Women in STEM: Attaining and Retaining Leadership Positions Under Stereotype Threat

A Dissertation submitted

by

Mary A. Ritzdorf, M.S.

To

College of Saint Mary

in partial fulfillment of the requirement

for the degree of

DOCTOR OF EDUCATION

with an emphasis on

Educational Leadership

We hereby certify that this Dissertation, submitted by Mary A. Ritzdorf, conforms to acceptable standards and fully fulfills the Dissertation requirements for the degree of Doctor of Education from College of Saint Mary.

Merryellen Towey Schulz, Ph.D
Committee Chair

Melanie K. Felton, Ph.D
Committee member

Joy A. Martin, Ph.D
Committee member

DEDICATION

This dissertation is dedicated first and foremost to my children Connor, Evan, and Jordan. I hope you know that you are my world. My love for you far surpasses anything I have ever known and greater than you can imagine. From the first moment I saw you and held you in my arms, I knew that God had sent me the very best boys he had. How lucky was I? I embrace every moment of time with you. The three of you have been my inspiration during my journey as your mom, as well as personally and professionally. I have learned so much from you. I love your smiles, laughs, great personalities, and not to mention, your good looks! I love watching you grow into young men. My whole heart and soul has been put into raising you to the best of my ability. I have been so blessed and honored to be your mom. Everything that I have worked for and achieved has been because of you. You are my labor of love. I am proud of you and extremely proud to be your mom. I love you.

I also want to dedicate my work to my parents, Margie and Al Bonta. Your strong work ethic has certainly rubbed off. I admired your tenacity, love and dedication raising ten children and giving us a strong Catholic upbringing. You raised each of us to be independent so we could spread our wings and fly. I know that you were proud of all of us and the successes that we each have achieved. Although I know that your journey was not easy at times, your love for us was unwavering. Dad, I miss your big smile, hearty laugh and your country singing. I love you. Mom, I admire your strength and determination. You are the best cook and baker in the whole world. You had to be to feed all ten of us! Thank you for teaching me perseverance and showing me your strong faith and the power of prayer. You prayed often, for each of us. Thank you for helping me with my own boys when I needed you the most. My time with you has been precious and I thank God for each moment I have with you. Finally, thank you for telling me that I could

do anything I wanted to do and be anything I wanted to be. I followed your lead, mom. You gave me the confidence I needed. I love you.

Denny, you are the most wonderful man in my life. Where would I be without you? You came into my life when I needed you the most. It was serendipity and fate that brought us together. It is love that will keep us there. Through you, I have learned what true love is. You love and appreciate me for who I am, and I love and appreciate you for who you are. You are special to me. Although we have been together for such a short period of time, it seems like I have known you forever, like yesterday. We definitely are, better together. Thank you for supporting me and encouraging me through this long journey at College of Saint Mary. Thank you for loving my boys without hesitation. You are my best friend on earth. I love you, more than you know.

Shelly, you are my best friend, forever. When you died, a huge part of me died with you. Not one moment of the day goes by without me thinking of you. If only I had one more day with you, my life would be complete. I would never let you go. Thank you for always being there for me. You truly were the most inspirational woman I have ever known. Your spark for life, huge heart and contagious crazy ways were loved by all. I miss you dearly. I love you.

Dan, I am forever indebted to you for your strength, love and support.

PERSONAL ACKNOWLEDGEMENTS

Thank you to the women who were a part of this research. I admire you more than you can imagine. Your strength, determination, intelligence and tenacity to be in leadership roles and pave the way for all women in the work force, is inspirational. The journey you have walked is astounding. You are great role models for all aspiring women, in any field.

I would like to thank all the wonderful women in my life. There are too many of you to mention by name. Professionally and personally you have stood by me, through thick and thin.

For all the women in education that I have had the privilege of knowing and working with: I have learned so much from you. I admire what you do each day and cherish our friendships. You truly have been a blessing in my life.

To my forever friends, Betty, Bonnie, and Karen; what can I say? We have been true friends for over 30 years. Your loyalty to me, through my happiest moments and darkest hours, is cherished. You have been my biggest advocates and cheerleaders, encouraging me and supporting me along the way. I love you for that.

Single mothers of the world: I know your plight. I have walked the walk with you and know that your journey is not an easy one. There is hope in knowing that your rewards will follow. The fruits of your labor will one day appreciate you more than you know. Keep the faith and know that you have God on your side. The task is exhausting, but the beauty is in the reward of knowing that you did your best and accomplished your goals with your children.

How can I ever thank my sisters Barbara, Cindy, Jan, Laurie, and sister-in-law Laura? You were there with me through the darkest time my life, our lives, when we had to say good-bye to my best friend and our sister, Shelly. I couldn't have done it without you. I love you more than you know. To my brothers: I love you.

PROFESSIONAL ACKNOWLEDGEMENTS

I would personally like to thank College of Saint Mary for their mission and commitment to the education of women. I started my career in education at College of Saint Mary and am proud to have achieved my highest degree possible, Doctor of Education, at College of Saint Mary. Sister Catherine McAuley's belief of the education of women has certainly held true in my life. She truly was a visionary.

Next, I would like to thank all of my professors that have guided me throughout the course of my degree. You certainly have pushed me beyond my boundaries helping me and shaping me along the way. You have given me inspiration to learn and grow and continued to give me encouragement and hope that I could climb this enormous mountain and succeed. A special thank you goes to Dr. Lois Linden. You had faith in me from the first class I had with you, and continued to have faith in me on one of the final legs of this journey. Your fun spirit and laugh was contagious.

Thank you to my doctoral committee: Dr. Joy Martin, Dr. Melanie Felton, and Dr. Merryellen Towey Schulz. You have taught me so much about myself. Your unwavering commitment and constant feedback to me and my writing meant so much to me. Your input on my dissertation was invaluable. You were inspirational to me and truly women of great talent and expertise.

A special thank you goes to Dr. Merryellen Towey Schulz, my Doctoral Committee Chair. I could have never made it to the finish line without your guidance. You went above and beyond with your commitment to me. You were always there for me. Whether it was emails, phone calls, meetings, or text messages you always pulled through for me, gave me advice and encouragement to go forward. You are truly a brilliant woman. I call you my friend.

Table of Contents

LIST OF APPENDICES 12

LIST OF TABLES 13

LIST OF FIGURES 14

Abstract 15

Chapter 1: INTRODUCTION 16

Background and Rationale 20

Theoretical Framework 23

Purpose of the Study 26

Research Questions 27

Definition of Terms 28

Assumptions 30

Limitations and Delimitations 30

Significance of the Study 31

Summary 31

Chapter II: LITERATURE REVIEW 34

Impact on Women 34

Stereotype Threat 35

Consequences of Stereotype Threat 38

Self-handicapping 38

Distancing 39

Professional identities and aspirations 39

Theories of Intelligence 40

Entity View Theory 41

Incremental View Theory 44

Psychology of Women in STEM Careers 47

Self-Efficacy 48

Mastery Experiences for Women 49

Viable mentors 49

Glass ceiling effect 50

Vicarious Experiences by Social Models 51

Social Persuasion 52

Somatic and Emotional State 53

Women in STEM Leadership Roles 54

Message Design Logic 54

Expressive message design logic 55

Conventional message design logic 56

Rhetorical message design logic 56

Summary 57

Chapter III: METHODOLOGY 60

Research Questions 60

Participants 61

Sample 63

Setting 64

Ethical Considerations 64

Data Collection and Analysis 65
Data Quality Measures 67
Data Analysis 69
Chapter IV: REPORT OF THE FINDINGS 72
Research Questions and Findings 73
Summary 96
Chapter V: CONCLUSION AND RECOMMENDATIONS 98
Purpose of the Research 98
Discussion of the Findings 99
Significance of the Findings 105
Recommendations for Future Research 107
Conclusion 109
References 112
Appendix A: Invitation to Participate 123
Appendix B: Adult Consent Form 125
Appendix C: Rights of the Research Participants 130
Appendix D: Participant Personal Narrative 131
Appendix E: Interview Form 132
Appendix F: Field Notes Observation Form 135

LIST OF APPENDICES

Appendix A: Invitation to Participate……..122

Appendix B: Adult Consent Form……...124

Appendix C: Rights of Research Participants……..129

Appendix D: Participant Personal Narrative ……...130

Appendix E: Interview Form ....……..131

Appendix F: Field Notes Observation Form……134

LIST OF TABLES

Table 1: Demographic Data of the Participants……61

Table 2: Difficulties and Struggles with Intelligence……...75

Table 3: Ritzdorf Table for Determination……...82

Table 4: Motivators of Competitiveness……...84

Table 5: Fear of Failure…….85

LIST OF FIGURES

Figure 1: Gender Shares of Total and STEM Jobs, 2009……..16

Figure 2: College-educated Workers with a STEM Degree by Gender and STEM Degree Field, 2009…….17

Figure 3: Ritzdorf Model: Overlapping Theories Impacting Women in STEM Careers……..23

Figure 4: Ritzdorf Model: Data Analysis Procedures……68

Abstract

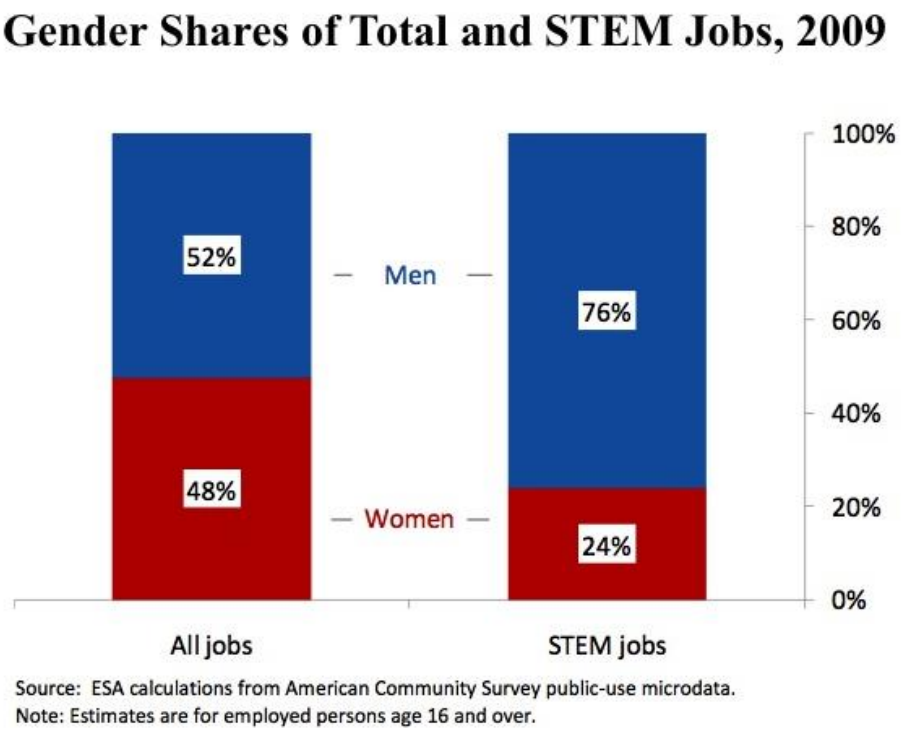
Considerable attention has been given to helping young people toward careers in science, technology, engineering, and math (STEM). Key organizations have played vital roles in the push for awareness and equity in STEM education held by both women and men. However, research has shown that there may be other possible factors contributing to the lopsidedness of women and men in STEM careers. The following phenomenological study explored the perceptions of seven women from Midwestern metropolitan cities in STEM leadership roles and how they attained and retained their leadership roles while influenced by stereotype threat. The study design consisted of participant personal narratives and one-on-one interviews. The information gathered in this study was divided into three distinct sections: stereotype threats with the impact of implicit theories of intelligence on women in STEM careers; the psychology of women in STEM careers; and communication theories as they currently relate to women in STEM leadership roles. The descriptions by these women and their lived experiences explored the influential factors that provided insight and information to the link between successful women in leadership positions and the gender inequities and underrepresentation of women in Science, Technology, Engineering, and Math (STEM) careers.

