty responses.

The perceptions of faculty support from the 3 point scale was summed across items and divided by the total number of items (10), yielding a measure which represented the strength of perceived faculty support. According to Hackett et al. (1992), coefficient alpha values for internal consistency reliability of the faculty encouragement scale ranged from .77 and .80 for the faculty discouragement responses.

**Scoring**

Part 2 is designed to provide an index of faculty support for the student and scores can be obtained by reversing scores number 2, 3, 4, 5, 7 and 10 and then adding all ten items. Within the subscales Hackett et al. (1992) designed the instrument to uncover information on student perceptions of their academic capabilities, sources of stress from psychological states which stem from familial relationships, as well as interpersonal sources. Additionally, according to Bandura (1977), a self-efficacious person in a domain specific area will be able to persevere in the presence of setbacks and adversity.

**Data Analysis**

**Academic Indicators**

The researcher used descriptive statistics for the indicators of academic achievement (high school and college GPA), demographic information, and the nine identified social cognitive variables. The research questions in this study were: Are there differences in academic performance determined by grade point average of first year
undergraduate engineering students based on ethnicity and gender? Is there a relationship among the nine social cognitive factors identified: occupational self-efficacy, academic self-efficacy, vocational interests, and outcome expectations (positive and negative), perceived stress, coping, global stress and coping, personal support, and faculty support or discouragement? For each of the nine social cognitive factors identified, is there a significant difference based on ethnicity and gender? Is there a relationship between the academic performance (college GPA) of first-year undergraduate engineering students and the nine identified social cognitive factors?

For each of the nine social cognitive factors identified, the study asked whether there was a relationship between high school GPA. In particular, the researcher included the ethnicities of Euro-American as compared to Hispanic, and African American engineering students if there were sufficient numbers in each group.

The researcher accomplished the analysis of question three by utilizing a sequence of eleven two-way ANOVA. The researcher employed the use of an ANOVA to examine the effect of race and gender on the nine variables (subscales) in this study. Also, the overall level of significance was set at .01, so that to some extent the researcher could control for the experiment wise rate of error.

At the same time, the researcher ran a two-way ANOVA in order to evaluate whether there were any significant interactions in relation to gender and ethnicity on the academic performance of the participants (question one). The researcher also determined the effect of the variables (ethnicity and gender) on the variables such as grade point average or the various subscales.
Pearson’s Correlation Matrix

The researcher utilized a Pearson’s Product Moment Correlation Matrix in order to show the relationship among the nine social cognitive variables found in the unique subscales (question two). In other words, the researcher calculated correlation coefficients to discover possible correlations and interrelationships among the variables. In addition, the researcher summed the participants’ responses to vocational interest in order to illustrate their degree of interest in engineering careers (Betz and Hackett, 1981).

Academic Performance

The researcher completed a regression analysis to ascertain the relationships among the eleven social cognitive variables to the academic performance of first-year engineering students (question four). More specifically, the researcher anticipated an adequate number of participants grouped by gender and ethnicity to participate in the study. With this in mind, the researcher completed eleven Pearson Correlation Analyses in order to determine if there were any significant correlations among the eleven identified social cognitive variables.

The researcher utilized the Pearson Correlation analyses in order to examine the relationships between high school grade point average GPA and the nine social cognitive variables (question five). As a result, the researcher completed 18 correlation analyses which included 9 for high school GPA of first year engineering students with each of the 9 social cognitive variables.

Summary

This chapter described the procedures and methods used to address the research questions presented in this study. These descriptions included demographic information
about the participants, data collection methods, and instrumentation. This chapter also included a description of the Survey instrument, the Engineering Occupation Self-Efficacy scale, along with the procedures used to analyze the variables using descriptive and inferential statistics.

The researcher submitted a request to the University of Dayton’s IRB asking permission to conduct this study and received approval on February 18, 2010. The researcher also submitted a request to each university requiring IRB approval and after completing the required Collaborative Institutional Training Initiative (CITI) course work, the researcher was granted approval from each institution.

Also, four of the participating universities required the researcher to secure IRB approval from them. The universities requiring approval were Central State University located in Appendix F, the University of Cincinnati located in Appendix G, the University of Toledo located in Appendix H, and Wright State University located in Appendix I. The results of the data analysis from student respondents are presented in Chapter 4.
CHAPTER IV
ANALYSIS OF THE DATA

Introduction

As noted in Chapter I, the primary purpose of this study was to assess the extent to which nine social cognitive variables correlate with each other based on student responses and considered whether statistically significant difference exists between ethnicity and gender. Also, this study examined the differences in academic performance determined by university grade point average of first-year engineering students based on ethnicity and gender. Another purpose of this study was to discover a possible correlation between the eleven identified social cognitive variables and high school grade point average.

The function of social cognitive theory is vital for understanding how the self-efficacious beliefs can allow students to regulate their actions connected to successful outcomes in academic learning environments. Further, the researcher sought to provide more data on the relationship between social cognitive factors and the academic achievement of first-year engineering students. With this in mind, Chapter IV addresses five research questions. These research questions were analyzed using descriptive and inferential statistics consisting of Pearson Correlations and Analysis of Variance.

The five research questions were:

First, are there differences in academic performance determined by grade point average of first-year undergraduate engineering students based on ethnicity and gender?

Second, is there a relationship between and among the nine social cognitive variables identified: (a) personal support, (b) occupational self-efficacy, (c) academic
self-efficacy, (d) vocational interest, (e) coping, (f) encouragement, (g) discouragement, 
(h) outcome expectations, (l) perceived stress?

Third, for each of the nine social cognitive variables identified, is there a
significant difference based on ethnicity and gender?

Fourth, is there a relationship between the academic performance (college grade 
point average) of first-year undergraduate engineering students and the nine identified 
social cognitive variables?

Fifth, is there a relationship between high school (GPA) and each of the nine 
social cognitive variables?

The first section of this chapter contains descriptive statistics for academic 
achievement of participating first-year engineering students. The second part consists of 
demographic data from the participants in this study. The third part addresses the research 
questions presented by examining descriptive and inferential statistics data derived from 
the Engineering Occupational Self-Efficacy Scale. The EOSES questionnaire provided 
descriptive and inferential quantitative data that addresses participants levels of academic 
and career related self-efficacy (educational requirement score).
Table 1 represents the descriptive statistics for academic achievement. The mean score for high school GPA 3.60 was higher than the mean score of 3.18 for university GPA. The standard deviations show little difference.

Table 1

*Academic Achievement Table of Student Participants*

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>High School GPA</td>
<td>3.6</td>
<td>0.56</td>
<td>202</td>
</tr>
<tr>
<td>University GPA</td>
<td>3.18</td>
<td>0.51</td>
<td>193</td>
</tr>
</tbody>
</table>
Table 2 presents a frequency distribution of participating universities and the responding students.

Table 2

<table>
<thead>
<tr>
<th>Participating Colleges</th>
</tr>
</thead>
<tbody>
<tr>
<td>College</td>
</tr>
<tr>
<td>Cedarville</td>
</tr>
<tr>
<td>Central State</td>
</tr>
<tr>
<td>Miami</td>
</tr>
<tr>
<td>Ohio University</td>
</tr>
<tr>
<td>Ohio State</td>
</tr>
<tr>
<td>Akron</td>
</tr>
<tr>
<td>Cincinnati</td>
</tr>
<tr>
<td>Dayton</td>
</tr>
<tr>
<td>Toledo</td>
</tr>
<tr>
<td>Wilberforce</td>
</tr>
<tr>
<td>Wright State</td>
</tr>
</tbody>
</table>
In Table 3 the researcher computed a frequency distribution on the gender of responding first year engineering students. Approximately 59% of the responding students (n = 119) were male while approximately 41% of participating students were female (n = 83).

Table 3

*Gender*

<table>
<thead>
<tr>
<th>Gender</th>
<th>Number of Respondents</th>
<th>Percent of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>83</td>
<td>41.09</td>
</tr>
<tr>
<td>Male</td>
<td>119</td>
<td>58.91</td>
</tr>
</tbody>
</table>
Table 4 represents frequency of distribution of the ethnicities of the student respondents.

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Number of Respondents</th>
<th>Percent of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black or African American</td>
<td>70</td>
<td>31.39</td>
</tr>
<tr>
<td>Chicano</td>
<td>2</td>
<td>0.90</td>
</tr>
<tr>
<td>Latino or Spanish American</td>
<td>13</td>
<td>5.83</td>
</tr>
<tr>
<td>Chinese or Chinese American</td>
<td>5</td>
<td>2.24</td>
</tr>
<tr>
<td>Japanese</td>
<td>3</td>
<td>1.35</td>
</tr>
<tr>
<td>Filipino</td>
<td>1</td>
<td>0.45</td>
</tr>
<tr>
<td>Mexican American</td>
<td>4</td>
<td>1.79</td>
</tr>
<tr>
<td>Native American</td>
<td>9</td>
<td>4.04</td>
</tr>
<tr>
<td>White or Caucasian</td>
<td>116</td>
<td>52.02</td>
</tr>
</tbody>
</table>
Table 5 represents the demographic information revealing that 89% of student respondents were traditional students that enrolled in college directly after high school.

Table 5

_Educational Background_

<table>
<thead>
<tr>
<th>Background</th>
<th>Number of Respondents</th>
<th>Percent of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directly Enrolled in College</td>
<td>180</td>
<td>89.11</td>
</tr>
<tr>
<td>Other</td>
<td>22</td>
<td>10.89</td>
</tr>
</tbody>
</table>

**Internal Consistency and Reliability**

The researcher analyzed nine social cognitive variables for internal consistencies. According to DeVellis (2003) the Alpha Cronbach values obtained were within the acceptable range for research scales which are as follows:

My personal comfort ranges for research scales are as follows: below 60, unacceptable; between .60 and .65, undesirable; between .65 and .70, minimally acceptable; between .70 and .80, respectable; between .80 and .90 very good; much above .90, one should consider shortening the scale. (pp. 95-96)

Personal support consisted of 10 items and of the 203 respondents 88 provided valid responses. The resulting Alpha Cronbach value of reliability for personal support was .89. Next, Occupational Self-efficacy consisted of 18 items and of the 203 respondents 131 provided valid responses. The resulting Alpha Cronbach value of reliability for Occupational Self-efficacy was .96. Academic Self-efficacy consisted of 12 items and of the 203 respondents 176 provided valid responses. The resulting Alpha
Cronbach value of reliability for Academic Self-efficacy was .96. Vocational Interest consisted of 18 items and of the 203 respondents 127 provided valid responses. The resulting Alpha Cronbach value of reliability for vocational interest was .86. Coping consisted of 7 items and of the 203 respondents 189 provided valid responses. The resulting Alpha Cronbach value of reliability for coping was .80. Encouragement consisted of 4 items and of the 203 respondents 35 provided valid responses. The resulting Alpha Cronbach value of reliability for encouragement was .71. Discouragement consisted of 6 items and of the 203 respondents, 6 provided valid responses. The resulting Alpha Cronbach value of reliability for discouragement was .87. Outcome Expectations consisted of 12 items and of the 203 respondents, 149 provided valid responses. The resulting Alpha Cronbach value of reliability for outcome expectations was .83. Finally, Perceived Stress consisted of 19 items and of the 203 respondents, 166 provided valid responses. The resulting Alpha Cronbach value for reliability for perceived stress was .88.

Hypothesis

The researcher collected data to provide evidence about the research hypothesis of this study which examined the relationship among nine social cognitive variables based on ethnicity, gender, high school, and college grade point average of first-year engineering students that participated in this study. The hypotheses were:

1. Gender and ethnicity will account for a statistically significant portion of variance in the academic performance of first year undergraduate engineering students determined by college grade point average.
2. The nine social cognitive variables identified: personal support, occupational self-efficacy, academic self-efficacy, vocational interest, coping, encouragement, discouragement, outcome expectations, and perceived stress will have statistically significant correlations with each other.

3. For each of the nine social cognitive variables identified there is a statistically significant difference based on ethnicity and gender.

4. There is a statistically significant relationship between the academic performance (college GPA) of first-year engineering students and the nine identified social cognitive factors.

5. There is a statistically significant relationship among the nine identified social cognitive variables and high school grade point average (GPA) of first-year engineering students.