Chapter 1: INTRODUCTION

Considerable attention has been given to helping young people toward careers in science, technology, engineering, and math (STEM) fields. Organizations such as the National Science Foundation, the STEM Education Coalition, NASA, and the U.S. Department of Education are playing a key role in the push for awareness and equity in STEM education and careers held by both men and women (U.S. Department of Commerce, July, 2011). The National Science Foundation (NSF) has numerous programs in STEM education for K-12 students such as Innovative Technology Experiences for Students and Teachers (ITEST). In April, 2012, NASA piloted an online mentoring project titled NASA G.I.R.L.S; Giving Initiative and Relevance to Learning Science (Executive Office of the President, 2013). Project G.I.R.L.S connects women engineers and scientists to girls across the country. The STEM Education Coalition works to support programs for teachers and students. Project Lead the Way (PLTW) was one initiative to help prepare students for STEM occupations (Fletcher, 2012). Project Lead the Way is a leading provider to STEM education curricular programs to middle and high schools in the United States (Fletcher). Programs include high school engineering curriculum, biomedical science, and a middle school engineering and technology program called Gateway to Technology. According to the U.S. Department of Commerce (July, 2011), the STEM workforce is crucial to America's innovative capacity and global competitiveness. However, the U.S. Department of Commerce (July, 2011) states that there are many possible factors contributing to the discrepancy of women and men in STEM careers. Of those factors, a lack of female role models, gender stereotyping, and less family-friendly flexibility in the STEM fields were among those mentioned (Litmanovitz, 2011).

Nevertheless, women are vastly underrepresented in STEM jobs. The underrepresentation of racial minorities and women in science, technology, engineering, and mathematics (STEM) disciplines is a national concern (Hernandez, Woodcock, Schultz, Estrada, & Chance, 2013). The American Association of University Women (AAUW) reports that in the academic workforce, women's representation varies by discipline as well as tenure status (Hill, Corbett, & Rose, 2010). Yet, there may be other possible factors contributing to the lopsidedness of women and men in STEM careers. Figure 1 demonstrates the gender imbalance in the total of all jobs versus STEM related jobs. The percentage of men to women in all jobs is somewhat equal, 48% to 52%.

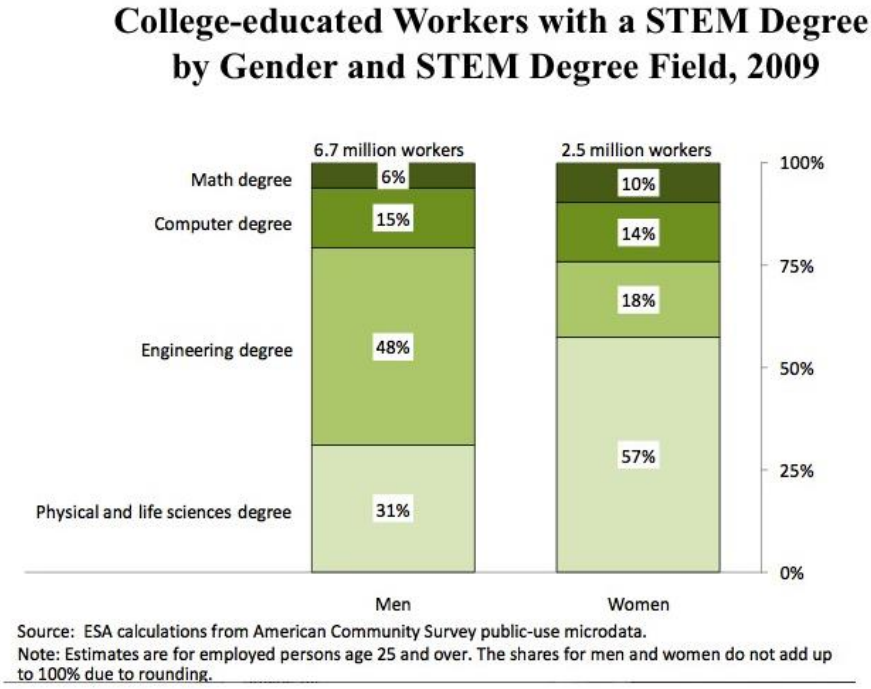
Figure 1: Gender Shares of Total and STEM Jobs, 2009



(U.S. Department of Commerce Economics and Statistics Administration, August 2011)

However, the percentage of men to women in STEM jobs is far outweighed by a percentage of 76% for men versus 24% for women. Figure 2 demonstrates a lopsidedness of college-educated workers with a STEM degree by gender and STEM degree field. The figure also shows a higher population of men to women workers in 2009 and the percentage comparison in each related category of STEM degrees.

Figure 2: College-educated Workers with a STEM Degree by Gender and STEM Degree Field, 2009



(U.S. Department of Commerce Economics and Statistics Administration, August 2011)

Research supports that girls' achievement and interests in STEM disciplines were often shaped by the environment around them. Ma (2011) stated that on science achievement, studies found a gender gap in favor of boys starting from young ages and across grade levels. In the study, "Science Anxiety as a Function of Gender and Experience" written by Brownlow, Jacobi,

and Rogers (2000), researchers examined the influence that gender had on science anxiety and the classroom. The study examined the effects that teachers had in the classroom. Teachers believed that boys had more ability than girls in math and science and perceived that girls' achievement in these areas was due to effort rather than innate capability. In a more recent article by Bursal (2013), girls were consistently found to have at least slightly higher science success than boys. It was concluded that females were being discouraged by school counselors from taking science and math classes, excluding them as preteens from careers in STEM fields. Gunderson, Ramirez, Levine, and Beilock (2012) reviewed research showing that parents' and teachers' expectancies for children's math competence were often gender-biased and can influence children's math attitudes and performance.

Another area of focus and concern was with the influence of stereotype threat on women. At an early age females and underrepresented minorities were taught about STEM stereotypes (Nicholson, Warren, Oppenheimer, Goodman, Coding, Robinson, & Chung, 2013). Studies showed that gender-STEM stereotypes had the potential to undermine girls' and women's self-perceptions of ability, performance and interest in pursuing careers in stereotypic or masculine disciplines (Smeding, 2012). Gervais and Vescio (2012) indicated that stereotype threat can bring about patronizing behavior that showed women were stereotypically perceived to be incompetent, but warm (Fiske, Cuddy, Glick, & Xu, 2002) and pitied across many cultures (Cuddy, Fiske, & Glick, 2007). In sum, there were many possible reasons women were affected by gender inequities and underrepresentation in STEM careers.

A final area considered was in the psychology of women in STEM careers. Byrn-Doran (2012) indicated that women continue to challenge the socially constructed ideas of women's place and position in society. Women constantly struggle with work-family guilt. With this in

mind, Morgan and King (2012) conveyed that work-family conflict has been linked with important job outcomes, including stress, well-being, and performance. Moreover, additional information was needed to fully understand this phenomenon.

Background and Rationale

In 1972, Congress passed Title IX. Title IX, the Education Amendment of 1972, ensured equal opportunity in education for all students from kindergarten through postgraduate school, regardless of sex. Title IX states that:

> No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance (U.S. Department of Education).

Title IX of the Education Amendments of 1972 protects people from discrimination based on sex in education programs or activities which receive Federal financial assistance. Title IX, prohibited sexual discrimination in education. When Congress enacted Title IX, the law was intended to help women achieve equal access to all aspects of education at all levels (Hill, Corbett, & Rose, 2010). However, for the last 30 to 40 years, Title IX expanded to mostly sports followed by science and math. Critiques argued that women do not face discrimination in STEM fields but are less interested than men in certain STEM fields (Tierney, 2008; Munro, 2009).

In 1983, *A Nation at Risk* (National Commission on Excellence in Education [NCEE], 1983) established the resurgence for the science, technology, engineering, and mathematics (STEM) movement in education (Mahoney, 2010). In response to *A Nation at Risk* the National Science Foundation (NSF) proclaimed to help all Americans become literate in science, mathematics, and technology (National Science Foundation, 1996). Throughout the 1990s, professional organizations such as the National Science Teachers Association (NSTA) and the National Council of Teachers of Mathematics (NCTM), as well as researchers, employers,

university faculty, and students called for instructional innovations in science, mathematics, engineering, and technology education (AAAS, 1989, 1993; Boyer Commission, 1998; NRC, 1996; NSF, 1996).

In 2001, the No Child Left Behind Act (NCLB) was signed into law by President Bush. At that time, there was wide concern about the state of education. At the heart of NCLB were several measures designed to make gains in student achievement and to hold states and schools more accountable for student progress. The NCLB legislation placed requirements such as teacher qualifications and adequate yearly progress (AYP) and took aim at improving the education of disadvantaged students in every public school in America (Editorial Projects in Education Research Center, 2011). When the No Child Left Behind (NCLB) Act passed in 2001, teacher accountability and the quest to help all students succeed became vital in American education. Performance with subgroups such as race, ethnicity, gender, socioeconomic status, English language proficiency, and special needs was expected from the Department of Education (Moore & Shaughnessy, 2012).

Another initiative promoting STEM in American education was *The Partnership for 21st Century Skills (2004).* The goal of this initiative was to prepare American children to develop the skills they needed to compete in our global economy. *Partnership for 21st Century Skills* helped build the skill set needed for American students to succeed in STEM disciplines as well as global competition (DeJarnett, 2012). Science, technology, engineering and math (STEM) has become a part of the 21st Century skills in education. The *Partnership for 21st Century Skills* defined five essential competencies that helped employees and citizens become successful in this century. They included: adaptability, self-direction, cross-cultural skills, productivity, and leadership (Partnership for 21st Century Skills, 2004). The organization has identified the five major

interdisciplinary themes that these skills focused on: global and financial awareness, civic, health, and environmental literacy (Cash, 2011).