The analyses of data presented in this chapter were calculated using the Statistical Package for the Social Sciences (SPSS) version 19.0 software program (2010). Raw data was collected from the survey and coded in order to answer the research questions. The research findings were based on the responses of 202 first year students from eleven universities in Ohio. Student responses describing their self-efficacy beliefs were identified in the study using the EOSES. The questionnaire was distributed to participants via email using E-Survey Pro.

The researcher used data to address research question one which was analyzed using the analysis of variance (ANOVA) in order to assess whether if the groups were significantly different. The researcher established an Alpha level of .01 as the perquisite
for determining the level of statistical significance. The researcher completed Levine test for equality of variances that was not found to be significant. Since the variances were homogenous the researcher conducted a standard two way ANOVA. The results are shown in Table 6. The researcher completed an ANOVA that resulted in a main effect for ethnicity only. As a result, ethnicity was found to be statistically significant $F(2,169) = 6.57, P < .01$ and gender was found not to be significant $F(2,169) = 2.36, P > .01$ nor was there a significant interaction $F(2,169) = 0.50, P > .01$ between the two.

A Tukey HSD Post Hoc Analysis revealed that Black students GPA’s ($M = 2.97$) were not significantly different from Hispanic students GPA’s ($M = 3.26$). Moreover, Hispanic students were not significantly different in their GPAs from White students ($M = 3.28$) but Blacks had lower GPAs than Whites. Ethnicities represented the Black, White and total Hispanic student participants.

Hispanic student participants were combined into one ethnicity due to the small number of responses from individual groups of Hispanic students. These groups included Chicano, Latino or other Spanish American, and Mexican American individuals. In addition, there were not enough Native American student respondents to be included in this study even though they are considered underrepresented in engineering. On the other hand, since Asian students are considered overrepresented in engineering when compared to their percentage of the United States population, they were not an ethnicity focused on in this study.
Table 6

Analysis of Variance for the Dependent Variable College GPA

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>4.84&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5</td>
<td>.967</td>
<td>3.71</td>
<td>.003</td>
<td>.099</td>
</tr>
<tr>
<td>Intercept</td>
<td>807.808</td>
<td>1</td>
<td>807.808</td>
<td>3101.44</td>
<td>.000</td>
<td>.948</td>
</tr>
<tr>
<td>Gender</td>
<td>.615</td>
<td>1</td>
<td>.62</td>
<td>2.36</td>
<td>.126</td>
<td>.014</td>
</tr>
<tr>
<td>Ethnicities</td>
<td>3.42</td>
<td>2</td>
<td>1.71</td>
<td>6.57</td>
<td>.002</td>
<td>.072</td>
</tr>
<tr>
<td>Gender*Ethnicities</td>
<td>.026</td>
<td>2</td>
<td>.013</td>
<td>.050</td>
<td>.951</td>
<td>.001</td>
</tr>
<tr>
<td>Error</td>
<td>44.02</td>
<td>169</td>
<td>.26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1817.24</td>
<td>175</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>48.86</td>
<td>174</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The difference is significant (P < .01)

a. R Squared = .099 (Adjusted R Squared = .072)

Research question two is reported in Table 7 which the researcher designed to evaluate whether a relationship exists among the nine social cognitive factors identified: personal support, occupational self-efficacy, academic self-efficacy, vocational interests, coping, encouragement (faculty support), or discouragement, outcome expectations (positive and negative), and perceived stress. The level of statistical significance was set at the .01 level. The researcher completed Pearson correlations in order to uncover a
possible relationship between and among the variables. The correlational matrix revealed some social cognitive variables that had a statistically significant correlation with each other while many were not significantly correlated.

Table 7

*Pearsons Correlational Matrix Between 9 Social Cognitive Variables*

<table>
<thead>
<tr>
<th>Personal Support</th>
<th>Occupational</th>
<th>Academic</th>
<th>Occupational Interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson correlation</td>
<td>.100</td>
<td>.829</td>
<td>.093</td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td></td>
<td>.829</td>
<td>.423</td>
</tr>
<tr>
<td>N</td>
<td>88</td>
<td>60</td>
<td>77</td>
</tr>
<tr>
<td>Personal Support</td>
<td>.028</td>
<td>1</td>
<td>.093</td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td></td>
<td>.829</td>
<td>.423</td>
</tr>
<tr>
<td>N</td>
<td>88</td>
<td>60</td>
<td>77</td>
</tr>
<tr>
<td>Occupational</td>
<td>-.112</td>
<td>-.117</td>
<td>-.114</td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td></td>
<td>.30</td>
<td>.198</td>
</tr>
<tr>
<td>N</td>
<td>81</td>
<td>122</td>
<td>113</td>
</tr>
<tr>
<td>Occupational Interest</td>
<td>-.112</td>
<td>-.117</td>
<td>-.114</td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td></td>
<td>.30</td>
<td>.198</td>
</tr>
<tr>
<td>N</td>
<td>81</td>
<td>122</td>
<td>113</td>
</tr>
<tr>
<td>Coping</td>
<td>.268</td>
<td>.002</td>
<td>.617</td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td></td>
<td>.206</td>
<td>.994</td>
</tr>
<tr>
<td>N</td>
<td>24</td>
<td>20</td>
<td>29</td>
</tr>
<tr>
<td>Encouragement</td>
<td>.212</td>
<td>-.516</td>
<td>.312</td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td></td>
<td>.732</td>
<td>.655</td>
</tr>
<tr>
<td>N</td>
<td>5</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Discouragement</td>
<td>.186</td>
<td>.172</td>
<td>.515</td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td></td>
<td>.148</td>
<td>.89</td>
</tr>
<tr>
<td>N</td>
<td>62</td>
<td>9</td>
<td>130</td>
</tr>
<tr>
<td>Outcome Expectations</td>
<td>.100</td>
<td>-.257</td>
<td>-.220</td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td></td>
<td>.410</td>
<td>.006</td>
</tr>
<tr>
<td>N</td>
<td>70</td>
<td>113</td>
<td>180</td>
</tr>
<tr>
<td>Perceived Stress</td>
<td>.100</td>
<td>-.257</td>
<td>-.220</td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td></td>
<td>.410</td>
<td>.006</td>
</tr>
<tr>
<td>N</td>
<td>70</td>
<td>113</td>
<td>180</td>
</tr>
</tbody>
</table>
Table 7 (continued)

*Pearson Correlational Matrix between 9 Social Cognitive Variables*

<table>
<thead>
<tr>
<th></th>
<th>Coping</th>
<th>Encouragement</th>
<th>Discouragement</th>
<th>Outcome Expectations</th>
<th>Perceived Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal Support</strong></td>
<td>Pearson correlation Significance (2-tailed)</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Occupational</strong></td>
<td>Pearson correlation Significance (2-tailed)</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Academic</strong></td>
<td>Pearson correlation Significance (2-tailed)</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Occupational Interest</strong></td>
<td>Pearson correlation Significance (2-tailed)</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Coping</strong></td>
<td>Pearson correlation Significance (2-tailed)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Encouragement</strong></td>
<td>Pearson correlation Significance (2-tailed)</td>
<td>-.040</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Discouragement</strong></td>
<td>Pearson correlation Significance (2-tailed)</td>
<td>.702</td>
<td>.972</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Outcome Expectations</strong></td>
<td>Pearson correlation Significance (2-tailed)</td>
<td>.193</td>
<td>.265</td>
<td>.269</td>
<td>1</td>
</tr>
<tr>
<td><strong>Perceived Stress</strong></td>
<td>Pearson correlation Significance (2-tailed)</td>
<td>.592</td>
<td>.164</td>
<td>.643</td>
<td>.234</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>189</td>
<td>30</td>
<td>35</td>
<td>140</td>
<td>157</td>
</tr>
</tbody>
</table>

The researcher discovered the ten following significant correlations: occupational and academic, occupational and vocational interest, academic and vocational interest, occupational and perceived stress, academic and encouragement, academic and outcome expectations, academic and perceived stress, vocational interest and, outcome expectations, discouragement and encouragement, outcome expectations and perceived stress.
The researcher utilized the Pearson correlational coefficient to examine the association between the nine identified social cognitive variables.

The third research question was designed to evaluate whether there were significant differences for each of the nine social cognitive factors identified based on ethnicity and gender. The researcher used two by three factorial ANOVAs to address research question three. The researcher set an alpha level of .01 as the criterion for determining the statistical level of significance. The results are shown in Tables 8 through 16. Nine ANOVAs were run separately in order to examine each variable.

**Personal Support**

The researcher completed a Levene test for equality of variances with an alpha level at .05 and was found to be significant with a value of .04. In examining the ANOVAs, there were no main effects or interactions that were significant between ethnicity, gender $F (2, 71) = 2.48, P = .04$. Gender and ethnicity were not found to be significant for personal support. The results are shown in Table 8.
Table 8

*Analysis of Variance for the Dependent Variable Personal Support*

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>1138.751&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5</td>
<td>227.750</td>
<td>2.377</td>
<td>.047</td>
<td>.143</td>
</tr>
<tr>
<td>Intercept</td>
<td>32986.360</td>
<td>1</td>
<td>32986.360</td>
<td>344.312</td>
<td>.000</td>
<td>.829</td>
</tr>
<tr>
<td>Gender</td>
<td>333.280</td>
<td>1</td>
<td>333.280</td>
<td>3.479</td>
<td>.066</td>
<td>.047</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>307.670</td>
<td>2</td>
<td>153.835</td>
<td>1.606</td>
<td>.208</td>
<td>.043</td>
</tr>
<tr>
<td>Gender*Ethnicity Interactions</td>
<td>179.271</td>
<td>2</td>
<td>89.636</td>
<td>.936</td>
<td>.397</td>
<td>.026</td>
</tr>
<tr>
<td>Error</td>
<td>6802.055</td>
<td>71</td>
<td>95.804</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>117614.000</td>
<td>77</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>7940.805</td>
<td>76</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> R squared = .143 (Adjusted R Squared = .083)

**Occupational Self-Efficacy**

The researcher completed a Levene test for equality of variances with an alpha level at .05 and was found to be significant with a value of .008. However, in examining the ANOVAs there were no main effects or interactions that were significant between ethnicity and gender F (2,115) = 1.91, P > .01 (see Table 9). Gender and ethnicity were not found to be significant for occupational self-efficacy.
Table 9

*Analysis of Variance for the Dependent Variable Occupational*

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>15341.182</td>
<td>5</td>
<td>3068.236</td>
<td>3.629</td>
<td>.004</td>
<td>.136</td>
</tr>
<tr>
<td>Intercept</td>
<td>910454.837</td>
<td>1</td>
<td>910454.837</td>
<td>1076.840</td>
<td>.000</td>
<td>.904</td>
</tr>
<tr>
<td>Gender</td>
<td>2800.651</td>
<td>1</td>
<td>2800.651</td>
<td>3.312</td>
<td>.071</td>
<td>.028</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>5026.955</td>
<td>2</td>
<td>2513.478</td>
<td>2.973*</td>
<td>.055</td>
<td>.049</td>
</tr>
<tr>
<td>Gender Ethnicity</td>
<td>3223.672</td>
<td>2</td>
<td>1611.836</td>
<td>1.906</td>
<td>.153</td>
<td>.032</td>
</tr>
<tr>
<td>Interactions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>97231.066</td>
<td>115</td>
<td>845.488</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1698798.000</td>
<td>121</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>112572.248</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. R Squared = .136 (Adjusted R Squared = .099)

**Academic Self-Efficacy**

The researcher completed a Levene test for equality of variances with an alpha level at .05 and was found to be significant with a value of .005. Insofar as the Levene test was found to be significant, the findings need to be interpreted with some caution.

The researcher completed an ANOVA which resulted in a main effect for ethnicity only. Ethnicity was found to be statistically significant F (2, 155) = 6.87, P < .01 and gender
was found not to be significant $F(1,155) = .000, P > .01$ nor was there a significant interaction $F(2,155) = 1.85, P > .01$ between the two (see Table 10). In a Tukey Honestly Significant Difference (HSD) test the Black students GPAs ($M = 83.30$) were found to be significantly lower than Hispanic students ($M = 100.9$). Hispanic students were found not to be significantly different in their GPAs from White students GPAs ($M = 90.70$). Black students were not found to be significantly different in their GPAs from White students.