Additionally, in 2009, President Obama created the White House Council on Women and Girls in an effort to enhance, support, and coordinate the efforts of existing programs for women and girls (U.S. Department of Commerce Economics and Statistics Administration, July, 2011). When President Obama signed the executive order creating the Council on Women and Girls, he noted that the issues facing women today "are not just women's issues" (U.S. Department of Commerce Economics and Statistics Administration, July, 2011). President Obama's goal was to move U.S. students from the middle to the top of the pack in math and science achievement over the next decade (Executive Office of the President, 2013).

Furthermore, this vision included engaging girls and other students in math and science who were historically underrepresented in STEM education disciplines. During the same year, Obama's administration's Race to the Top 2009 competition encouraged states to develop strategies to improve achievement in STEM curricula and also expanded the participation of women and girls (Executive Office of the President, 2013). States who demonstrated efforts to address any barriers to STEM careers for women, girls, and other underrepresented groups would receive funding. In November of 2009, Obama launched *Educate to Innovate*, a campaign to expand STEM education and career opportunities for underrepresented groups, including women (Executive Office of the President, 2013).

Finally, two reports were disseminated by President Obama that shed light on the achievement of girls in math and science, underrepresentation and the earning potential of women in STEM careers. These reports were: U.S. Department of Commerce Economics and Statistics Administration *Women in STEM: A Gender Gap to Innovation* (August 2001) and U.S.

Department of Education *Gender Equity in Education* (June 2012). These reports shed light on women in the workforce and the narrowing gap in girls' participation in math and science courses respectively. In sum, President Barack Obama (2013, February) stated:

> "One of the things that I really strongly believe in is that we need to have more girls interested in math, science, and engineering. We've got half the population that is way underrepresented in those fields and that means that we've got a whole bunch of talent… that is not being encouraged… (Executive Office of the President, 2013, p.1) "

In September 2011, First Lady Michelle Obama stated:

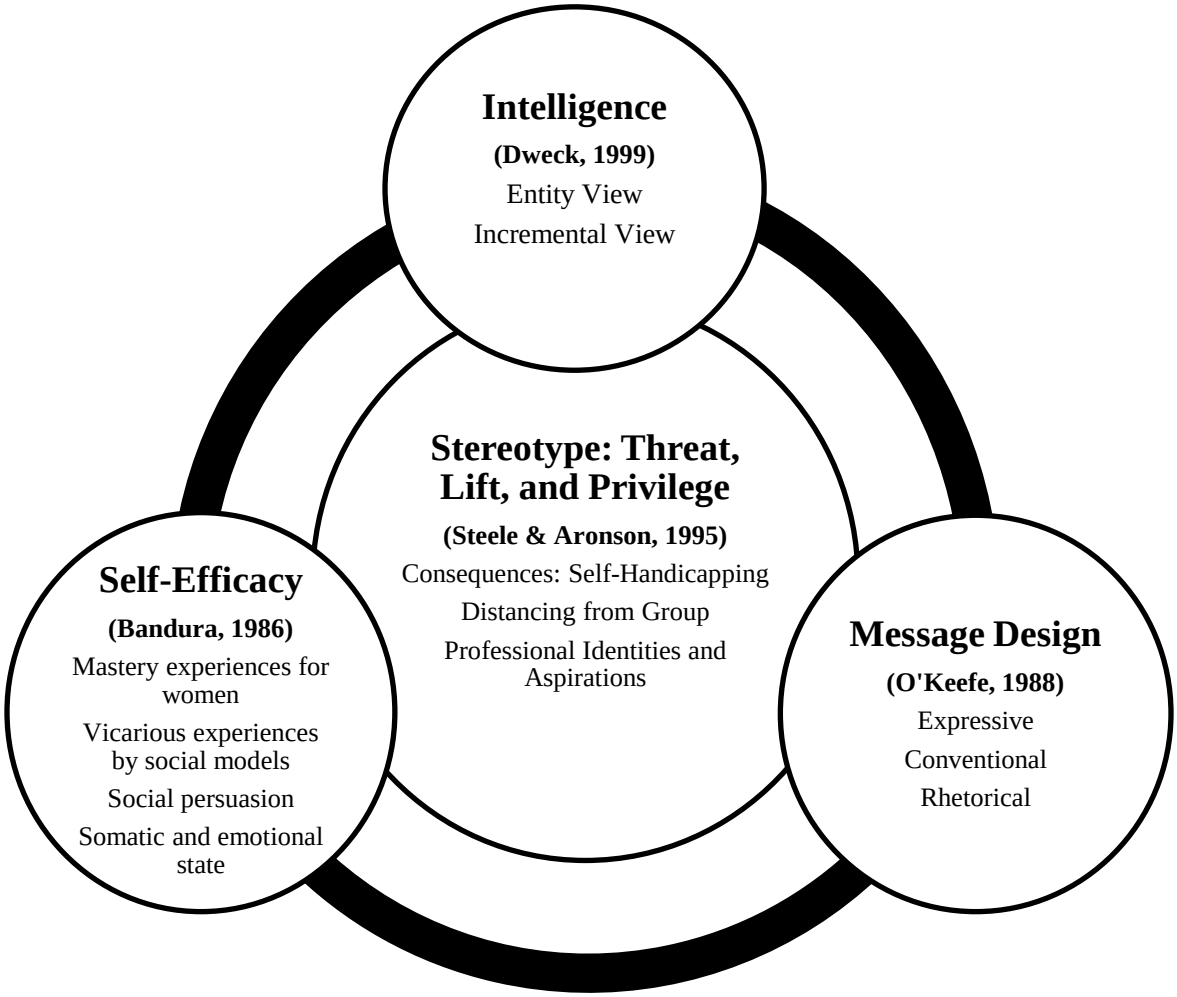
> "If we're going to out-innovate and out-educate the rest of the world, we've got to open doors for everyone. We need all hands on deck, and that means clearing hurdles for women and girls as they navigate careers in science, technology, engineering, and math." (Office of Science and Technology Policy, 2011)

To that end, President Obama understood the status of women and girls in STEM and is working to engage and support women and girls through his initiatives. These initiatives would help provide better conditions for women in the workforce, exceptional role models, mentoring and training programs that would increase the representation of women and girls in STEM.

Theoretical Framework

To gain a better understanding of the workings of this research study's theoretical framework, a visual representation is demonstrated in Figure 3. Figure 3 demonstrates the overlapping relationships between the overarching theory of Steele and Aronson's (1995) stereotype threats, Dweck's (1999) implicit theories of intelligence, Bandura's (1986) self-efficacy theories, and O'Keefe's (1988) message design logic theories.

Figure 3: Ritzdorf Model: Overlapping Theories Impacting Women in STEM Careers



The theoretical framework for this study began with Steele and Aronson's (1995) concept of *stereotype threat*. Steele and Aronson (1995) coined the term *stereotype threat* and showed through their research that individuals who performed a difficult task in an area in which their group is considered weak feel at risk of confirming the stereotype, and this psychological pressure leads them to underperform (Steele & Aronson, 1995). Stereotype threat can impair

performance in intergroup contexts, and this can include anxiety, intrusive thoughts shifting toward caution, performance expectancy, disengagement, and effort withdrawal (Gerstenberg, Imhoff, & Schmitt, 2012). Stereotypes with diverse group membership included racial, ethnic, socioeconomic, as well as gender groups (Aronson, 2004). Aronson (2004) also stated that everyone is vulnerable to stereotype threat. Along with stereotype threat, came the negative consequences for women: self-handicapping strategies, distancing one's self from the stereotyped group, and altered professional identities and aspirations (Steele & Aronson, 1995). On the other hand, Dweck's (1999) implicit theories of intelligence and the impact on women in STEM, focused on two views of ability and intelligence: the entity view and incremental view. In the research, Dweck demonstrated that self-theories affected how people believe in themselves and how these theories affected a person's psychological thoughts, feelings, and behaviors. These theories also exposed reasons that women were motivated to work while others took on self-defeating behaviors of learning.

The theoretical framework continued with the Social Cognitive Theories of Bandura (1986) and the psychology of women in STEM careers. Bandura is best known for contributions to the fields of psychology. This included the Social Learning Theory, Social Cognitive Theory, and the theoretical construct of self-efficacy. Bandura's (1971) Social Learning Theory discussed the developments of learning and suggested that learning is a cognitive process that takes place in a social context and could occur by observation of different types of modeling. From this theory, self-efficacy arose as a belief that a person could succeed in specific social situations. Bandura (1994) focused on four main sources of influence for self-efficacy; mastery experiences, vicarious experiences provided by social models, social persuasion, and somatic and emotional states.

Finally, O'Keefe's Message Design Logic (1988) theories were discussed as they currently related to women in STEM leadership positions. O'Keefe's messages reflected the implicit theory of communication that guided all communicators in their interactions. This theory suggested that there were three different views of communication. They were: expressive, conventional, and rhetorical. This study carefully developed the relevance and validated the need for the research.

Purpose of the Study

There is a plethora of literature about women who have been successful in STEM careers. The research problem for this qualitative study was the lack of evidence showing a relationship between successful women in STEM leadership positions and the impact stereotypes had in preventing women from going into or attaining success in STEM careers. The research for this study examined the connection between Steele and Aronson's (1995) stereotype threats, the influence of stereotype threat on women, the impact stereotype had on women in STEM careers, and Dweck's (1999) implicit theories of intelligence. Secondly, there was a lack of research connecting these theories to Bandura's (1986) self-efficacy theory and how it affected women's self-regulation toward STEM careers. Finally, the research for this study examined the connection with O'Keefe's (1988) Message Design Logic and messages from home, school, and/or work that encouraged or discouraged women from pursuing a STEM leadership position. The purpose for this research was to provide valuable insight and information identifying the link between these theories and successful women in leadership positions and STEM careers. Additionally, the purpose for this qualitative study was to identify the influential factors that affected women in leadership positions, specifically, STEM careers and disciplines in the education, business, medical, and political sector. The results of this research study supported a

detailed understanding of the central phenomenon of how women attained STEM leadership roles and how they retained their positions.

Research Questions

With this study the researcher investigated the influence of stereotype with the implicit theories of intelligence and the impact it had on women in STEM careers. Further, the psychology of women in STEM careers was investigated by examining self-efficacy and message design logic as it pertained to women in leadership roles. The study sought to identify the factors that influenced and affected women in leadership positions, specifically, STEM careers and disciplines, and how women attained and retained their positions. The design of this study included a participant personal narrative that was collected at the time of the one-on-one personal interview. The interview included an overarching question with three subsequent questions and subquestions which guided the interview process. A follow up question was included for closing remarks by the participants. The data was collected, professionally transcribed, and organized into a matrix for analysis that led to further discussion of the findings.

The research questions in this study began with the overarching question of: what is the impact of stereotype on women in leadership roles in STEM careers? Specifically, three research questions were addressed. The first question was: how do implicit theories of intelligence affect self-regulation in women from Midwestern metropolitan cities in STEM leadership roles regarding achievement motivation and how they attain and retain their professional STEM careers while influenced by stereotypes? The second question addressed was: does self-efficacy affect how women from Midwestern metropolitan cities in STEM leadership roles attain and retain STEM careers while influenced by stereotypes? Finally, the third question addressed was: how does message design logic from home, school, and/or work encourage or discourage women

from Midwestern metropolitan cities in STEM leadership roles toward attaining and retaining STEM careers while influenced by stereotypes?

Definition of Terms

The following list provides operational definitions of key terminology used in this study.

Attain. To reach, achieve, or accomplish one's personal goal after hard work, education, and dedication.

Achievement motivation. A particular class of goals; those involving competence, which falls into two classes: learning goals, in which individuals seek to increase their competence, to understand or master something new, and performance goals, in which individuals seek to gain favorable judgments of their competence or avoid negative judgments of their competence (Dweck & Elliott, 1983).

Entity view. The first theory of intelligence which believes intelligence is an unchangeable, fixed, internal characteristic (Dweck, 1999).

Implicit theories of intelligence. Two theories of intelligence. Entity view; which believes intelligence is an unchangeable fixed internal characteristic; and Incremental view which believes that intelligence is malleable, fluid, changeable, and can be increased through effort (Dweck, 1999).

Incremental view. The second theory of intelligence which believes that intelligence is malleable, fluid, changeable, and can be increased through effort (Dweck, 1999).

Leadership roles. Those who engage with others in such a way that leaders and followers raise one another to higher levels of motivation and morality (Burns, 1978). Examples of leadership roles include but are not limited to Chief Executive Officer (CEO), Chief Financial Officer (CFO), Vice President, or Presidential positions.

***Message Design Logic*.** The theory that suggests that there are at least three fundamentally different views of communication (i.e., Expressive, Conventional, and Rhetorical) and examines each of these as an inherently logical system for viewing the communication world, one's relations to others, and the possibilities for one's messages (O'Keefe, 1988).

Midwest metropolitan. Pertaining to a large city and its surrounding suburbs in the Midwestern states of: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Ohio, Nebraska, North Dakota, South Dakota and Wisconsin.

Retain. To hold a place in a leadership position, for the future, after attaining one's personal goal.

Self-efficacy. A self-judgment of one's ability to perform a task within a specific domain (Bandura, 1994).

Self-regulation. Demonstrating control over thoughts, feelings, motivation, and actions (Bandura, 1994).

STEM. Acronym for Science, Technology, Engineering, and Math (Teaching Institute for Excellence in STEM, 2010).

Stereotype lift. The boosting of performance in a given domain that occurs when an outgroup is negatively stereotyped (Walton & Cohen, 2003).

Stereotype privilege. The ability to counteract stereotype threat in a certain domain by those individuals who have been consistently perceived having an advantage in this certain domain, such as men in math (Johnson, Barnard-Brak, Saxon, & Johnson, 2012).

Stereotype threat. A situational experience in which underrepresented peers feel pressured by the possibility of being adversely judged by prevailing negative gender and/or racial stereotypes associated with a particular performance context (Steele & Aronson, 1995).

Leadership. Those who engage with others in such a way that leaders and followers raise one another to higher levels of motivation and morality (Burns, 1978).

Assumptions

It was assumed that each of the participants in this study was a woman, with a four year college degree in science, technology, engineering, or math and worked her way up into a leadership position in a STEM career. Additionally, the women in this study were assumed to be working full time. It was also assumed that each participant was not given her leadership position based on family relationship to the business or setting of the STEM career.

Another assumption was that the participants in this study would openly discuss their path and/or journeys to achieving success in and retaining a leadership role in a STEM career without concern for disclosure of their identities or personal information. All personal information regarding the participants' identities and information was kept confidential.

Limitations and Delimitations

The research for this study was conducted using a personal written narrative for the participants' formative years, and an interview approach during their college and current leadership positions. The first limitation for this study was that participants were asked to reconstruct their experiences based on the questions, not remembering their experiences. According to Thelen (1989) reconstruction is based partially on memory and partially on what the participant now senses is important about the past event. Another limitation was that the work location of each participant varied. This research was not limited to one specific STEM field. Female leaders in each sector of science, technology, engineering, and math had different experiences and varying amounts of education.

Another limitation was age. There was no set age limitation. Participants in this study potentially ranged in age from 30 to 65. Each participant's path to successful leadership was based on many environmental and historical factors. The final limitation was that this study was conducted in a Midwestern city and therefore cannot be generalized to the greater population.

There were two delimitations to this research. First, the research concentrated on women who have been successful in STEM related leadership positions. The study did not include the women who were in leadership positions in a STEM field, but took another path such as motherhood, part-time status, a humanities field, teaching, etc. Secondly, in the case of this research, females in engineering were not represented.

Significance of the Study

The research for this study was especially important to key stakeholders: parents, educators, employers, and policy makers. Research has shown that parents, as well as educators have an impact on girls at a young age with regard to STEM education. Employers and policy makers are influential in hiring and supporting women for STEM related leadership positions and initiatives. Through this research, it was the hope that stakeholders would be made more aware of the impact stereotype has on women's views of intelligence and self-efficacy, as well as the impact that messages have had on girls and women.

Summary

This chapter focused on the underrepresentation of women in science, technology, engineering, and math (STEM) careers and the impact that theories of intelligence and stereotype threat had on women. This chapter also focused on Social Cognitive Theories and the psychology of women in STEM careers and message design that girls and women received at home, school, and work. The purpose of the study, research questions and the background

provided the foundation of the research for this study. Chapter two continued with a review of literature that supported the need for this research.

Chapter II: LITERATURE REVIEW

The purpose of this review of literature is to examine the link between successful women in leadership positions and the gender inequities and underrepresentation of women in Science, Technology, Engineering, and Math (STEM) careers. Further, the purpose of this review of literature is to look at prior research completed in the areas of intelligence and stereotype threats as they pertain to the educational and professional impact on women in STEM careers and the influence of gender inequities for women in STEM positions. The review of the literature substantiates that there is a connection between the psychologies of women in STEM careers with theories of intelligence and social cognitive behavior. To that end, this review of literature explores how achievement motivation and self-regulation can influence leadership of women in STEM careers, as well as impact the relationship between the theory of communication theories with message design and STEM leadership success of women.

This review of literature will be divided into three distinct sections of theory. The first section will investigate the seminal studies of Steele and Aronson's (1995) stereotype threats with women, as well as the influence of Dweck's (1999) implicit theories of intelligence and the impact on women in STEM. The second section will discuss the Social Cognitive Theories of Bandura (1986) and the psychology of women in STEM careers. Finally, the third section will discuss O'Keefe's (1988) Message Design theories as they currently relate to women in STEM leadership roles. The theoretical framework for this review of literature will carefully develop the relevance for this review and validate the need for further research.

Impact on Women

This literature review begins with the theoretical framework of Steele and Aronson's (1995) stereotype threat which is the overarching premises for this research study. Along with

stereotype threat, stereotype lift, vulnerabilities associated with stereotype threat and the consequences of stereotype threat will be discussed. For the purpose of this literature review, the research on stereotype threat will focus the impact on girls and women.

Stereotype Threat

Stereotype threat (ST) is being at risk of confirming, as self-characteristic, a negative stereotype about one's group (Steele & Aronson, 1995). The term stereotype threat was first used by Steele and Aronson (1995) who showed in several experiments that black college freshman and sophomores performed more poorly on standardized tests than white students when their race was emphasized. When race was not emphasized, black students performed better and equivalently with white students. Gerstenberg, Imhoff and Schmitt (2012) indicated that stereotype threat has been identified as a pervasive phenomenon. Gersentberg et al. (2012) studied individuals with a fragile self-concept in the domain of performance and found them to be particularly vulnerable to stereotype threat. Specifically, Study 1 participants were explicitly told that their group (women) was expected to show suboptimal performance on the task at hand. Study 2 was conducted with a very subtle stereotype manipulation to reinforce the generalizability of their findings. Finally, Study 3 studied anxious worrying. This study found that a greater degree of worry was found to be responsible for the depreciation in performance of individuals.

Along with stereotype threat is another form of stereotype, stereotype lift. Walton and Cohen (2003) defined stereotype lift as the boosting of performance in a given domain that occurs when an out-group is negatively stereotyped.

According to the stereotype threat model (Steele & Aronson, 1995), individuals who perform a difficult task in an area in which their group is considered weak feel at risk of

confirming the stereotype, and this psychological pressure leads them to underperform. Performance-inhibiting thoughts or emotions, such as worry, appear to mediate stereotype effects (Steel & Aronson, 1995). In addition, Gerstenberg Imhoff and Schmitt (2012) presented research that other social groups have shown declines in performance when negative stereotypes about their group's abilities were made salient. These groups have included men (Aronson, Lustina, Good, Keough, Steele, & Brown, 1999), people from low socio-economic backgrounds (Croizet & Claire, 1998), elementary and middle school girls (Ambady, Shih, Kim, & Pittinsky, 2001), and women (Spencer, Steele & Quinn, 1999). Stereotype threat can impair performance in intergroup contexts, and this can include anxiety, intrusive thoughts, shifting toward caution, performance expectancy, disengagement, and effort withdrawal (Gerstenberg et al., 2012).

In sum, the research emphasized by Steele and Aronson (1995), as well as Gerstenberg, Imhoff and Schmitt (2012) indicated that psychological pressure such as worry and anxiety can affect the performance of all groups. Moreover, negative stereotype can make groups, especially women, feel weak and lead to underperformance. Psychological pressure for women and stereotype leads to counterintuitive performance in a male-dominated environment and this proposed research study will draw the link for the vulnerability in women in threatening situations.