Table 10

*Analysis of Variance for the Dependent Variable Academic Self-Efficacy*

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>4938.131(^a)</td>
<td>5</td>
<td>987.626</td>
<td>3.154</td>
<td>.010</td>
<td>.092</td>
</tr>
<tr>
<td>Intercept</td>
<td>590073.150</td>
<td>1</td>
<td>590073.150</td>
<td>1884.416</td>
<td>.000</td>
<td>.924</td>
</tr>
<tr>
<td>Gender</td>
<td>.061</td>
<td>1</td>
<td>.061</td>
<td>.000</td>
<td>.989</td>
<td>.000</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>4305.166</td>
<td>2</td>
<td>2152.583</td>
<td>6.874</td>
<td>.001</td>
<td>.081</td>
</tr>
<tr>
<td>Gender*Ethnicity Interactions</td>
<td>1157.341</td>
<td>2</td>
<td>578.671</td>
<td>1.848</td>
<td>.161</td>
<td>.023</td>
</tr>
<tr>
<td>Error</td>
<td>48535.646</td>
<td>155</td>
<td>313.133</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1327687.000</td>
<td>161</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>53473.776</td>
<td>160</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b. $R^2 = .092$ (Adjusted $R^2 = .063$)
Vocational Interest

The researcher completed a Levene test for equality of variances with an alpha level at .05 and was found not to be significant with a value of .37. In examining the ANOVAs, there were no main effects or interactions that were significant between ethnicity and gender \((2,112) = .601, P > .01\) (see Table 11). Gender and ethnicity were not found to be significant for vocational interest.

Table 11

*Analysis of Variance for the Dependent Variable Vocational Interest*

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>2830.449(^a)</td>
<td>5</td>
<td>566.090</td>
<td>1.481</td>
<td>.202</td>
<td>.062</td>
</tr>
<tr>
<td>Intercept</td>
<td>612632.020</td>
<td>1</td>
<td>612632.020</td>
<td>1602.463</td>
<td>.000</td>
<td>.935</td>
</tr>
<tr>
<td>Gender</td>
<td>93.022</td>
<td>1</td>
<td>93.022</td>
<td>.243</td>
<td>.623</td>
<td>.002</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>2007.687</td>
<td>2</td>
<td>1003.844</td>
<td>2.626</td>
<td>.077</td>
<td>.045</td>
</tr>
<tr>
<td>Gender*Ethnicity</td>
<td>459.774</td>
<td>2</td>
<td>229.887</td>
<td>.601</td>
<td>.550</td>
<td>.011</td>
</tr>
<tr>
<td>Error</td>
<td>42818.340</td>
<td>112</td>
<td>382.307</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1132177.000</td>
<td>118</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>45648.788</td>
<td>117</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) R Squared = .062 (Adjusted R Squared = .020)
Coping

The researcher completed a Levene test for equality of variances with an alpha level at .05 and was found not to be significant with a value of .60. In examining the ANOVAs there were no main effects or interactions that were significant between ethnicity and gender $F(2,167) = .421$, $P > .01$ (see Table 12). Gender and ethnicity were not found to be significant for coping.

Table 12

*Analysis of Variance for the Dependent Variable Coping*

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>96.783$^a$</td>
<td>5</td>
<td>19.357</td>
<td>.658</td>
<td>.656</td>
<td>.019</td>
</tr>
<tr>
<td>Intercept</td>
<td>28187.620</td>
<td>1</td>
<td>28187.620</td>
<td>958.053</td>
<td>.000</td>
<td>.852</td>
</tr>
<tr>
<td>Gender</td>
<td>.323</td>
<td>1</td>
<td>.323</td>
<td>.011</td>
<td>.917</td>
<td>.000</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>66.394</td>
<td>2</td>
<td>33.197</td>
<td>1.128</td>
<td>.326</td>
<td>.013</td>
</tr>
<tr>
<td>Gender*Ethnicity</td>
<td>24.792</td>
<td>2</td>
<td>12.396</td>
<td>.421</td>
<td>.657</td>
<td>.005</td>
</tr>
<tr>
<td>Error</td>
<td>4913.436</td>
<td>167</td>
<td>29.422</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>65316.000</td>
<td>173</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>5010.220</td>
<td>172</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. R Squared = .019 (Adjusted R Squared = .010)
Encouragement

The researcher completed a Levene test for the equality of variances with an alpha level at .05 and was found not to be significant with a value of .11. In examining the ANOVAs there were no main effects or interactions that were significant between ethnicity and gender $F(2, 23) = .323, P > .01$ (see Table 13). Gender and ethnicity were not found to be significant for encouragement.

Table 13

*Analysis of Variance for the Dependent Variable Encouragement*

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>11.352</td>
<td>5</td>
<td>2.270</td>
<td>1.070</td>
<td>.402</td>
<td>.189</td>
</tr>
<tr>
<td>Intercept</td>
<td>464.702</td>
<td>1</td>
<td>464.702</td>
<td>219.081</td>
<td>.000</td>
<td>.905</td>
</tr>
<tr>
<td>Gender</td>
<td>4.993</td>
<td>1</td>
<td>4.993</td>
<td>2.354</td>
<td>.139</td>
<td>.093</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>8.364</td>
<td>2</td>
<td>4.182</td>
<td>1.972</td>
<td>.162</td>
<td>.146</td>
</tr>
<tr>
<td>Gender*Ethnicity Interactions</td>
<td>1.371</td>
<td>2</td>
<td>.686</td>
<td>.323</td>
<td>.727</td>
<td>.027</td>
</tr>
<tr>
<td>Error</td>
<td>48.786</td>
<td>23</td>
<td>2.121</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1165.000</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>60.138</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. R Squared = .189 (Adjusted R Squared = .012)
Discouragement

The researcher conducted a Levene test for the equality of variances with an alpha level at .05 and was found not to be significant with a value of .39. In examining the ANOVAs there were no main effects or interactions that were significant between ethnicity and gender (see Table 14). Due to the extremely low number (n) there was no f value obtainable for the interaction. Gender and ethnicity were not found to be significant for discouragement.

Table 14

Analysis of Variance for the Dependent Variable for Discouragement

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>2.133(^a)</td>
<td>2</td>
<td>1.067</td>
<td>.457</td>
<td>.686</td>
<td>.314</td>
</tr>
<tr>
<td>Intercept</td>
<td>117.813</td>
<td>1</td>
<td>117.813</td>
<td>50.491</td>
<td>.019</td>
<td>.962</td>
</tr>
<tr>
<td>Gender</td>
<td>1.333</td>
<td>1</td>
<td>1.333</td>
<td>.571</td>
<td>.529</td>
<td>.222</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>8.364</td>
<td>1</td>
<td>1.333</td>
<td>1.972</td>
<td>.529</td>
<td>.222</td>
</tr>
<tr>
<td>Gender*Ethnicity</td>
<td>.000</td>
<td>0</td>
<td>.000</td>
<td>.000</td>
<td></td>
<td>.000</td>
</tr>
<tr>
<td>Error</td>
<td>4.667</td>
<td>2</td>
<td>2.333</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>238.000</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>6.800</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. R Squared = .314 (Adjusted R Squared = .373)
Outcome Expectations

The researcher completed a Levene test for equality of variances with an alpha level at .05 and it was found to be significant with an alpha level of .003. Because the Levene test revealed significance, the findings need to be interpreted with caution. However, in examining the ANOVAs there were no main effects or interactions that were significant between ethnicity and gender $f(2,131) = 1.90, P > .01$ (see Table 15). Gender and ethnicity were not found to be significant for outcome expectations.

Table 15

*Analysis of Variance for the Dependent Variable Outcome Expectations*

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>947.704</td>
<td>5</td>
<td>189.541</td>
<td>1.119</td>
<td>.354</td>
<td>.041</td>
</tr>
<tr>
<td>Intercept</td>
<td>372881.793</td>
<td>1</td>
<td>372881.793</td>
<td>2200.657</td>
<td>.000</td>
<td>.944</td>
</tr>
<tr>
<td>Gender</td>
<td>5.080</td>
<td>1</td>
<td>5.080</td>
<td>.030</td>
<td>.863</td>
<td>.000</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>105.88</td>
<td>2</td>
<td>52.942</td>
<td>.312</td>
<td>.732</td>
<td>.005</td>
</tr>
<tr>
<td>Gender*Ethnicity Interactions</td>
<td>644.051</td>
<td>2</td>
<td>322.026</td>
<td>1.901</td>
<td>.154</td>
<td>.028</td>
</tr>
<tr>
<td>Error</td>
<td>22196.792</td>
<td>131</td>
<td>169.441</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>908445.000</td>
<td>137</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>23144.496</td>
<td>136</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. $R^2 = .041$ (Adjusted $R^2 = .004$)
Perceived Stress

The researcher conducted a Levene test for equality of variance with an alpha level at .05 and it was not found to be significant with a value of .53. In examining the ANOVAs there were no main effects or interactions that were significant between ethnicity and gender f (2,146) = 512, P >.01 (see Table 16). Gender and ethnicity were not found to be significant for perceived stress.

Table 16

Analysis of Variance for the Dependent Variable Perceived Stress

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>1552.695^a</td>
<td>5</td>
<td>310539</td>
<td>1.728</td>
<td>.132</td>
<td>.056</td>
</tr>
<tr>
<td>Intercept</td>
<td>146111.653</td>
<td>1</td>
<td>146111.653</td>
<td>813.219</td>
<td>.000</td>
<td>.848</td>
</tr>
<tr>
<td>Gender</td>
<td>74.875</td>
<td>1</td>
<td>74.875</td>
<td>.417</td>
<td>.520</td>
<td>.003</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>476.653</td>
<td>2</td>
<td>238.327</td>
<td>1.326</td>
<td>.269</td>
<td>.018</td>
</tr>
<tr>
<td>Gender*Ethnicity Interactions</td>
<td>183.822</td>
<td>2</td>
<td>91.911</td>
<td>.512</td>
<td>.601</td>
<td>.007</td>
</tr>
<tr>
<td>Error</td>
<td>26231.930</td>
<td>146</td>
<td>179.671</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>323731.000</td>
<td>152</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>27784.625</td>
<td>151</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

^a. R Squared = .056 (Adjusted R Squared = .024)
The fourth research question was designed to evaluate whether there is a relationship between the academic performance (college GPA) of first-year undergraduate engineering students and the nine identified social cognitive variables as measured by the Engineering Occupational Self-Efficacy Questionnaire. The correlational matrix revealed some social cognitive variables that had a statistically significant correlation with academic performance while many were not significantly correlated. The researcher discovered three significant correlations which were as follows: academic performance and occupational self-efficacy, academic performance and academic self-efficacy, and academic performance and encouragement. The data analysis utilized to answer research question four was a Pearson correlational coefficient. The results of this analysis are presented in Table 17.
Table 17

**Pearson Correllational Matrix University GPA with 9 Social Cognitive Variables**

<table>
<thead>
<tr>
<th></th>
<th>Univ GPA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Univ GPA</strong></td>
<td><strong>Univ GPA</strong></td>
</tr>
<tr>
<td></td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig (2-tailed)</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>193</td>
</tr>
<tr>
<td><strong>Personal Support</strong></td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig (2-tailed)</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>-.091</td>
</tr>
<tr>
<td><strong>Occupational</strong></td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig (2-tailed)</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>.242</td>
</tr>
<tr>
<td><strong>Academic</strong></td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig (2-tailed)</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>.448</td>
</tr>
<tr>
<td><strong>Occupational Interest</strong></td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig (2-tailed)</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>.135</td>
</tr>
<tr>
<td><strong>Coping</strong></td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig (2-tailed)</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>-.132</td>
</tr>
<tr>
<td><strong>Encouragement</strong></td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig (2-tailed)</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>.464</td>
</tr>
<tr>
<td><strong>Discouragement</strong></td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig (2-tailed)</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>.597</td>
</tr>
<tr>
<td><strong>Outcome Expectations</strong></td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig (2-tailed)</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>.071</td>
</tr>
<tr>
<td><strong>Perceived Stress</strong></td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig (2-tailed)</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>-.105</td>
</tr>
</tbody>
</table>

*P<.01
Research question five was designed to evaluate whether there is a statistically significant relationship between the respondent’s high school GPA and each of the nine identified social cognitive factors as measured by the Engineering Occupational Self-Efficacy Questionnaire. The Pearson Correlational Matrix revealed one social cognitive variable that had a statistically significant correlation with high school GPA. The significant correlation was academic self-efficacy and high school GPA. The results of this analysis are presented in Table 18.
Table 18