Since the publication of Steele and Aronson's (1995) study, researchers have identified risk factors that increase one's vulnerability to stereotype threat (Aronson, 2004). These risks include, but are not limited to, group membership, domain identification, and group identification. Stereotype with diverse group membership include racial, ethnic, socioeconomic, as well as gender groups. Stereotype threat can be experienced by anyone in a domain in which one encounters stereotype-based expectations of poor performance (Aronson, 2004). The higher

the domain identification, the more one is bothered by implications of inferiority in that domain. Aronson (2004) stated that everyone is vulnerable to stereotype threat. These vulnerabilities can happen with diverse groups such as women in math. Johnson, Barnard-Brak, Saxon, and Johnson (2012) examined the differential effects of stereotype threat and stereotype lift between genders on math test performance. In their study (Johnson, et al., 2012) the participants were randomly assigned to three stereotyping conditions: no stereotype; stereotype lift; and stereotype threat. The students were to complete a Stereotype Vulnerability Scale (SVS) developed by Spencer (1993) to measure the degree to which an individual reports feeling threatened by a negative stereotype threat with regard to a specific domain of academic success (Johnson et al., 2012). Their findings reported that men performed better on math tests when under stereotype threat than when under no threat or stereotype lift. Women, on the other hand, performed better under no threat or stereotype lift than under stereotype threat. The study suggested that women may be aware of the negative stereotypes about their gender's performance in math (Spencer, Steele & Quinn, 1999). Wigfield and Meece (1988) stated that the difference in performance under stereotype threat has been found to be related to the negative connotations that women associate with math; namely, women felt vulnerable to the negative stereotype of women performing more poorly in math than did men. Johnson et al. discovered the concept of stereotype privilege. This concept is the ability to counteract stereotype threat in a certain domain by those individuals who have been consistently perceived having an advantage in this certain domain, such as men in math. According to Johnson et al., stereotype privilege is not a coping mechanism, but rather an offensive or counteracting measure.

In conclusion, everyone is vulnerable to stereotype threat. Group membership, domain identification and group identification increase one's vulnerability to stereotype threat. Women

perform better under no threat or stereotype lift. Women are aware of the negative stereotypes about their gender's performance, especially in math and negative connotations are associated with women performing poorly. The review of literature will continue with vulnerabilities and consequences of stereotype threat and the impact on women.

Consequences of Stereotype Threat

Along with the research of what stereotype threat is, the impact it has on social groups, plus the vulnerabilities that diverse groups have with stereotype threat, this review of literature will look at three negative consequences that stereotype threat produces for women and the effect it has on women in STEM. Stereotype threat produces a number of negative consequences for women: self-handicapping strategies, distancing one's self from the stereotyped group, and altered professional identities and aspirations (Steele & Aronson, 1995). The first negative consequence to be examined in this review of literature is self-handicapping.

Self-handicapping

Self-handicapping is a defensive strategy by which individuals erect barriers to performance to provide attributions for failure. If barriers undermine performance, individuals can point to the barriers rather than deficiencies in ability or effort (Steele & Aronson, 1995). Keller (2002) showed that girls who performed poorly on math tests under stereotype threat were more likely to raise stress they had been experiencing before the test taking and possible failure. Gunderson, Ramirez, Levine, and Beilock (2012) detail how negative stereotypes about women's math abilities are transmitted to girls by their parents and teachers, shaping girls' math attitudes and ultimately undermining performance and interest in science, technology, engineering, and math (STEM) fields. According to Gunderson et al. (2012) parents and teachers often put their own anxieties and beliefs about math ability onto children from a very young age. This may have

a significant impact on children, especially girls. Girls may choose not to pursue math coursework, and therefore, fewer women going into math careers.

Distancing

The next negative consequence to stereotype threat is *distancing* one's self from the stereotyped group. Steele and Aronson (1995) convey that distancing can occur when one experiences collective threat, threat that arises when one observes another group member who might confirm a group stereotype. Collective threat can produce lowered self-esteem and greater distancing (both physically and psychologically) from ingroup members who might confirm a stereotype that applies to the self (Cohen & Garcia, 2005). Shapiro and Williams (2012) discussed self-as-source stereotype threats. When in this stereotype situation, one's performance has the possibility of confirming, in one's own mind, that the stereotype is true of one's own, or the group's abilities. Shapiro and Williams (2012) continue with, by virtue of gender, a girl may feel an inadequate performance on a math test and in her own mind feel that women (as a whole) are less competent in STEM domains compared to men. For self-as-source threats to emerge, a woman must feel that there is some possibility that the stereotype could be true (Shapiro & Neuberg, 2007; Shapiro, 2011). In sum, stereotyped individuals distance themselves from any facet of their social group uniqueness that could bear the affliction of a negative stereotype, thus producing stereotype threat.

Professional identities and aspirations

In addition to self-handicapping and distancing from a stereotyped group, Steele and Aronson (1995) discuss the impact of altered *professional identities and aspirations*. Research has shown that stereotype threat can affect stereotyped students' professional identities by redirecting their path for college and career (Steel & Aronson, 1995). Shapiro and Williams

(2012), report that in addition to hindering performance, stereotype threat can also negatively influence career aspirations in women. The report by Shapiro and Williams (2012) continues to state that women in the stereotype threat condition were less likely to report interest in quantitative majors and STEM career paths (e.g. engineering, mathematician, computer science, statistics, accountant, physics) compared to verbal majors and career paths (author, linguistics, journalist, communications, political science, editor). In a recent study, "Why They Leave: The Impact of Stereotype Threat on the Attrition of Women and Minorities from Science, Math, and Engineering Majors" by Beasley and Fischer (2012), attrition of women and minorities from STEM majors was examined. The researchers focused on the impact of stereotype threat and the anxiety caused by the expectation of being judged based on a negative group stereotype. Beasley and Fischer (2012) also focused on whether or not the reputation of math, science, and engineering was a hostile environment for minorities and women that may provoke these students to ultimately withdraw from STEM majors. Steele, James, and Barnett (2002) found that undergraduate women in male-dominated fields had stronger perceptions of discrimination toward themselves and other women than did women in other disciplines.

Theories of Intelligence

This literature review continues with Dweck's (1999) implicit theories of intelligence and the impact on women in STEM. Dweck, social psychologist, has identified two theories of intelligence, or self-theories. These theories or views on ability and intelligence are the entity view and the incremental view (Dweck, 1999). Dweck's empirically-based studies investigate how people believe in themselves, self-theories and how these self-theories affect their psychological thoughts, feelings, and behaviors. These theories expose the reasons why some

students, or women, are motivated to work to the best of their ability and why other students take on self-defeating behaviors of learning.

Dweck (1986) completed a study of motivation and motivational patterns. Through these studies, Dweck identified achievement motivation as it involves a particular class of goals. These goals fell into two classes of competence: learning goals and performance goals. The first, learning goals, is defined as individuals who seek to increase their competence to understand or master something new (Dweck, 1986). The second, performance goals, in contrast is defined as individuals who seek to gain favorable judgments of their competence or avoid negative judgments of their competence (Dweck & Elliott, 1983). In the literature, further exploration will reveal the differences the entity view and incremental view demonstrate and the impact that they have on women in STEM.

Entity View Theory

The first theory of intelligence is the entity view theory. The entity view theory identifies intelligence as being an unchangeable, fixed internal characteristic (Dweck, 1999). Dweck (2007) stated that students with this fixed mind-set become excessively concerned with how smart they are. Students care most about how they will be judged: smart or not smart. Dweck, (2006) specified further that people who are consumed with the goal of proving themselves in the classroom, in their careers, and in their relationships call for confirmation of their intelligence, personality, or character. “Will I succeed or fail? Will I look smart or dumb? Will I be accepted or rejected? Will I feel like a winner or a loser?” (p. 6). As a result, those with an entity view are more likely to engage in behaviors that will give them face-saving excuses for poor performance (Hong, Chiu, Dweck, Lin, & Wan, 1999). Those behaviors included withdrawing effort, procrastination, absenteeism, and avoiding situations and activities that

would jeopardize their chances for success. Entity view individuals often have an excuse for failure. They feel dumb. Furthermore, Hong et al. (1999) indicated that there is growing evidence that entity theory of intelligence fosters defensive behavior, behavior designed to ward off meaningful failure. Entity theorists tend to be more concerned with besting others in order to prove their intelligence ("performance goals"), leaving them highly vulnerable to negative feedback (Chiu, Hong, & Dweck, 1997). Moore and Shaughnessy (2012) acknowledged that entity theorists see intelligence as a person's skill and knowledge. Further, these individuals are more likely to shun learning opportunities where they anticipate a high risk of errors, or to disengage from situations when errors occur. Women holding this view could see themselves as less intelligent, skilled or knowledgeable and could possibly shun opportunities for careers (Moore & Shaughnessy, 2012).

Additionally, Good, Rattan, and Dweck (2012) conducted several studies in which investigated why women shun or opt out of math-based disciplines, such as physics or engineering. Their studies focused on the sense of belonging or one's feeling of membership and acceptance in the math domain. Study number 3, students' perceptions, included the critical message that math ability is a fixed trait. This stereotype message established that women have less of this ability than men and, therefore, eroded women's, but not men's, sense of belonging in math. Good et al. (2012) stated that when the sense of belonging is reduced, individuals such as women may opt out of the domain to pursue studies and professional goals within different disciplines. Additional research (Steele & Aronson, 1995; Good, Aronson, & Harder, 2008; & Spencer, Steele, & Quinn, 1999) has shown that ability impugning stereotypes can trigger psychological processes that can undermine the performance of stereotyped individuals, including females in math. Furthermore, Good, Rattan, and Dweck (2012) emphasized that the

sense of belonging is a critical component affecting representation within an academic discipline, and the long-term effects of negative stereotypes combined with messages of fixed ability have not been well studied.

In a study by Blackwell, Trzesniewski, and Dweck (2007), research focused on students' own theory of intelligence as predictors of their achievement and has repeatedly shown that when students hold an entity view of intelligence, they are at risk for decreased achievement, especially when facing a challenge. Dweck's (1999) results from her social-cognitive studies emulate those results in achievement and motivation in that students who see their abilities as fixed, entity theorists, will not achieve as much success as those who see their abilities as malleable and changeable as an incremental theorist would see. Entity theorists are susceptible to learned helplessness because they may feel that circumstances are outside their control and give up easily (Dweck, 1999). This fixed mind-set can cause many bright students to stop working in school when the curriculum becomes challenging (Dweck, 2007). Students with fixed mind-set decrease their efforts and consider cheating (Blackwell et al., 2007).

Where do women fit into this mind-set? According to Halvorson (2011), smart and talented women rarely realize that one of the toughest hurdles they have to overcome lies within themselves. As young girls, Halvorson (2011) believed that smart girls are more vulnerable and less confident even at a 5th grade level. Girls at this level routinely outperform boys in every subject, including math and science, but the difference was how girls and boys interpreted difficulty in learning material (Dweck, 1986). Halvorson (2011) indicated that bright girls were much quicker to doubt their ability, lose confidence, and become less effective learners. Halvorson (2011) expounded on the research that bright girls believe that their abilities are innate

and unchangeable, while bright boys believe that they can develop ability through effort and practice.