*Pearson Correlational Matrix High School GPA with 9 Social Cognitive Variables*

<table>
<thead>
<tr>
<th></th>
<th>HS GPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS GPA</td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig (2-tailed)</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>202</td>
</tr>
<tr>
<td>Personal Support</td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig (2-tailed)</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>.125</td>
</tr>
<tr>
<td></td>
<td>.244</td>
</tr>
<tr>
<td></td>
<td>88</td>
</tr>
<tr>
<td>Occupational</td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig (2-tailed)</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>.163</td>
</tr>
<tr>
<td></td>
<td>.063</td>
</tr>
<tr>
<td></td>
<td>131</td>
</tr>
<tr>
<td>Academic</td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig (2-tailed)</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>.201</td>
</tr>
<tr>
<td></td>
<td>.007</td>
</tr>
<tr>
<td></td>
<td>176</td>
</tr>
<tr>
<td>Occupational Interest</td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig (2-tailed)</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>.048</td>
</tr>
<tr>
<td></td>
<td>.590</td>
</tr>
<tr>
<td></td>
<td>127</td>
</tr>
<tr>
<td>Coping</td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig (2-tailed)</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>.044</td>
</tr>
<tr>
<td></td>
<td>.551</td>
</tr>
<tr>
<td></td>
<td>189</td>
</tr>
<tr>
<td>Encouragement</td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig (2-tailed)</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>.402</td>
</tr>
<tr>
<td></td>
<td>.017</td>
</tr>
<tr>
<td></td>
<td>35</td>
</tr>
<tr>
<td>Discouragement</td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig (2-tailed)</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>.431</td>
</tr>
<tr>
<td></td>
<td>.393</td>
</tr>
<tr>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Outcome Expectations</td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig (2-tailed)</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>-.033</td>
</tr>
<tr>
<td></td>
<td>.693</td>
</tr>
<tr>
<td></td>
<td>149</td>
</tr>
<tr>
<td>Perceived Stress</td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig (2-tailed)</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>-.029</td>
</tr>
<tr>
<td></td>
<td>.714</td>
</tr>
<tr>
<td></td>
<td>166</td>
</tr>
</tbody>
</table>

*P < .01
Summary

The purpose of this study was to examine the relationship between and among nine social cognitive variables and the academic achievement of first-year engineering students based on ethnicity and gender. This study was conducted at both private and public universities in Ohio and focused on the following ethnicities, Black or African American, Hispanic, and Caucasian or White students. This study looked at student participants’ self-assessed academic achievement, perception of support and level of self-efficacy beliefs within the measurable parameters of the nine identified social cognitive factors.

The researcher emailed the Engineering Occupational Self-Efficacy survey to college administrators and professors utilizing e-Survey Pro during the 2010-2011 school year. Each faculty member then notified their students that they were being requested to complete a voluntary survey focusing on student self-efficacy. The researcher received 203 responses from student participants from eleven different universities with engineering programs in Ohio. Descriptive and inferential statistics were used to analyze the student responses.

This study utilized an ANOVA in order to examine the data and determine the differences between groups and among the nine identified social cognitive variables. The study employed Pearson correlation to investigate the relationships between and among the nine social cognitive variables and ethnicity and gender.

The ANOVA for differences in academic performance (university GPA of first-year undergraduate engineering students) analyzed ethnicity and gender. There was a main effect for ethnicity only. Gender was found not to be significant. Hispanics were not
found to be significantly different in their GPAs than Whites but Blacks were found to have lower GPAs than Whites.

The researcher used Pearson correlation coefficients to examine the relationship between and among the nine identified social cognitive variables. The data from the analysis uncovered ten significant correlations which were as follows: occupational self-efficacy and academic self-efficacy, occupational self-efficacy and vocational interest, occupational self-efficacy and perceived stress, academic self-efficacy and encouragement, academic self-efficacy and outcome expectations, academic self-efficacy and perceived stress, vocational interest and outcome expectations, discouragement and encouragement, coping and perceived stress, outcome expectations and perceived stress.

The researcher conducted an ANOVA to evaluate whether a significant difference exists for each of the nine identified social cognitive variables based on ethnicity and gender. The analysis of variance indicated that ethnicity was found to be significant for academic self-efficacy. Black students GPAs were found to be lower than White students.

Next, the researcher used a Pearson correlation coefficient to examine the relationship between academic performance (college GPA) of first-year undergraduate engineering students and the nine identified social cognitive variables. The data analysis revealed three significant correlations which were as follows academic performance and occupational self-efficacy, academic performance and academic self-efficacy, and academic performance and encouragement.

Finally, the researcher utilized a Pearson correlation coefficient to examine the relationship between high school GPA and the nine identified social cognitive variables. The Pearson correlational coefficient indicated that there was one statistically significant
correlation which was high school GPA and academic self-efficacy. Chapter V addresses the summary of these findings, conclusions, and recommendations for further study.
CHAPTER V

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

The primary purpose of this study was to examine the relationship between and among nine social cognitive variables with the academic achievement of first-year engineering students based on ethnicity and gender. The nine social cognitive variables investigated are (a) personal support, (b) occupational self-efficacy, (c) academic self-efficacy, (d) vocational interest, (e) coping, (f) encouragement, (g) discouragement, (h) outcome expectations, and (i) perceived stress. Further, this study was designed to extend the findings of (Hackett, Betz, Casas, & Rocha-Singh, 1992) by applying Bandura’s self-efficacy theory in order to enhance students’ beliefs in their abilities to complete the educational requirements of an engineering or engineering technology program.

With this in mind, this study was intended to provide research to explain how the relationship between social cognitive career theory factors can be translated as a component of self-efficacy theory and used to provide useful information for high school counselors and college faculty. Therefore, this study was designed to contribute information that can be used to strengthen support systems to encourage students to improve their academic performance. As a result, educators and college faculty members can implement strategies designed to enhance the self-efficacy beliefs and academic performance and persistence of first-year minority and female engineering students.
Given the importance of the self-efficacy construct as it relates to the academic success of minority and female students, Hackett & Betz (1981) suggested specific interventions. These interventions include structuring performance accomplishments, providing observational learning, teaching anxiety management, and providing verbal persuasion and encouragement. When counselors understand the relationships between and among these social cognitive factors, they are better equipped to develop effective programs and plan successful interventions for underrepresented students in engineering.

The results from the data also provide theoretical and practical insights for predicting the academic achievement and persistence of first-year engineering students. Prediction of persistence and academic achievement in this study refers to the way students are expected to perform as they approach tasks. For example, Bandura (1982) asserts that self-efficacy is a more precise predictor of task oriented performance, than actual abilities. Further, Social Cognitive Career Theory (SCCT) has often been used for making predictions about students’ academic achievement and task oriented academic behaviors (Lent & Hackett 1993). SCCT incorporates a plethora of social cognitive variables, such as outcome expectations, academic self-efficacy, and vocational interests. Strong self-efficacy beliefs are associated with the persistence and successful academic performance of engineering students. Therefore, based on SCCT, students who have been identified as processing high levels of self-efficacy beliefs toward academic task completion based on social cognitive variables are expected to have the motivation to successfully complete the academic requirements in an engineering program (Pintrich and Schunk, 1996).
In like fashion, students with low self-efficacy beliefs as measured by the Engineering Occupational Self-Efficacy Survey (EOSES) instrument are expected to have little confidence in their abilities and to have a tendency to become discouraged when experiencing difficult academic challenges. Accordingly, the results of this study can be used to identify students who need additional academic support in order to discourage their attrition. This can be accomplished by examining the interactive influence of the nine social cognitive stress and support variables with ethnicity, gender, and students’ academic performance in high school and college.

**Organization of the Chapter**

This chapter is divided into three sections including a summary of the findings, conclusions, and recommendations regarding the impact of self-efficacy beliefs for the use of secondary and post-secondary school counselors and advisors when counseling students. The first section presents a summary of findings based on the data analysis of each of the five research questions.

The findings of this study were derived from data representing first-year engineering students from ten universities in Ohio. These schools were The University of Akron, Cedarville University, Central State University, The University of Cincinnati, The University of Dayton, Miami University, Ohio University, The Ohio State University, Wilberforce University, and Wright State University.

**Summary of the Findings**

The researcher collected descriptive data and created frequency tables on the demographic information provided by student respondents, which included: academic achievement, participating colleges, gender, ethnicity, and educational background.
The frequency data from respondents who completed the EOSES revealed the following information: a total of 202 respondents were included in the statistical analysis (n = 202) which consisted of students with a mean high school GPA of 3.6. A smaller number of students numbering (n = 193) listed their university GPA with a mean university GPA of 3.18.

The gender of the responding first-year undergraduate engineering students consisted of eighty-three female students (n = 83), representing forty-one percent of respondents; the remaining fifty-nine percent (58.91%) of respondents were male (n = 119). The results of this distribution suggest that engineering continues to be a male-dominated profession. At the same time, this sample provided a good representation for female participants. Also, there was a good distribution of underrepresented students for the ethnicity component of this study. The underrepresented ethnicities in engineering focused on in this study included African American and a combined group of Hispanic students.

Over half (52.02%; n = 116) of the student participants in the study were White. About thirty-one percent (31.39%; n = 70) of the responses came from Black students. A smaller number of respondents, about nine percent (8.52%; n = 19) came from a combined group of Hispanic students. The Chicano, Latino or Spanish American, and Mexican American ethnicities were combined into one group due to the small number of respondents. The other student respondents included Japanese, Filipino, and Native American students. However, these students were not investigated in this study. Finally, eighty-nine percent (89.11%; n = 180) of the students in this study were traditional college students who directly enrolled in college after high school. Eleven percent of the
respondents (10.89%; n = 22) enrolled in college at a time after graduating from high school.

The questions were addressed using the Engineering Occupational Self-Efficacy Survey Questionnaire (EOSES). The researcher described the purpose of the study to college faculty members and program administrators requesting that they share the EOSES web-based survey with their students via a link that I provided. The web-based survey was facilitated through e-Survey Pro. Two hundred and two students participants completed the EOSES (n = 202).

The research was guided by the following questions:

First, are there differences in the academic performance determined by grade point average of first-year undergraduate engineering students based on ethnicity and gender?

Second, is there a relationship between and among the nine social cognitive factors identified: (a) personal support, (b) occupational self-efficacy, (c) academic self-efficacy, (d) vocational interests, (e) coping, (f) encouragement, (g) discouragement, (h) outcome expectations, and (i) perceived stress?

Third, for each of the nine social cognitive factors identified is there a significant difference based on ethnicity and gender?

Fourth, is there a relationship between the academic performance (college GPA) of first-year undergraduate engineering students and the nine identified social cognitive factors?

Fifth, is there a relationship between high school GPA and each of the nine social cognitive factors identified?
The related hypotheses for this study were:

1. Gender and ethnicity will account for a statistically significant portion of variance in the academic performance of first-year engineering students determined by college grade point average.

2. The nine social cognitive variables identified (a) personal support, (b) occupational self-efficacy, (c) academic self-efficacy, (d) vocational interest, (e) coping, (f) encouragement, (g) discouragement, (h) outcome expectations, and (i) perceived stress will have a statistically significant correlation with each other.

3. For each of the nine social cognitive variables identified there is a statistically significant difference based on ethnicity and gender.

4. There is a statistically significant relationship between academic performance (college GPA) of first-year engineering students and the nine identified social cognitive factors.

5. There is a statistically significant relationship among the nine identified social cognitive factors and high school grade point average (GPA) of first-year engineering students.

The first question the researcher sought to answer was addressing whether there were differences in academic performance defined by university GPA of first-year undergraduate engineering students based on ethnicity and gender. Therefore, the results of this study were designed to address the research questions and the related hypothesis.

The researcher completed an ANOVA to assess whether the groups were significantly different. The results revealed that there was no significant difference for
gender for university GPA. Results drawn from the ANOVA showed a statistically significant difference for ethnicity only. The results of the analysis of variance revealed that there was no significant difference between the GPA’s of Black and Hispanic university students. Likewise, Hispanic students were not significantly different from White students in their academic performance. Even so, Black students’ had lower academic performance scores than White students. Therefore, the men and women responding in this study reported similar university GPAs for this survey item. As a result, statistical hypothesis one was partially accepted for ethnicity based on the sample of responding students.

The findings, with regard to question one were not consistent with the Hackett et al. (1992) study, which found no significant interactions from the results of ANOVAs by gender and ethnicity on the academic performance variable (university GPA). Other research conducted by Winer (1971) discovered results that were consistent with this present study indicating significant main effects for ethnicity and no main effects or interactions for gender. Winer’s results revealed that Asian students scored higher than Black and Hispanic students while White students had significantly higher college GPAs than Black students.