In a study by Litmanovitz (2011), the problem with women in educational leadership was explored. Litmanovitz (2011) discovered that men have dominated leadership positions because of society's view on the characteristics of effective leaders. The research has shown that public officials do not associate character traits that are possessed by women with leadership ability. Therefore, women are not encouraged to pursue leadership opportunities. These implicit biases that masculinity is required for effective leadership remain a stereotype in the workplace. Litmanovitz (2011) continued to explain that women who might make great leaders may not even see themselves in a leadership role, and therefore, will not pursue leadership positions.

Through her research, Dweck also investigated how self-concept affects student achievement, motivation, goal-setting, and sense of intelligence (Moore & Shaughnessy, 2012). Korpershoek, Kuyper, van der Werf, and Bosker (June, 2011) discussed the underlying theory of achievement motivation and state that achievement is the result of conflict between two needs: striving for success and avoiding failure. Can people's beliefs and mind-set be changed? Is this a personality trait or are there other factors that affect intelligence and achievement? This will be explored further in Dweck's (1999) second theory of intelligence.

Incremental View Theory

Dweck's (1999) second theory of intelligence is the incremental view theory. People with the incremental view theory have the belief that their intelligence is malleable, fluid, changeable, and can be increased through effort (Dweck, 1999). These students see satisfaction coming from the process of learning and often see opportunities to get better. In a separate study, Mangels, Butterfield, Lamb, Good, and Dweck (2006) identified that incremental theorists

are more likely to endorse the goal of increasing ability through effort and are more likely to gravitate toward tasks that offer real challenges ("learning goals"). They do not focus on what the outcome will say about them, but what they can attain from taking part in the venture (Dweck, 1999). Children who believe their intelligence is malleable achieve to improve the quality of their intelligence. These children tend to choose tasks that are challenging and that foster learning (Moore & Shaughnessy, 2012). They view intelligence as a person's potential.

Furthermore, Blackwell, Trzesniewski, and Dweck's (2007) study has shown that students who believe their intelligence is malleable have higher levels of achievement than those who believe it is fixed. When these students make a mistake or exhibit a deficiency, they correct it (Blackwell et al., 2007). For them, effort is a positive thing. It ignites their intelligence and causes it to grow. These students escalate their efforts and look for new learning strategies (Dweck, 2007). Those with an incremental view, when faced with failure, react differently: they desire to master challenges and, therefore, adopt a mastery-oriented pattern (Dweck, 1999). Good, Rattan, and Dweck's (2012) research explored messages women may hear in their math environment. Their findings supported that the more women perceived fixed-ability environments and high gender stereotyping the more they were susceptible to lowered sense of belonging. Whereas, the more women perceived malleable-ability environments the more they maintained a sense of belonging to math even when they perceived their environments as highly gender stereotypical. By reviewing Dweck's work, educators and parents can gain valuable knowledge about increasing their students' achievement.

Dweck has also applied her achievement and motivation theories to the concepts of stereotype formations in children and adults and found that entity theorists believed more stereotypes and were more rigid in their judgments concerning changes of stereotyped behavior

(Moore & Shaughnessy, 2012). Levy, Stroessner, and Dweck (1998) found that peoples' implicit theories about the fixedness versus malleability of human attributes predict differences in degree of social stereotyping.

Continuing with the research study by Levy, Stroessner, and Dweck (1998) five experiments were conducted to support peoples' implicit theories about the permanency versus malleability of human attributes (entity versus incremental theories). This study was conducted to predict differences in the degree of social stereotyping. Experiment 1 participants generated stereotypes of several ethnic groups and indicated how much they believed in these stereotypes. Experiment 2 focused in greater detail on perceptions of African Americans. Experiment 3 addressed differences in the formation of stereotypes. Experiments 4 and 5 were designed to assess whether implicit theories play a causal role in level of stereotyping, and assess the extent to which implicit theories predict unique variance in level of stereotyping. Levy, et al. (1998) found that people holding an entity theory view made more stereotypical trait judgments of ethnic and occupational groups and formed more extreme trait judgment of novel groups. Further, entity theorists appear more likely than incremental theorists to engage in a key process implicated in stereotyping: They tend to make more extreme trait judgments (both positive and negative) of a target person from limited social information (Erdley & Dweck, 1993). In addition, entity theorists, relative to their incremental counterparts, have been found to draw strong trait judgments even when situational information (i.e. external pressures acting on a person) and psychological process information (e.g. a target's thoughts, intentions, goals, emotion states) are made salient (Erdley & Dweck, 1993).

In summary, stereotype threat is a characteristic that can impair performance of social groups and make them feel inferior. This inferiority can cause psychological pressures and lead

one to feel vulnerable and underperform in school, work and social domains. The consequences of stereotype threat include self-handicapping, distancing, and altering professional identities and aspirations. The review of literature supported that women ultimately withdraw from situations that they feel discriminated against.

The research of Dweck's (1999) implicit theories of intelligence and the impact on women in STEM show evidence that can affect women in science, technology, engineering and math (STEM). Dweck's (1999) theories support the idea that achievement motivation has an effect on learning goals and performance goals. Further, Steele and Aronson's (1995) research on stereotype threat has shown that vulnerable social groups are impacted. These groups include low socio-economic backgrounds, elementary and middle school girls, men, and women. This phenomenon will lead further to the review of literature on the psychology of women in STEM careers and the affect it has on the leadership of women.

Psychology of Women in STEM Careers

The review of literature continues with the psychology of women in science, technology, engineering and math (STEM) careers by examining the relationship of the social cognitive theories of Bandura. Psychologist, Bandura (1986), is best known for his contributions to the fields of psychology including Social Learning Theory, Social Cognitive Theory, and the theoretical construct of self-efficacy. Bandura's theories were first introduced to the psychology world in 1963 when he introduced *Social Learning Theory*. Bandura's theory focused on people's behaviors and why they behave in a particular manner. Bandura's (1971) social learning theory discussed the developments of learning and suggested that learning is a cognitive process that takes place in a social context and can occur by observation of different types of modeling. Bandura's (1971) theory placed emphasis on the roles played by vicarious, symbolic,

and self-regulatory processes. Bandura's ideas on behaviorism continued with the elements of cognitive control through the learning process (Bandura, 1977). He introduced the idea of reciprocal determinism which revealed that an individual's behavior is influenced by their environment and the environment is influenced the individual's behavior. Bandura's social learning theory then took on a name change (Bandura, 1986). The name change was meant to help distinguish his theory from other theories. Bandura (1986) changed the name of his theory to social cognitive theory. From this theory, self-efficacy arose as a belief that a person can succeed in specific social situations. This theory will be discussed further as a specific component to the social cognitive theory.

Self-Efficacy

Bandura's (1994) theory on self-efficacy determines how people feel, think, motivate themselves and behave. Bandura's theory includes the processes of cognitive, motivational, affective, and selection processes. According to Bandura (1994), people who have a strong sense of efficacy and personal well-being foster intrinsic interests and deep engrossment in activities. They set challenging goals for themselves and uphold a strong commitment to them. Bandura's research stated that people with a strong self-efficacy are able to sustain their efforts in the face of failure and quickly recover their sense of efficacy after failures or setbacks. In contrast, people with low self-efficacy doubt their capabilities and shy away from difficult tasks which they view as personal threats. Bandura stated that people with a low self-efficacy have low aspirations when faced with difficult tasks. They dwell on their personal deficiencies, obstacles they will encounter, and the adverse outcomes. They are slow to recover their sense of self-efficacy and fall victim to stress and depression. Bandura focused on four main sources of influence for self-efficacy; mastery experiences, vicarious experiences provided by social

models, social persuasion, and somatic and emotional states. The review of literature will further detail each source in relationship to the psychology of women.

Mastery Experiences for Women

Bandura's (1994) explanation for mastery experiences starts with the belief in one's personal efficacy. Overcoming obstacles and determination helps one emerge stronger from adversity. Women rely on coping efficacy (Morganson, Jones, & Major, 2010). Morganson et al. (2010) examined coping efficacy and social coping to explain the gender gap in science, technology, engineering, and math (STEM) education. The relationship commitment to a STEM major for men versus women was also examined. This study was conducted by email invitations to undergraduate students from two urban universities in the eastern United States. The report stated that women undergraduates reported using significantly more social coping than did men. In the study by Morganson et al. (2010), the goal of the research was to help explain the underrepresentation of women in STEM fields and to provide guidance for career development. Scholars have identified numerous barriers to the success and persistence of women in STEM curricula, including lack of viable mentors, the glass ceiling effect, and low self-efficacy (Camp, 2002; Litmanovitz, 2011; Margolis & Fisher, 2002). How do these barriers affect women entering college or the job market? Can women's underrepresentation in STEM careers be explained? The review of literature will continue with a detailed discussion of the barriers to success and persistence of women in STEM.

Viable mentors

Camp (2002) reported that many young women enter college without viable mentors and role models than can encourage females to enroll in math and computer science courses. Jackson (2013) stated that mentee-mentor relationship has a positive impact on a female's decision to

pursue STEM majors. Jackson also acknowledged that this positively impacted the self-efficacy of women in STEM. Jackson's (2013) report elaborated that encouragement from both home and school helped to develop self-confidence in women. Teachers, counselors, and others who work in educational settings had a critical influence on women who aspire to be in STEM careers. The Camp (2002) report also included information that advanced female students make good candidates for mentors and women and girls are best mentored by women. In sum, successful women in STEM understand the importance of mentee-mentor relationships (Jackson, 2013) and the research from the proposed study will further validate the impact it has on women.

Glass ceiling effect

The *glass ceiling effect* is a socially-mediated factor that has emerged in social science research and higher education over the past 20 years (Jackson & O'Callaghan, 2009). The term glass ceiling was first coined to describe the experiences of women in corporate America. The glass ceiling phenomenon was an obstacle for women to overcome. The glass ceiling prohibited the advancement of women and people of color in the workplace. Jackson and O'Callaghan (2009) described the obstacle that women and people of color encounter in their quest for career advancement or senior-level positions (e.g. CEOs) in society as glass ceiling effects. Jackson and O'Callaghan's analysis procedure for this study was focused on three fields or disciplines of study. The areas concentrated on were education, business, and social sciences. The results from education drew contradictory conclusions about how the glass ceiling functioned. Jackson and O'Callaghan's report for education found that there were various forms of the glass ceiling effect. In education, the glass ceiling effect was more in the form of racial factors affecting rank among faculty (Ards, Brintnall, & Woodard, 1997), salary discrepancies between males and females (Ginther & Hayes, 1999), the brevity of careers for female faculty causing inequalities

(Bain and Cummings, 2000), and pay differences due to years worked, not gender bias (Fisher, Motowidlo, &Werner, 1993). Business focuses included how the organization was organized, as well as salary and wage differences (Jackson & O'Callaghan, 2009). The results indicated women are not given the same amount of responsibility or supervisory tasks as males (Ohlott, Ruderman, & McCauley, 1994). Finally, Jackson and O'Callaghan (2009) reported on the social sciences and the effect of the glass ceiling. This area concentrated on gender with race or ethnicity coupled with promotions and organizational characteristics. The results from this area indicated that the glass ceiling is a unique and identifiable form of discrimination (Cotter, Hermsen, Ovadia, & Vanneman, 2001).