More recently, the disparity in academic performance among Black students as compared to White and Asian students” in general academic performance has been referred to as the achievement gap (Gordon, Kane & Staiger, 2006). The achievement gap refers to a wide range of factors, both cultural and institutional, that may contribute to disparities in academic achievement based on ethnicity. For example, Steele (1997)
reported that the academic gap performance between Black and White students is approximately one-third of a letter grade.

Research question two investigated the relationship between and among the nine identified social cognitive factors. The researcher completed a Pearson correlation in order to evaluate the results of this research question setting the level of statistical significance at the .01 level.

The data from the Pearson correlational coefficient were presented in the form of a matrix and revealed that some of the social cognitive variables had statistically significant correlations with each other. Yet, there were some social cognitive factors that were not significantly correlated.

The data from the Pearson correlational analysis provided evidence of eleven significant relationships between and among the social cognitive factors. The significant relationships among the variables were: occupational self-efficacy and academic self-efficacy, occupational self-efficacy and vocational interest, academic self-efficacy and vocational interest, occupational self-efficacy and perceived stress, academic self-efficacy and encouragement, academic self-efficacy and outcome expectations, vocational interest and outcome expectations, discouragement and encouragement, outcome expectations and perceived stress, perceived stress and academic self-efficacy, and perceived stress and coping. Therefore, student respondents who reported a high score on occupational self-efficacy also reported a high score on academic self-efficacy. In addition, students reporting high scores on occupational self-efficacy reported high scores on vocational interest. Those students with high scores on academic self-efficacy also reported high scores on vocational interest. However, students with high
occupational self-efficacy scores had low perceived stress scores. Students reporting high academic self-efficacy scores also reported high scores for encouragement, and high outcome expectation scores. In contrast, students with high academic self-efficacy scores showed low scores for perceived stress.

Respondents with high vocational interest scores had high outcome expectation scores, and students reporting high scores for perceived stress had high scores for coping. Participants reporting high scores for discouragement also had high scores for encouragement. Finally, respondents reporting high outcome expectations reported high scores for perceived stress. These findings suggest that the second hypothesis can be only partially accepted due to the correlation between some variables.

In addition, these results indicate that the presence of significant correlations means that a relationship exists among some of the social cognitive variables. For example, as outcome expectations increased, academic self-efficacy also increased, thereby indicating a positive relationship between these two variables. Therefore, students with positive outcome expectations may be more efficacious toward their academic abilities. On the other hand, as perceived stress increased, academic self-efficacy decreased, suggesting a significant negative relationship. Thus, students experiencing high levels of stress due to the rigors of their academic course work may experience lower self-efficacy beliefs in their academic capabilities.

Research question three sought to evaluate whether there were significant differences for each of the nine social cognitive factors identified based on ethnicity and gender. The researcher completed an ANOVA to examine the relationship between each of the nine social cognitive factors and ethnicity and gender. The results obtained from
the ANOVA indicated a main effect for ethnicity and academic self-efficacy only. Academic self-efficacy and ethnicity was the only statistically significant main effect found among all nine social cognitive factors. Black students were found to have significantly lower GPAs than Hispanic students. Yet, Hispanic students were found not to have significantly higher GPAs than their White counterparts. Gender was not found to be significant among any of the nine social cognitive factors. In light of these findings, one can conclude that ethnicity is a factor in the strength of students’ academic self-efficacy beliefs. In addition, one can conclude that the social cognitive factors that revealed no significant main effect were the same when considering ethnicity and gender. The information drawn from the data shows that hypothesis number three can only be accepted for ethnicity. The results support the notion that academic self-efficacy was the best predictor of academic performance. This is consistent with the work of Lent et al. (1986) who also reported that strong academic self-efficacy beliefs are strongly correlated with good academic performances.

Research question four investigated the relationship between and among the academic performance (college GPA) of first-year undergraduate engineering students and the nine identified social cognitive factors. The researcher used a Pearson correlation to uncover three significant relationships between academic performance and occupational self-efficacy, academic performance and academic self-efficacy, and academic performance and encouragement. These results suggest that student respondents who had increased scores on occupational self-efficacy, academic self-efficacy, and encouragement tended to have higher academic performance as measured by their university GPA. As a result, hypothesis number four was only partially accepted.
for three of the nine social cognitive factors identified above. The results support the
notion that academic self-efficacy scores were positively related to occupational self-
efficacy, personal support and encouragement.

Research question five was designed to evaluate whether there is a statistically
significant relationship between and among high school GPA and each of the nine social
cognitive factors identified. The results of the Pearson correlational coefficient revealed
that only the social cognitive factor academic self-efficacy had a statistically significant
correlation with high school GPAs. This indicates that hypothesis five can be accepted.
This outcome may be due to a greater sense of confidence or academic self-efficacy
processed by students who received good grades in high school.

Conclusions

The results of the ANOVA investigating the difference in academic performance
based on gender and ethnicity found a main effect for ethnicity. This indicated that Black
students had lower GPAs than White students. This means that ethnicity was a significant
factor for academic performance. These results are partially consistent with the results
reported by Hackett et al. (1992) in the original study, who found no significant
interactions for gender or ethnicity. The difference in findings may have been due to the
difference in the number of respondents in each study. Therefore, it is important to note
that only nine African American students (5 men and 4 women) participated in the
original study as compared to 70 in this study. As such, the results should be interpreted
with caution due to the small number of African American participants in the original
study.
The remaining ethnicities in the original study consisted of 125 Caucasian students (99 men and 26 women) and 42 Hispanic participants (32 men and 10 women). In this study the number of respondents consisted of 116 White students and 19 Hispanic. Therefore, the difference as it pertains to ethnicity in this present study versus the original study may have been due to the higher number of African American student respondents.

The results reported in research question one were consistent with Besterfield-Sacre, Atman, and Shuman (2001) finding on gender. Besterfield-Sacre, in an eleven college cross-institutional study, reported that there were no significant differences in male and female students’ academic-self efficacy for the core courses of mathematics and chemistry for first-year engineering students. These results in this study were drawn from a pre-survey attitudinal measure of self-accessed confidence using the PFEAS instrument. This finding supports the notion that female students enter college with the same level of confidence as males in at least two of the major core academic requirements for first-year engineering students.

On the other hand, there have been various explanations presented as to why African American students have not performed as well academically as Caucasian students. The lower number of African American students taking advanced science and mathematics courses than Caucasian students has been identified to be among the factors contributing to the performance gap (U.S. Department of Education, 2000).

Conversely, according to the U.S. Department of Education (2009), the number of African American and Hispanic American students taking advanced level science and mathematics courses has increased 4 and 6 percentage points correspondingly since 1990. Even so, the data reveal no significant difference found in the number of Black and White
students completing midlevel or advanced science and mathematics curriculum by 57% and 60% respectively. Yet, the performance gap still remains in academic performance in college.

Other researchers have suggested that the achievement gap is due to a resource gap. For example, the U.S. Department of Education (1999) has tied lower academic performance among African Americans with low-income status and having fewer educational resources. Research by Ogbu (1978) focused on differences between minority groups and majority groups from six different countries. Ogbu concluded that lower academic performance was due to adaptation barriers in terms of outcome expectations or opportunity barriers. Ogbu also found that an educational resource gap existed between minority and majority middle class students.

Other researchers asserted that there is no significant difference in cognitive ability between different ethnicities as it pertains to the achievement gap, rather educational environment has an impact on academic performance Lareau (1987). According to Roscigno & Tomaskovic-Devey (2006), economically disadvantaged and minority students are more likely to attend poorly funded lower achieving schools and have less qualified teachers. Conversely, more qualified teachers can actually help diminish or eliminate the gap in academic performance between Caucasian and minorities specifically the under-represented groups in this study.

Finally, stereotype threat (Steele & Aronson, 1995) occurs when students are aware of negative typecasts in specific domains that exist for the groups in which they belong. As a result, the awareness of this undesirable perception may cause individuals to experience anxiety and thus, hinder their academic performance. This occurrence is
associated with the self-efficacy theory’s emotional and psychological states and may contribute to negative outcome expectations. The negative effect of stereotype threat on women and minorities in STEM academic majors has been widely researched (Bergeron, Block & Echtenkamp, 2006; Kellow & Jones, 2008). Cohen, Steele & Ross (1999) found that the effects of stereotype threat could be reduced if faculty members provided students with constructive feedback. Such feedback should consist of communicating high expectations while assuring students that they have the capability of achieving the required academic tasks. This researcher believes that this approach would provide students with encouragement resulting in an increase in motivation and a sense of inclusion such that their academic self-efficacy is likely to improve. This phenomenon can be associated with the self-efficacy construct termed the physiological state, which can improve due to encouragement. Also, minority students who experience peer support and have exposure to role models are more likely to overcome barriers to success and exhibit increased academic performance.

The results obtained from the second research question show that there were statistically significant correlations between the nine social cognitive factors. The researcher completed correlation coefficients which revealed significant interrelationships among ten pairs of variables. According to Cohen (1977), correlational strength ranges from $r = .1$ (small), $r = .3$ (medium), and $r = .5$ (large). The correlational matrix illustrating the correlations can be found in Table 7 in chapter four. The results obtained from this study were consistent with previous research from (Hackett et al., 1992) who found a strong correlational strength between academic and occupational self-efficacy ($r = .63$). Thus, when academic self-efficacy increased, the respondents”
occupational self-efficacy also increased. In other words, students with strong self-efficacy beliefs in their abilities to complete their academic requirements successfully also believed that they could successfully perform the various tasks required in their profession.

As noted, this researcher found the exact same strong correlation between the identified social cognitive variables for academic self-efficacy and occupational self-efficacy ($r = .63$) as Hackett et al. (1992). This may have occurred because students who are committed to their future careers may be more dedicated to their academic studies. In fact, students who are committed to their academic majors may possess stronger academic self-efficacy beliefs in their core academic requirements as first-year engineering students. As a result, students may be motivated to achieve higher GPAs. Leppel (2001) asserted that students who were confident about selecting academic majors and who were profession-oriented typically exhibited considerable diligence toward degree attainment. For this reason, students may have strong academic self-efficacy and occupational self-efficacy beliefs due to anticipation of future employment.

The researcher found that vocational interests and occupational self-efficacy were strongly correlated with each other ($r = .52$). Hackett et al. (1992) found these variables are significantly but moderately correlated with each other ($r = .39$). Vocational interest and occupational self-efficacy may be strongly correlated because first-year engineering students with strong interests in academic majors may also have strong self-efficacy beliefs that they can perform the tasks required for the engineering profession. As reported in research by Taylor and Pompa (1990), students with strong career related self-
efficacy also tend to have better vocational decision certainty in academic major
selections.

The researcher discovered that vocational interest and academic self-efficacy
were moderately to strongly correlated (r = .50). Lent & Brown (2005) measured
vocational interest and assessed the strength of students’ academic self-efficacy
beliefs and found that both variables showed a strong positive correlation (r = .89).
Hackett et al. (1992) found vocational interest and academic self-efficacy to have a
moderate to low correlation. Hence, the findings of other researchers were somewhat
consistent with the results uncovered in this study. High vocational interest may compel
students to put more effort forth toward their academic requirements. Further, according
to Lent et al. (2005), African American students reported higher academic self-efficacy
and vocational interests along with more reported interest toward their core mathematics
and science courses than White students. However, the researchers noted that this sample
of engineering student respondents were from historically black colleges and universities
(HBCUs). The results from Lent et al.’s study are possibly due to the additional faculty
support African American students received while attending various HBCUs. Also, the
majority of African American student respondents in this study attended HBCUs (Table
2).

The researcher uncovered a strong correlational relationship between
encouragement and academic self-efficacy (r = .62). Therefore, encouragement from
faculty members may embolden students by boosting their perceived abilities to perform
academically. Next, the researcher found that outcome expectations were positively
correlated with occupational self-efficacy (r = .52). Betz and Hackett (1986) found that
occupational self-efficacy was related to students” confidence in their career plans and goals. Thus, students with confidence in career related outcomes were also likely to have confidence in their ability to fulfill their career aspirations. Likewise, the researcher established that outcome expectations were moderately correlated with vocational interests (r = .46). This tendency is supported by the results of the Hackett et al. (1992) study, which reported a moderate relationship between the two variables (r = .33). As such, the social cognitive variable outcome expectations relationship with vocational interests may reflect the respondents” optimistic views toward their engineering majors. For example, according to the U.S. Department of Education (2008), engineering students anticipate comparatively good future employment and salaries when compared with other professions. Consequently, the student respondents in this study perceived themselves to be efficacious concerning their career expectations and interests while anticipating positive outcomes from their engineering degree.