Bandura's (1994) idea of mastery experiences stated that if people persevere through tough times, they would emerge stronger from adversity. Hence, mastery experiences begin with belief in one's personal efficacy. Scholars have found other barriers such as the lack of viable mentors and the glass ceiling phenomenon as areas that impede women and people of color in career advancement (Jackson & O'Callaghan, 2009). The review of literature continues with Bandura's second source of influence for self-efficacy, vicarious experience by social models.

Vicarious Experiences by Social Models

Bandura's (1994) second way of creating and strengthening self-beliefs of efficacy is through the vicarious experiences provided by social models. Seeing people similar to oneself succeed raises the belief that they too can succeed. Bandura (1994) was referring to modeling influences. In a study by McIntyre, Paulson, Taylor, Morin, and Lord (2011), the research examined how thinking about role models can be used as an effective intervention into stereotype threat. According to Bandura (2000), individuals may look to proxy agents (direct role models to which they compare) or to collective agents (in-groups) to help restore or create

feeling of efficacy when available components of self-efficacy have been threatened or reduced. Proxy, "if she/he can do it, so can I", and collective, "my group can do it" (McIntyre et al., 2011, p. 301). Research by Litmanovitz (2011) was conducted on women in leadership positions. Litmanovitz (2011) reported that there was a gender gap because of a lack of role models, a lack of leadership stereotypes, and a lack of a pipeline for teachers in education. In summary, vicarious experiences by social models is a way for oneself to succeed. Role models can be an effective agent to stereotype threat, thus help to restore self-efficacy.

Social Persuasion

The third way of strengthening people's self-efficacy beliefs is with social persuasion. Social persuasion is the belief that you have what it takes to succeed. Bandura (1994) stated that people who are persuaded verbally that they possess the competencies to master activities are more likely to put forth greater effort and sustain it. This promotes personal efficacy. Bandura (1986) specified that positive social appraisals have their greatest impact when challenges are structured in graduated steps that are likely to bring success. Bandura (1986) continued with self-beliefs of efficacy can be altered by changing physiological states that are read as signs of strength and personal vulnerability. Bandura (1994) goes on to say that people who have been persuaded that they lack capabilities tend to avoid challenging activities and give up quickly. These people create situations that bring them success. In a study by VonHippel, Issa, Ma, and Stokes (2011), stereotype threat and its consequences for working women were examined in an Australian law firm. VonHippel et al., (2011) found that women who engage in social comparisons with men were more likely to experience increased feelings of stereotype threat compared to women who do not engage in these comparisons. How does social persuasion affect

women? This question will continue to be investigated in Bandura's (1994) fourth way of creating and strengthening self-beliefs, somatic and emotional state.

Somatic and Emotional State

The final area for strengthening a person's self-efficacy is through somatic and emotional state. People in this area interpret their stress reactions and tension as a sign of vulnerability to poor performance (Bandura, 1994). People judge any activity that involves strength and stamina as fatigue. Aches and pains as are viewed as a physical debility. Bandura (1994) stated that people in this category rely on their somatic and emotional states in judging their capabilities. Positive and negative moods and how they were perceived and interpreted were mentioned as a means of modifying self-beliefs.

Cadinu, Maas, Rosabianca, and Kiesner (2005) conducted a study on why women underperform while under stereotype threat. Canindu et al. (2005) tested a group of women completing a difficult math test under stereotype threat or in a no-threat condition. Anxiety was focused on with self-efficacy and intrusive thought process. Canindu et al. (2005) found that anxiety plays a role in anxiety-related cognitive deficits. Specifically, preoccupation with regards to one's performance or a sense of inadequacy was expected. Another study by Beasley and Fischer (2012) examined on the impact of stereotype threat on the attrition of women and minorities from STEM majors. The focus was on group performance anxiety. Beasley and Fischer (2012) researched whether the reputation of STEM was a hostile environment for women and minorities and if it led to attrition. Support from Beasley and Fischer's (2012) research reinforced that minority and/or female status increased the likelihood of STEM attrition. Lastly, Cheema and Galluzzo (2013) analyzed the existence of persistent racial and socioeconomic gaps

in math achievement. Their studies showed that both anxiety and self-efficacy contributed significantly toward variations in math achievement.

In summary, Bandura's (1994) theory on self-efficacy determines how people feel, think, motivate themselves and behave. Bandura's (1994) four main sources of influence for self-efficacy include mastery experiences, vicarious experiences, social persuasion and somatic and emotional states. The review of literature supported the effect that self-efficacy has on the psychology of women in STEM careers and will continue to examine women in STEM leadership roles with message design theory.

Women in STEM Leadership Roles

The review of literature continues with women in STEM leadership roles and communication theories with message design. Communication helps us to understand and interpret how individual's verbal messages are delivered. Teachers use verbal communication to articulate expectations, show care for students, and encourage discussion of specific content knowledge (Forrest, 2008). Employers use communication to accomplish goals with their employees. Communication at home may include conflict with work-family guilt that has been linked with important job outcomes, including stress, well-being, and performance. Communication will be explored further with O'Keefe's Message Design Logic (1988).

Message Design Logic

In 1988, O'Keefe introduced the theory of Message Design Logic (O'Keefe, 1988). O'Keefe's (1988) theory assumes that communication is a goal-directed process. Communicators produce messages that are designed to meet objectives and gain insight to the goals of the other person. In a study by Edwards, Rose, Edwards, and Singer (2006) social support and loneliness are considered important factors to a person's social well-being. According to Edwards et al.

(2006), an important determinant of an individual's levels of social support and loneliness is their implicit theories of communication. O'Keefe's (1988) messages reflect implicit theory of communication that guides all communicators in their interactions. This theory suggested that there are three different views of communication. Each of these views has a logical system for the way we communicate, our relations with one another, and the possibilities for messages and their interpretations. O'Keefe's (1988) beliefs were that these three logics are hierarchically ordered. The three types of message design logic are: expressive, conventional, and rhetorical. The first message design to be discussed is expressive message design.

Expressive message design logic

Expressive message design logic refers to the simplest form of message production. O'Keefe (1988) stated that communication in this view is primarily "a process in which persons express what they think or feel so others will know what they think or feel" (O'Keefe, 1988, p.85). Hart (2002) indicated that successful communication hinges on the conversational partner(s) understanding one's viewpoints. Hart reported that good communication is clear communication. People with this view are very literal (O'Keefe, 1988). Hart stated that individuals using the expressive design logic often face a choice between telling the entire truth or withhold parts of it. They have to decide whether to be honest, the ethically correct choice, or to lie or revise the truth. Hart (2002) continued to note that these communicators take pride in saying what they think, are recognized for wearing their hearts on their sleeves, and are up front with people. Forrest (2008) conveyed that individuals using this logic believe listeners will understand the message provided that they speak openly, directly, and clearly. Forrest (2008) continued by reporting that in the math classroom a teacher who uses expressive design logic reacts to a student's question by stating his or her immediate thoughts. These thoughts will focus

more on the teacher's thinking, not the student's thinking. Forrest (2008) stated that a teacher will repeat what was said earlier in an attempt to be clearer with their communication. This leads us to the second message design logic, conventional message design.

Conventional message design logic

The primary purpose of conventional message design logic is to build an understanding that communication is a cooperative game to play, with socially conventional rules and procedures (O'Keefe, 1988). Conventional message design logic is the most common message design logic individuals use in conversations (Lambert & Gillespie, 1994; O'Keefe & McCornack, 1987; Peterson & Albrecht, 1996). People using this logic work to accomplish goals based on defined roles, identities, and situations (Hart, 2002). Forrest (2008) reported that communicators who employ this message design logic try to say things they believe are appropriate and meaningful for the situation. In a math classroom, teachers using conventional message design focus on conventional practices for communicating with the students. Teachers listen and evaluate students' responses and then the teacher says what is needed to move students in the appropriate direction. According to Forrest (2008) this communication is more purposeful and guided by conventional rules for communicating, though it may not necessarily address the students' needs or questions. The review of literature continues with rhetorical message design.

Rhetorical message design logic

The third message design is rhetorical message design. Of the three message designs, rhetorical is the most elaborate and most difficult to achieve. Rhetorical message design is based on the belief that "communication is the creation and negotiation of social selves and situations" (O'Keefe, 1988, p. 87). Persons employing this message design realize that the intended meanings of his or her messages are not fixed, but are part of the social reality being created with

others (Forrest, 2008). With rhetorical logic, communication is fluid and flexible, and situations are negotiated (Hart, 2002). Messages are proactive, rather than reactive. Rhetorical logic tries to create ways that allow for problem-solving. According to Forrest (2008), rhetorical communicators use language to transform situations to be more motivational and give redirections of the context so that goals are achieved. Forrest (2008) elaborated that communicators using rhetorical message design logic will modify their language so that listeners can interpret and be motivated to give acceptable responses. In a math classroom, the teacher focuses on student thinking and encourages discussion to help the student reach mathematical understanding.

Message design logic has three distinct theories or views of communication. Those views include: expressive message design logic, conventional message design logic, and rhetorical message design logic. Expressive message design logic is the simplest form of communication and helps a person think or feel when communicating with others. These people are very literal. Conventional message design logic is a communication theory that is used to accomplish goals, and has defined roles and is purposeful. Lastly, rhetorical message design logic is based on communication that is fluid and flexible and communication situations are negotiated. Rhetorical communicators allow for problem-solving and modify their language to reach acceptable answers in the classroom.

Summary

The research theories in this review of literature focused on implicit reasons why women are underrepresented in science, technology, engineering, and math leadership roles. Those reasons included Dweck's (1999) implicit theories of intelligence which included the entity view theory and incremental view theory of intelligence, as well as Steele and Aronson's (1995)

stereotype threats with women. Steele and Aronson's (1995) theory focused on stereotype threat and the consequences associated with the impact on social groups, plus the vulnerabilities for each diverse group. Those consequences included self-handicapping, distancing, and the impact of altered professional identities and aspirations. The phenomenon of intelligence and stereotype threat was shown to have an effect on the psychology of women in STEM careers.

The review of literature continued with the psychology of women in STEM careers by examining the relationship of social cognitive theories of Bandura (1869). From Bandura's (1971) Social Learning Theory, self-efficacy was born. Self-efficacy included four main sources of influence; mastery experiences, vicarious experiences provided by social models, social persuasion, and somatic and emotional states. Discussion included the impact of viable mentors and the glass ceiling effect for women. Finally, the review of literature focused on O'Keefe's (1988) Message Design Logic and communication theories. These theories included: expressive message design logic, conventional message design logic, and rhetorical design logic. The proposed study seeks to examine the effects of these theories on the leadership roles of women in STEM careers and how they have attained and retained their positions.