Conversely, the researcher uncovered a significant, but weaker, negative correlation between perceived stress and personal support (r = .26). These results were inconsistent with Hackett et al.”s (1992) findings, which uncovered a positive significant relationship between the two variables. Further, their analysis provided support for the notion that additional personal support for students encountering stress, enhanced their self-efficacy and academic performance. With this in mind, the respondents in this study may have perceived less faculty support during stressful times during the rigors of their academic studies. Finally, the researcher discovered that the social cognitive variables of perceived stress and occupational self-efficacy had a significant and weak negative correlation (r = .22). This suggests that students experiencing low levels of stress may
have less efficacious beliefs concerning their abilities to meet the professional demands of engineering careers.

The third research question was designed to evaluate whether there were significant differences for each of the nine social cognitive factors identified based on ethnicity and gender. The results revealed a main effect for ethnicity and academic self-efficacy only. The results of the ANOVA demonstrated some difference between the ethnicities examined in this study concerning the dependent variable academic self-efficacy. More specifically, the results revealed that African American students had lower academic scores than Euro and Hispanic American students.

The researcher calculated means and standard deviations for responses for each ethnicity comparison with academic self-efficacy. The results revealed that Hispanic students had the highest academic self-efficacy mean score (M = 101). Results also indicated that Caucasian or White students had the next highest mean score (M = 91) among the study population. Next, based on the mean scores for each ethnicity, African American student respondents reported the lowest mean score for academic self-efficacy (M = 83). The researcher completed a Tukey Post Hoc Comparison in order to keep down the experimental wise error. The Tukey Post Hoc analysis set at the .05 level of significance revealed discernible comparisons between each of the ethnicities and academic self-efficacy. The Tukey Post Hoc analysis demonstrated that African American student respondents were significantly different as related to academic self-efficacy when compared with Hispanic (r = .009). Next, the Post Hoc analysis revealed a significant difference between Hispanic student respondents’ level of academic self-efficacy beliefs when compared to African American student respondents (r = .009), but
no significant difference when compared to Caucasian student respondents \( (r = .169) \).
The academic self-efficacy scores in rank order were as follows Hispanic \( (M = 101) \), Caucasian \( (M = 91) \), and African Americans \( (M = 83) \).

The results of this study are partially consistent with research indicating that academic self-efficacy is a good predictor and mediator for academic achievement (Bong and Skaalvik, 2003). Academic self-efficacy refers to students’ beliefs that they can perform specific academic tasks at certain levels (Schunk, 1991). For instance, Hispanic students reported the second highest GPAs and the highest degree of academic self-efficacy in this study. In the same way, Caucasian students reported the highest GPA \( (M = 3.28) \) and the next highest level of self-efficacy beliefs in this study. At the same time, African American students reported the lowest GPAs \( (M = 2.97) \) and the lowest level of self-efficacy beliefs. Accordingly, other researchers have investigated engineering students and discovered that their academic successes and persistence toward graduation is significantly influenced by their academic self-efficacy beliefs (Bandura 1997; Pajares, 1996). Thus, this researcher found that academic self-efficacy has a strong positive effect on the academic performance of first-year undergraduate engineering students; this is consistent with previous research (Lent et al., 2005). Equally important, (Lent, Brown, & Hackett, 2000), contend that social cognitive factors and cultural variables such as ethnicity exerts influence on academic outcomes.

The results obtained for research question four indicate that occupational self-efficacy is positively related to students’ academic performance scores and their commitment to their academic majors. This finding supported results from a study conducted by (Lent et al., 2005) showing that students reporting high self-efficacy and
occupational self-efficacy scores typically achieved high GPAs. To illustrate, students with high occupational self-efficacy beliefs choose academic disciplines that align with their self-beliefs about personal capabilities, (Pajares, 2002). On the other hand, students avoid majors leading to occupations, if they believe themselves to be less competent, in meeting the career requirements. In particular, studies have shown that self-efficacy beliefs can forecast undergraduate students’ persistence and academic performance in science based career choices (Zelden et al., 2008).

Likewise, the researcher found that academic self-efficacy and academic performance had a significant relationship. The aforementioned role of academic self-efficacy is positively correlated with high academic performance (Hackett et al., 1992). Torres and Solberg (2001) found that strong academic self-efficacy beliefs were accurate predictors of persistence and positive academic outcomes.

Finally, the researcher discovered that a significant relationship existed between encouragement and academic performance. According to Bandura (1997), self-efficacy beliefs are influenced by verbal statements and social persuasions that students’ encounter from others. These encouraging messages can prompt individuals’ to employ the additional energy required to succeed in their engineering courses. Yet, Bandura (1997) makes it clear that individuals’ self-efficacy beliefs are not bolstered by insincere praise that can generally be detected. As an illustration, Bandura warns that:

a weak ego is not strengthened by being persistently flattered and that children cannot be fooled by empty praise and condescending encouragement. In fact, a strong ego, secured in its identity by a strong society, does not need, and in fact is immune to any attempt at artificial inflation. (Bandura 1997, p. 47)
Therefore, encouragement is an important social cognitive factor for improving educational outcomes of first-year engineering students transitioning from high school to college. These results show that students who received positive encouragement in high school also had some degree of positive impact in regard to their high school GPAs. In other words, instructors of first-year engineering students can enhance their academic self-efficacy by communicating sincere positive verbal persuasions.

Bandura (1997) postulated that difficult tasks are better to observe because they offer more information about the students’ true capabilities. For example, physiological states anxiety and stress provide information about the strength of self-efficacy beliefs. For this reason, positive encouragement is needed when students encounter difficult academic tasks in order to increase their resilience and to counteract the effects of stress or dejection.

The researcher investigated the relationship between and among high school GPA and each of the nine social cognitive factors. The results were congruent with research indicating that self-efficacy aligns with an individual’s exposure to mastery experiences Bandura (1997). Thus, students who experience successful academic experiences in high school are more likely to exhibit higher academic performances in college. Put another way, high levels of effort in high school likely resulted in higher GPAs and continued to be positively correlated with higher GPAs for students during their first year in college. According to NACME, African American male students entering their first year as engineering majors with high SAT scores and correspondingly lower high school GPAs tended to have lower college GPAs their first year. These results suggest that this group of students possessed the intellect to do well academically in high school, but did not
perform up to their capabilities, both in high school and their first year of college. These findings suggest that social cognitive factors can exert a combined influence as determinants for academic performance.

**Recommendations for Practice**

The following recommendations are based on findings and conclusions presented in this study.

First, the results of research question one indicate that there was no significant difference for university GPA for gender. However, the results drawn from the ANOVA showed a statistically significant difference for university GPA for ethnicity. Therefore, program administrators should consider implementing a series of seminars for incoming first-year underrepresented engineering students beginning in the fall. These seminars should be designed to ease the transition from high school to college and provide students with proven techniques and strategies for academic success.

At the same time, underrepresented students should be enrolled in the same sections of mathematics, chemistry and physics courses during their first-year. First-year under-represented engineering students should attend collaborative learning study sessions twice a week during their entire first year. These study tables should be designed for students to work on their core engineering studies only. The study tables should also promote teamwork and active involvement in learning. Additionally, upper-class students should act as facilitators to assist students with their work. Since this study has shown that ethnicity was related to academic performance, the implementation of this peer-supported educational model should provide a vehicle to improve the academic performance of first-year underrepresented students.
Second, this study found 11 positive correlations between the identified social cognitive variables. Social Cognitive Career Theory highlights cognitive variables, including self-efficacy, personal support, academic self-efficacy, occupational self-efficacy, and coping, which are positively correlated with successful academic performance. Hence, the researcher recommends additional investigations utilizing components of SCCT to improve understanding of how these factors affect student learning. Understanding how self-efficacy impacts student academic success can be used as a framework to develop intervention strategies to increase students’ academic performances.

Third, an important finding in this study that was garnered from an ANOVA discovered a main effect for ethnicity and academic self-efficacy of the nine identified social cognitive variables. Put another way, the researcher discovered one main effect out of the nine identified social cognitive variables. In light of this finding, one can conclude that ethnicity is a factor in the strength of students’ academic self-efficacy beliefs.

The results of this study suggest that one way to increase the academic performance of first-year minority engineering students is by implementing strategies to strengthen students’ academic self-efficacy beliefs. Academic self-efficacy is linked to higher academic performance Lent et al. (2005). Bandura (1997) posits that there are specific factors that contribute to the development of individuals’ self-efficacy beliefs. These factors are mastery experiences; vicarious experiences or modeling; verbal persuasions; and psychological and effective states. Consequently, developing an understanding of how academic self-efficacy beliefs affect student learning can facilitate interventions designed to improve measures of this psychological factor. For example,
according to Tinto (1993), students who perceived positive interactions with university faculty members had higher levels of academic self-efficacy and were also more confident in their ability to complete the academic demands of their coursework requirements.

Likewise, students identified with low levels of academic self-efficacy beliefs should be afforded access to academic advisors and counselors trained to use social cognitive theory to develop their levels of personal efficacy. According to Bandura (1997), mastery experiences are the most influential determinant of self-efficacy beliefs. Thus, this researcher recommends that interventions designed to increase the strength of academic self-efficacy beliefs should include mastery experiences as a component for student success. Verbal persuasion and encouragement are also important factors faculty members should be aware of that could positively impact student success. Programmatic and initiatives such as these underscore the important role for faculty and student interactions, particularly for minority students, since the results of this study showed a main effect for ethnicity and low levels of academic self-efficacy for first-year undergraduate African American engineering students.

Fourth, this researcher recommends research involving investigations designed to compare academic performance with occupational self-efficacy, academic self-efficacy, and encouragement. Further examination of these social cognitive factors may expand the knowledge base for intervention strategies to improve student learning. The relationships between these variables could be more closely examined with the development of new testing instruments, that would allow college faculty members access to the effects of these specific factors and their impact on students’ academic performance.
Fifth, the results of a Pearson Correlational coefficient revealed academic self-efficacy as the only significant variable out of the nine identified social cognitive factors. Support exists for the effectiveness of SCCT using the nine identified social cognitive factors for increasing self-efficacy beliefs (Sullivan & Mahalik, 2000). Therefore, high school students might benefit if counselors and others investigated the impact of academic self-efficacy on high school GPA.

**Recommendations for Further Study**

As noted, this study sought to examine the relationship between nine identified social cognitive factors and the academic performance of underrepresented first year engineering students based on ethnicity and gender. The results of this study can be used to add to the research on the impact of self-efficacy on minority engineering students. The retention of underrepresented students in engineering programs has been projected by researchers to be vital for America to remain a strong economic and technological power in the global economy (NACME, 2010). For this reason, the researcher offers the following recommendations to encourage further studies utilizing self-efficacy theory to assess more information on student learning in engineering as it relates to underrepresented minority students.

The researcher recommends future research involving investigations that compare a variety of institutions in different regions of the country. For example, universities in the southern part of the United States could be compared to colleges along the Western coast of the nation in a similar study. This type of study should be completed to gain geographic diversity and to address whether different regions of the country yield different results.
The researcher recommends further investigations utilizing open-ended responses from engineering students based on interviews. This type of research may afford students the opportunity to provide in-depth explanations about their college experiences.

The researcher recommends a replicated study in 5 to 10 years to evaluate whether differences emerged relating to ethnicity and gender due to possible societal or cultural changes. Replicated studies are useful in confirming or contradicting past findings. Although the participants are different than in the original studies, replicated studies, nonetheless, add to the amount of literature and data available and thus improve the knowledge base. Replicated studies afford researchers the opportunity to test the consistency of past findings by investigating the responses of a different set of participants. As a result, new information can be added to the knowledge base to reinforce specific areas of study.

The researcher recommends a study involving a pretest and posttest. The pretest would be administered when students first arrive on campus. On the other hand, the post-test would be administered after at least one semester or quarter, if interventions had taken place. These interventions would be designed to strengthen students’ self-efficacy beliefs, such as academic self-efficacy or outcome expectations. For example, faculty members could provide students with opportunities for mastery experiences by introducing learning objectives that students are likely to be able to complete successfully. In addition, instructors can offer encouragement to students through positive verbal persuasions.

Finally, the researcher recommends a qualitative study specifically involving interview questions aimed at students with moderate level grades and SAT scores who
exhibited above average academic performance. Feedback from these students may provide useful information that could help the academic performance of other moderate level students perform well academically.

**Summary**

To summarize, the purpose of the study was to examine the relationships between social cognitive variables with the academic achievement of underrepresented first-year engineering students. Given the importance of self-efficacy derived from social cognitive theory, it is essential for program administrators and engineering faculty members to use this theory to develop support systems to strengthen minority and female students’ efficacious beliefs. This study shows that underrepresented minority engineering students benefit from support and encouragement.

According to Hackett et al. (1992), self-efficacy beliefs can be improved through the following interventions: creating learning environments that lead to mastery experiences, providing opportunities for students to learn vicariously due to observations of their peers, and by faculty members practicing positive verbal persuasions and encouragement. Acknowledgment of the relationship among the nine identified social cognitive factors can aid faculty members and college advisors as they create programs designed to improve the academic performance of the underrepresented engineering students.

This study examined nine social cognitive factors that have been found to influence self-efficacy. Bandura’s self-efficacy theory (1986) severed as the theoretical framework for this study along with SCCT. Self-efficacy theory and the social cognitive factors found in SCCT can be used to provide program administrators and engineering
faculty members with techniques to develop interventions that strengthen the self-efficacy beliefs of minority and female students. Students’ levels of academic self-efficacy can be improved using the four sources of self-efficacy (Bandura, 1996). Mastery experiences involve performing a task successfully and thereby can be utilized to strengthen students’ personal self-efficacy beliefs. Verbal persuasions such as positive verbal encouragement can help students overcome the feeling of low academic self-efficacy. College administrators can use vicarious learning or social modeling strategies to influence students by creating opportunities for them to observe individuals similar to themselves successfully accomplish a task, resulting in the belief that the observer can accomplish the task as well. Finally, psychological response can impact the way students respond to stress. If students receive personal support from program administrators and engineering faculty members, then they are more likely to be better equipped to cope with stress and persist toward graduation. Self-efficacy theory and SCCT, then, are valuable resources that can be used to create supportive environments for underrepresented students and women to improve their opportunities for success in engineering.
REFERENCES


Hayes, R. (2007, September) Review of the latest CSRDE STEM retention study:
Science, technology, engineering and mathematics. Paper presented at the annual
National Symposium on Student Retention, Milwaukee, WI.

school students attitudes to and knowledge about engineering. Proceedings of the
33nd ASSEE/IEEE Frontiers in Education Conference, Boulder, CO, 2, F2A_7-
F2A_12.doi:10.1109/FIE. 203.126489

discussions at work. National Institute of Career Education and Counseling

doi: 101111/j.1467-9744.1989.tb00974.x24

Kellow, T. J., & Jones, B. D. (2008). The effects of stereotypes on the
achievement gap: Reexamining the academic performance of African American
high school students. Journal of Black Psychology, 34, 94-120.

engineering.

Lareau, A. (1987). Social class differences in family-school relationships the importance
cognitive constructs in career research: A measurement guide. *Journal of Career
Assessment, 14*(1), 12. doi:10.1177/1069072705281364

social cognitive perspective, Career choices and development* (3rd ed.) San

expectations to academic persistence. *Journal of Counseling Psychology, 33*,
356-362.

of academic performance and perceived career options. *Journal of Counseling
Psychology, 33*, 265-269.

theoretically derived variables in predicting career and academic behavior: Self-
efficacy interest congruence, and consequence thinking. *Journal of Counseling
Psychology, 34*, 293-298. doi: 10.1037/0022-0167.34.3.293

of scholastic aptitude-academic performance relationships. *Journal of Vocational
Behavior, 35*, 64-75.

women and students at historically Black universities. *Journal of Counseling
Psychology, 52*, 84-92.


doi:10.1177/00444118x92024002006


<table>
<thead>
<tr>
<th>Participating Universities</th>
<th>Affiliations</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Akron</td>
<td>Public, Research (high research activity)</td>
</tr>
<tr>
<td>Cedarville University</td>
<td>Baccalaureate College (diverse fields)</td>
</tr>
<tr>
<td>Central State University</td>
<td>Baccalaureate College (diverse fields)</td>
</tr>
<tr>
<td>University of Cincinnati</td>
<td>Public, Research (very high research activity)</td>
</tr>
<tr>
<td>University of Dayton</td>
<td>Private, Research (high research activity)</td>
</tr>
<tr>
<td>Miami University</td>
<td>Public, Research (high research activity)</td>
</tr>
<tr>
<td>Ohio University</td>
<td>Public, Research (very high research activity)</td>
</tr>
<tr>
<td>The Ohio State University</td>
<td>Public, Research (very high research activity)</td>
</tr>
<tr>
<td>University of Toledo</td>
<td>Public, Research (high research activity)</td>
</tr>
<tr>
<td>Wilberforce University</td>
<td>Baccalaureate College (diverse fields)</td>
</tr>
<tr>
<td>Wright State University</td>
<td>Public, Research (high research activity)</td>
</tr>
</tbody>
</table>
APPENDIX B

UNIVERSITY of
DAYTON

COMMITTEE FOR THE PROTECTION OF
HUMAN SUBJECTS IN RESEARCH
Mary Connolly Ph.D., Chair
Kettering Laboratories, Rm. 542
300 College Park
Dayton, OH 45469-0104
Phone (937) 229-3493; FAX (937) 229-2291
18 February 2010

Bruce H. Carr
Educational Leadership
University of Dayton
300 College Park Ave.
Dayton, OH 45469

SUBJECT: “Examining the relationship of ethnicity, gender and social cognitive factors…”

Dear Mr. Carr,
The Institutional Review Board for the Protection of Human Subjects in Research has reviewed the subject proposal. The proposed research protocol is exempt from human subject regulations as described in 45 CFR 46.101(b)(2). Therefore, you have approval to proceed with the study.
The Committee expects that all relevant subject protection measures and ethical standards will be followed, as outlined in your proposal. Please feel free to contact me should you encounter other issues relevant to the protection of human subjects or ethical conduct of this research. Good luck in your work!

Best regards,

SIGNATURE ON FILE

Mary S. Connolly, PhD
Chair, Committee for the Protection of Human Subjects in Research
Coordinator of Bio-Research Initiatives
Office for Research
University of Dayton
Dayton, OH 45469
Cc: A. Hill; Dr. C. Russo
Dear Student:

My name is Bruce Carr and I am an assistant principal at Wayne High School in Huber Heights Ohio. I am in the process of conducting a research study to complete my Ph.D. in Educational Leadership at the University of Dayton.

I am writing to ask you to participate in a study entitled “Examining the Relationship of Ethnicity, Gender and Social Cognitive Factors with Academic Achievement of First Year Engineering Students”. This study investigates self-efficacy beliefs based on social cognitive factors (motivational constructs) such as vocational interest, outcome expectations (positive or negative), perceived stress, coping, personal support, faculty support or discouragement as they relate to ethnicity and gender. The purpose of this research is to discover the potential relationship between these social cognitive factors and academic performance.

There is no direct benefit from your participation in this study. However, you may walk away with a greater awareness of factors that contribute to your success as a first year engineering student. Also, once this study has been completed it may provide faculty advisors with an additional tool in order to counsel students to achieve greater academic success.

All survey responses will be collected for analysis with out any identifiers. More specifically, you will not be asked to give your name on the survey and only group data (not individual data) will be examined. Therefore, your confidentiality will be maintained.

The survey questionnaire will take about 15 to 20 minutes to complete.

If you have general questions about giving consent or your rights as a research participant in this research study, please call me at (937) 233-6431 Ext 2033 or my dissertation chair, Dr. Charles Russo, at the University of Dayton, at (937) 229-3722. In addition questions may be directed to the University of Dayton”s Review Board (IRB) Chair, Dr. Mary Connolly, at (937) 229-3493.

Your participation in this survey is completely voluntary. You have the right to decline to answer questions, and refuse to participate in this study or withdraw at any time. Your decision not to participate will not result in any penalty or loss of benefits to which you are otherwise entitled. Completing the survey questionnaire implies your consent to participate.

Please click on the link below in order to take the survey.

http://www.esurveyspro.com/Survey.aspx?id=222cad68-dc00-45f3-a8f6-18417a6a0183

Sincerely,

Bruce Carr,
PhD Candidate Educational Leadership
University of Dayton
August 11, 2008

Bruce Carr
Clayton OH 45415

Dear Bruce:

This letter is to grant you permission to use the Education Plans, Stress, and Support Questionnaire in your dissertation.

Best wishes on your interesting project.

Most Sincerely,

Nancy E. Betz, Ph.D.
Professor
APPENDIX E

Educational Plans, Stress, and Support Questionnaire

1. Please list your high school grade point average (If you do not remember your exact GPA but you feel you can provide a reasonably close number, you are encouraged to list it).

2. Please list your current college grade point average. (You should provide this score based on your current level of performance Therefore, in order to answer this question, it is not necessary to wait until the end of the quarter or semester). Again, please provide a reasonably close GPA if you do not know your exact score.

3. I attend
   - Cedarville University
   - Central State University
   - Miami University
   - Ohio University
   - The Ohio State University
   - University of Akron
   - University of Cincinnati
   - University of Dayton
   - University of Toledo
   - Wilberforce University
   - Wright State University

4. Gender
   - Male
   - Female

5. Age __

6. Which of the following comes closest to describing your race or ethnic group?
   - Black or African American
   - Chicano
   - Latino or other Spanish American
   - Japanese or Japanese American
Filipino/ Phillippino
Mexican-American
Native American
White or Caucasian

7. Year in School

8. Please identify your educational background from among the following options:

Graduated high school and directly enrolled in my college or University
Transferred from a Junior or Community College
Transferred from another College or University
Attended another College or University In the past and after an interruption, am transferring to my current institution to complete my education
Attended my current College or University and after an interruption, I am returning to complete my education
Attended high school, did other things first, and now decided to obtain a College education

9. Are you the first in your immediate family to attend a College or University?

Yes
No

10. Where do you currently live?

Campus Residence Halls
I commute (less than twelve miles)
I commute (more than twelve miles)
Other

11. With whom do you currently live? (check all that apply)

Student(s) from your Department
Student(s) from unrelated Department
Parent(s) □
Alone □
Friend(s) from same ethnic/racial Background □
A partner (i.e., spouse, girlfriend, boyfriend) □
Other □

12. What best describes your living situation?
Supportive □
Stressful □
Neutral □

13. Part B. Science and Engineering Careers Questionnaire

Part 1. For each profession identified below, please indicate how confident you are that you could successfully complete the education and/or training necessary to enter the profession – assuming you are motivated to do your best.

How confident are you that you could successfully complete the education and/or training for each profession?

Please rate yourself using the following scale:

0-1=Not at All Confident, 2-3=Somewhat Confident, 4-5=Moderately Confident, 6-7=Very Confident, 8-9=Completely Confident

<table>
<thead>
<tr>
<th>Career</th>
<th>Not at all Confident</th>
<th>Not at all Confident</th>
<th>Moderately Confident</th>
<th>Very Confident</th>
<th>Completely Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Aerospace Engineer</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. Agricultural Engineer</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. Architect</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. Landscape Architect</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. Astronomer</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. Chemical Engineer</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. Chemist</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. Civil Engineer</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9. Computer Scientist</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. Electrical Engineer</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>11. Geologist</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12. Management</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>13. Mathematician</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
14. Mechanical Engineer 0 1 2 3 4 5 6 7 8 9
15. Nuclear Engineer 0 1 2 3 4 5 6 7 8 9
16. Physicist 0 1 2 3 4 5 6 7 8 9
17. Statistician 0 1 2 3 4 5 6 7 8 9
18. Technical Sales 0 1 2 3 4 5 6 7 8 9

14. Part 2. Again assuming you were motivated to do your best, please use the following scale to rate how confident you are that you could successfully do the following:

0-1=Not at All Confident, 2-3=Somewhat Confident, 4-5=Moderately Confident, 6-7=Very Confident, 8-9 = Completely Confident

<table>
<thead>
<tr>
<th>Question</th>
<th>Not at all Confident</th>
<th>Not at all Confident</th>
<th>Moderately Confident</th>
<th>Very Confident</th>
<th>Completely Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete the mathematics requirements of most Engineering/Science majors?</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td>Complete the chemistry requirements for most Engineering/Science majors?</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td>Complete the physics requirements for most Engineering/Science majors?</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td>Complete the lab requirements for your major?</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td>Complete some technical or science degree at your school?</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td>Perform competently in some technical/scientific career field?</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td>Remain in Engineering or Science over the next quarter/semester?</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td>Remain in Engineering/Science over the next 2 quarters/semesters?</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td>Remain in Engineering/Science over the next 3 quarters/semesters?</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td>EXCEL in Engineering/Science over the next quarter/semester?</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td>EXCEL in Engineering/Science over the next two quarters/semesters?</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td>EXCEL in Engineering/Science over the next three quarters/semesters?</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
<td>0 1 2 3 4 5 6 7 8 9</td>
</tr>
</tbody>
</table>
15. C. OCCUPATIONAL INTEREST SCALE
Please select the number that best represents how you feel about each of the following occupations:

0-1=Strongly Dislike, 2-3=Dislike, 4-5=Indifferent, 6-7=Like, 8-9 = Strongly Like

<table>
<thead>
<tr>
<th>Career</th>
<th>Strongly Dislike</th>
<th>Dislike</th>
<th>Indifferent</th>
<th>Like</th>
<th>Strongly Like</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Aerospace Engineer</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. Agricultural Engineer</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. Architect</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. Landscape Architect</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. Astronomer</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. Chemical Engineer</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. Chemist</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. Civil Engineer</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9. Computer Specialist</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. Electrical Engineer</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>11. Geologist</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12. Management</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>13. Mathematician</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>14. Mechanical Engineer</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>15. Nuclear Engineer</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>16. Physicist</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>17. Statistician</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>18. Technical Sales</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

16. D. OUTCOME EXPECTATIONS QUESTIONNAIRE
Please use the following scale to rate the degree to which you agree with each of the following statements.

0-1=Strongly Disagree, 2-3=Disagree, 4-5=Moderately Confident, 6-7=Very Confident, 8-9 = Completely Confident

<table>
<thead>
<tr>
<th>Statement</th>
<th>Not at all Confident</th>
<th>Not at all Confident</th>
<th>Moderately Confident</th>
<th>Very Confident</th>
<th>Completely Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. A degree in Engineering/Science will allow me to obtain a well-paying job.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. A degree in Engineering/Science will allow me to obtain a job I like doing.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
3. With a degree in Engineering/Science I will be respected by others.  

4. A degree in Engineering/Science will allow me to get a job where I can use my talents and creativity.  

5. A career in Engineering/Science will leave me enough time to have things such as a family, friends, and leisure activities.  

6. I expect to be treated fairly on the job. That is, I expect to be given the same opportunities for pay raises and promotions as my fellow workers.  

7. I expect to feel “part of the group” on my job.  

8. I expect to be fairly rewarded for the contributions I make.  

9. I worry that I will not get a “fair shake” in the job market.  

10. I worry that I will be seen as “different” when I get my first job in Engineering/Science.  

11. I worry that employers will doubt my competence.  

12. A degree in Engineering/Science will give me the kind of lifestyle I want.

17. E. STRESS INVENTORY

Part I. Below is a list of event concerning a variety of topics related to your college education that you may be experiencing. Please indicate, using the space below, the extent to which each of the following events has been stressful for you since you have been at this university.

If one of the events listed below has happened to you and has caused you a great deal of stress, please rate that event toward the “Very stressful” or “Extremely stressful” end of the rating scale. If an event happened to you while you were attending this university, but has not bothered you, then please rate that event toward the lower end of the scale (“Not at all stressful”).
If you have never experienced one of more of the events listed, please relate that event as “Not at all stressful.”

Please use the following scale to rate how stressful each one of the following events have been for you since you came to this College or University.

Not at all stressful = 1, Minimally Stressful = 2. Please use the following scale to rate the degree to which you agree with each of the following statements.

How stressful have each of the following been for you?

<table>
<thead>
<tr>
<th>Type of Stress</th>
<th>Not at all stressful</th>
<th>Minimally stressful</th>
<th>Moderately stressful</th>
<th>Very stressful</th>
<th>Extremely stressful</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Teachers treating you differently than other students.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. Peers treating you differently than other students.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. Not meeting personal expectations for academic achievement.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. Not meeting teachers’ expectations for academic achievement.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. Earning a lower GPA than peers.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. Approaching a faculty member, staff member, or administrator to resolve an issue, get assistance, or the like.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. Taking tests/examinations.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8. Having a conflict with family members.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9. Family members having financial problems.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>10. Family members having health problems.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>11. Family members having personal problems.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>12. Being told by parents to attend or not to attend an institution.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>13. Pressure from family to go to school close to home.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>14. Family disapproval of chosen major.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>15. Pressure from family to major in Engineering/Science.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
16. Conflicts with personal changing values.  
17. Adjusting to a new educational environment.  
18. Adjusting to a new educational environment.  
19. Adjusting to a new educational environment.  
20. Making friends with people from different backgrounds and/or values.  
21. Enrolling in an institution and feeling different (isolated, alienated, not belonging).  

18. Part II: For the following questions, please indicate the extent to which the situations or event checked in question 17 part I above have interfered with your ability to function effectively as a student at this University.  

Does not Interfere = 1, Minimally Interferes = 2, Moderately Interferes = 3, Very Much Interferes = 4, Extremely Interferes = 5  

Does the stress that you experience in the above situations actually interfere with:  

<table>
<thead>
<tr>
<th>Does Not Interfere</th>
<th>Minimally Interfere</th>
<th>Moderately Interfere</th>
<th>Very Much Interfere</th>
<th>Extremely Interfere</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Your ability to concentrate while studying or writing papers.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. Your ability to prepare effectively for a test and perform up to your ability.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. Your ability to concentrate while studying or writing papers.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. Your ability to enjoy acquiring knowledge and growing intellectually at the University.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. Your ability to develop yourself as a person (emotionally, socially, philosophically) while at the University.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
19. Part III:
   A. Considering all things, how stressed do you feel?
      1. Not stressed at all.
      2. Minimally stressed.
      3. Moderately stressed.
      4. Very stressed.
      5. Extremely stressed.

   B. Considering all things, how successfully do you feel you are coping?
      1. Not at all successfully.
      2. Minimally successfully.
      3. Moderately successfully.
      4. Very successfully.
      5. Extremely successfully.

20. Part IV: What do you do to cope with the stress, if any, that you experience in connection with your education? Please list all of the ways in which you have coped with the stress of academic life while you have been enrolled in your College or University.

   1.
   2.
   3.

21. F. SUPPORT QUESTIONNAIRE

Part I: Please use the following scale to relate how much support and encouragement for your education/career plans that you have received, or are receiving, from each of the following people.

Please DO NOT select a response if it is not relevant to you. For example, if you do not have any sisters, leave that question blank.

Little or No support = 1-2, Some Support = 3, A Lot of Support = 4-5

<table>
<thead>
<tr>
<th></th>
<th>Little or no support</th>
<th>Some support</th>
<th>A lot of support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother</td>
<td>1 2</td>
<td>3 4 5</td>
<td></td>
</tr>
<tr>
<td>Father</td>
<td>1 2</td>
<td>3 4 5</td>
<td></td>
</tr>
<tr>
<td>Brother (s)</td>
<td>1 2</td>
<td>3 4 5</td>
<td></td>
</tr>
<tr>
<td>Sister(s)</td>
<td>1 2</td>
<td>3 4 5</td>
<td></td>
</tr>
</tbody>
</table>
5. Other Relatives  
6. Friends of the same sex  
7. Opposite – sex Friends  
8. Boyfriend / Girlfriend  
9. Faculty Members  
10. Significant older peoples, e.g., family friends

**Part II. Using the scale identified below, since you have been at this College or University, has any Faculty Member in your Department ever told or given you the impression that:**

**No One = 0, One Faculty Member = 1, Yes, Two or More Faculty Members = 2**

<table>
<thead>
<tr>
<th></th>
<th>No one</th>
<th>One faculty member</th>
<th>Yes, 2 or more faculty members</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. You should apply for a scholarship or fellowship.</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2. You are not well-suited for Engineering/Scientific fields</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3. Your progress is too slow.</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4. You are not working up to the standards of your College or University.</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5. You should switch to another field.</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>6. You are well-suited to Engineering/Scientific fields.</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>7. You are not a serious student.</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>8. You are one of the best students in your Department</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>9. You are one of the best students in your class.</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>10. You are inferior to other students.</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
March 4, 2010

Mr. Bruce H. Carr
University of Dayton
Doctoral Program in Educational Leadership
Dayton, OH 45409

IRB #UD0310GS

Please be informed that a full review of your grant petition has been conducted in accordance with the guidelines provided by the Office for Human Research Protections (OHRP) of the US Department of Health and Human Services (Protection of Human Subjects, 45 CFR 46, part 46.109).

The CSU Institutional Review Board Committee has approved your proposed study: “Examining The Relationship of Ethnicity, Gender, and Social Cognitive Factors with Academic Achievement of First Year Engineering Students” under the following conditions:

- Approval is limited to one year. An extension of IRB approval for an additional twelve months period requires that the principal investigator notify the IRB.
- If any immediate changes are made, the IRB must be immediately notified and approval of the change must be sought.
- The principal investigator must report to the IRB on the status to their project at the end of each approval period.

If you should require additional information or guidance on any of the above matters, please contact the IRB committee.

Sincerely,

[Signature]
November 8, 2010

Bruce Carr, BS, M.Ed, PhD Candidate
Dept. of Engineering
ML 1492

RE: IRB #10-11-05-08X “Examining the Relationship of Ethnicity, Gender and Social Cognitive Factors with Academic Achievement of First Year Students in Engineering”

Dear: Bruce Carr

The University of Cincinnati Institutional Review board – Social and Behavioral Sciences (IRB-S) has reviewed and approved your new research project under §46.101(b) 2.

APPROVAL EXPIRES ON: 11/06/2011.

If your research requires signed consent, the approved consent version (with the IRB approval stamp) is attached to this approval. This is the version that MUST be used with your participants.

The research MUST be conducted EXACTLY as approved. ANY modifications to the approved project must be reviewed and approved by the IRB-S BEFORE being implemented.

Also attached to this approval are Investigator Responsibilities, which are expected of all human subjects researchers at the University of Cincinnati.

Best wishes on your research.

Sincerely,

Julie Weltz-Gedach
BSN, MPH, CIP
Chair, UC IRB-S
JWG:
APPENDIX H

April 12, 2010

Bruce H. Carr
Educational Leadership
University of Dayton
300 College Park Ave.
Dayton, OH 45469

Dear Mr. Carr,

I have reviewed the human subjects research project, Examining the Relationship of Ethnicity, Gender and Social Cognitive Factors, that you have had approved by the University of Dayton IRB.

I feel that this research will be of minimal risk to the research participants; and that all of the elements of the human subjects research regulations have been addressed. Therefore, the research activities taking place at The University of Toledo (UT) and/or with subjects affiliated with UT are approved.

Thank you for this opportunity to review your proposal and good luck on this project.

Sincerely,

Rosemary R. Haggett

Rosemary R. Haggett, Ph.D.
Executive Vice President
Provost for Academic Affairs, Main Campus

cc: Barbara Chesney, Ph.D.
Carolyn Pinkston, R.N., B.S.
DATE: March 22, 2010

TO: Bruce H. Carr, P.I., Student
    Educational Leadership, UD
    P. Ruby Mawasha, Ph.D., PE, Asst. Dean
    Engineering & Computer Science

FROM: B. Laurel Elder, Chair
    WSU Institutional Review Board

SUBJECT: SC# 4152

'Examining the Relationship of Ethnicity, Gender and Social Cognitive Factors with Academic Achievement of First Year Engineering Students'

At the recommendation of the IRB Chair, your study referenced above has been recommended for exemption. Please note that any change in the protocol must be approved by the IRB; otherwise approval is terminated.

This action will be referred to the Full Institutional Review Board for ratification at their next scheduled meeting.

NOTE: This approval will automatically terminate one (1) year after the above date unless you submit a "continuing review" request (see http://www.wright.edu/rsp/IRB/CR_sc.doc) to RSP.

If you have any questions or require additional information, please call Robyn Wilks, IRB Coordinator at 775-4462.

Thank you!

Enclosure