Chapter III: METHODOLOGY

The research design for this study was a qualitative study method. Creswell (2013) stated that to study a problem, qualitative researchers use an emerging qualitative approach to inquiry, the collection of data in a natural setting sensitive to the people and places under study, and data analysis that is both inductive and deductive and establishes patterns or themes. Corbin and Strauss (2008) also identified that another important reason to conduct qualitative research is the desire to step beyond the known and enter into the world of participants, to see the world from their perspective and in doing so make discoveries that will contribute to the development of empirical knowledge.

The qualitative strategy used for this research was a phenomenological method. Creswell (2014) described phenomenological research as inquiry coming from philosophy and psychology in which the researcher described the lived experiences of individuals about a phenomenon as described by participants. Creswell (2013) stated that phenomenologists focus on describing what all participants had in common as they experienced a phenomenon. Through this study, the researcher examined common lived experiences of the participants attaining and retaining their leadership positions. Phenomenology has a strong philosophical component to it (Creswell, 2013). Based on the findings in the literature review from chapter two, the philosophical and psychological components shared by the participants were explored through the participants' descriptions of lived experiences with stereotypes, intelligence, self-efficacy and message design as it pertained to current STEM leadership positions held by the participants in this study.

Research Questions

The research for this study investigated the influence of stereotype with the implicit theories of intelligence and women in STEM careers. Further, the psychology of women in

STEM careers were investigated by examining self-efficacy and message design logic as it pertained to women in leadership roles. The study sought to identify the factors that influenced and affected women in leadership positions, specifically, STEM careers and disciplines, and how women attained and retained their positions.

The research questions in this study began with the overarching question of: what is the impact of stereotype on women in leadership roles in STEM careers? Specifically, three research questions were addressed. The first question was: how do implicit theories of intelligence affect self-regulation in women from Midwestern metropolitan cities in STEM leadership roles regarding achievement motivation and how they attain and retain their professional STEM careers while influenced by stereotypes? The second question addressed was: does self-efficacy affect how women from Midwestern metropolitan cities in STEM leadership roles attain and retain STEM careers while influenced by stereotypes? Finally, the third question addressed was: how does message design logic from home, school, and/or work encourage or discourage women from Midwestern metropolitan cities in STEM leadership roles toward attaining and retaining STEM careers while influenced by stereotypes?

Participants

The participants for this study were women from Midwestern metropolitan cities in science, technology, engineering, and math (STEM) leadership roles. The women for this study were recruited from top-ranking females in their organizations who were in leadership positions that included, but were not limited to, Chief Executive Officer, Chief Financial Officer, Vice President, President, or executive-level positions. Major community and professional employer lists from local Chambers of Commerce were utilized to identify women in leadership roles in health care, education, technology, engineering and collegiate institutions. Inclusion criteria

Table 1

Demographic Data of the Participants

Participant	Strand of STEM	Degree	Year of Degree	Years of Experience in Current Position and Title
Cindy	Science	B.S. Health Administration B.S Nursing M.S. in Public Health Admin Ph.D. Healthcare Administration	1986 1988 1993 1999	8 Years Vice President and Chief Operating Officer
Shelly	Science	Doctor of Pharmacy	2007	4 Years Healthcare Business Partner
Barbara	Math	B.S. Math & Business M.B.A.	1968 1969	42 Years Senior Vice President and Manager of Private Banking
Janice	Math	B.S. Accounting	1986	7 Years Chief Financial Officer
Maggie	Technology	B.S. Masters Science Economics M.B.A. Economics	2001 2003 2005	3 Years Executive Director of Infrastructure and IT Security
Mary	Technology	B.S. Management Information Systems	1998	16 Years Technical Project Administrator
Laurie	Technology	Associate in Computer Science B.S. Strengths Based Management	1998 2004	16 Years Director of Software Development

for the participants included having a Bachelor's degree or higher in one of the STEM disciplines. Table 1 illustrates in more detail the demographic data regarding the participants.

Sample

A criterion sampling of women from Midwestern metropolitan cities in science, technology, engineering, and math (STEM) leadership roles were used for this interview procedure and the collection of the data. Seidman (2013) detailed that there were basic assumptions underlying an interview study by stating that an interview is different than an experimental study, therefore, selecting participants is approached differently. Creswell (2013) stated that criterion sampling works well when all individuals studied represent people who have experienced the phenomenon. Seven women in STEM leadership roles were interviewed. Each specified strand of STEM, with the exception of women in engineering leadership roles, was represented. To protect the identities of the participants, the participants were identified as Cindy, Shelly, Barbara, Janice, Maggie, Mary, and Laurie. Specifically, two women came from science leadership positions, two from math leadership positions, and three from technology leadership positions. Qualified female engineers in leadership positions were not represented. Creswell (2014) specified that with a phenomenological study, three to ten participants is a qualified number to interview. Seidman (2013) stated that people must reflect on their experience and give the details of their experience a beginning, middle, and an end. Seidman (2013) continued by declaring that the process of selecting constitutive details of experience, reflecting on them, giving them order, and thereby making sense of them is what makes telling stories a meaning-making experience. Based on the analysis of the seven participants, four common themes with corollary subthemes emerged from the personal narratives and the interview process with each of the participants. The saturation level was achieved in relationship to the research questions (Creswell, 2014). Had saturation not been met, additional participants would have been recruited.

Setting

The setting for the data collection occurred in a familiar setting of the participant's choice. Creswell (2013) contended that qualitative researchers often collect data at the site where participants experienced the issue or problem under study. Creswell (2013) also stated that in the natural setting, the researchers gather up close information by actually talking directly to people and seeing them behave and act within their context. Two participants chose to be interviewed in conference rooms at their places of employment. Two participants were interviewed in their offices at work, and another participant was interviewed on the phone as she traveled to her office out of state. The final two participants chose to meet at local restaurants for personal and professional reasons.

Ethical Considerations

Prior to conducting this study, the researcher sought full Institutional Review Board (IRB) approval. Once IRB approval was given to conduct this study, the researcher began the process of inviting the potential participants through email (Appendix A). During the interview, the research participants were provided applicable ethical considerations for this research study. The researcher explained to the participants the instructions for Adult Consent Form (Appendix B). The participants could have decided not to participate in the study (Creswell, 2014). The decision to participate was seen as voluntary, without coercion or reward. The researcher then read The Rights of The Research Participants (Appendix C). An overview and brief description of the research study was given to the participants prior to the participants providing consent to participate. Participants were able to withdraw from the research study at any time during the interview. The researcher minimized any risks or discomforts as much as possible during the interview. All data collected during the interview was treated with respect to privacy and

confidentiality. The participants were assigned identification pseudonyms to be used on all documents related to this study protecting anonymity of the participants. A code key was used to match the actual name of the participant to the pseudonym. The code key was kept in a separate place to maintain ethical measures and maintain the anonymity of the participants. The researcher worked to establish trust by explaining to the participants that all information they shared would remain confidential. By establishing trust, participants were more willing to share information honestly and without fear of data being compromised. While gathering, organizing, and analyzing the data, the researcher maintained ethical guidelines by assuring that the data on the audio recording and computer hard drive were secure and that only the researcher had access to the information. The researcher destroyed the audio recordings following the transcription of the interviews and verification for accuracy was completed by conducting member check. The written documents and computer files of the transcript will be maintained exclusively in the possession of the researcher and will be destroyed after five years. The participants retained all legal rights while participating in this study. The researcher maintained dignity and respect for all participants during this interview process.

Data Collection and Analysis

The data collection procedures for this qualitative research study began with purposeful selection of a criterion sampling of women currently in STEM leadership positions in a Midwestern metropolitan city. Once the participants had been identified, an invitation to participate in the research study was sent to each potential participant through email (Appendix A). A follow-up email was not required as all seven participants who were invited responded to the email giving the researcher their permission to participate in the research. The researcher contacted each participant by phone regarding her decision to participate in the study. At that

time, the researcher arranged a meeting time and place for the interview. Location was discussed with each participant and was based on accessibility to both the researcher and participant. The interviews took place in several different locations, of the participants choosing, where anonymity was maintained. The participants were informed that a Participant Personal Narrative (Appendix D) for reflective data collection would be emailed or mailed to participants prior to the interview and was used in the research study. The Personal Narrative allowed participants time to reflect on the questions in the document and answer at their convenience. This information was used for triangulation data collected during the interviews. All seven participants completed the personal narrative reflecting on their formative years.

During the interview, the researcher used a recording device which was placed between the researcher and the participant. To begin the interview, the researcher gave each participant the Adult Consent Form (Appendix B) and The Rights of The Research Participants (Appendix C), read the documents to the participants, which allowed them time to read through the paperwork and ask questions regarding the study. Participants, as required by the Institutional Review Board (IRB), received a copy of the consent form. The Adult Consent Form (Appendix B) was signed prior to any interview questions (Appendix E). The researcher collected the Participant Personal Narrative (Appendix D) that was sent to the participants prior to the interview and continued with the one-on-one interview, which was audio recorded. The interview lasted approximately 60 minutes with the researcher asking the participants to answer the three main research questions with subquestions for each of the main questions. The subquestions were targeted to obtain the information needed to elicit further data related to each of the main research questions. Two additional questions were used as follow-up questions. Question number four addressed the overarching question for the research study, and question

number five was a closing remarks question used to further elicit information. During the interview the researcher took handwritten field notes (Appendix F) to obtain additional observational data. Creswell (2013) stated that observational data through field notes is one of the key tools for collecting data in qualitative research. Creswell (2014) stated that up close information gathered by actually talking directly to people and seeing them behave and act within their context is a major characteristic of qualitative research. At the end of the interview, the researcher thanked the participants. Immediately following the interview, the researcher had a professional transcribe the interview verbatim from the audio recording for analysis. The researcher emailed a copy of the transcribed interview to the participants for member checking verification. Participants reviewed the interview transcriptions for member checking and to better understand their own experiences influencing their leadership position. All seven participants responded to the transcript giving confirmation of the information for the themes. After analysis, the data from the interviews and personal narratives are to be stored for five years in a safe, secure location and will protect the anonymity of the participants. A backup copy of each recording was made, as well as copies of the interview notes and personal narratives. After five years the data will be destroyed.

Data Quality Measures

Silverman (2004) stated that "validity" "is another word for 'truth' (p. 224). According to Creswell (2014) validity is one of the strengths of qualitative research and is based on determining whether the findings are accurate from the standpoint of the researcher, the participant, or the readers of the account (p. 201). To ensure content validity and reliability, the researcher took several steps to verify the credibility of the research. To begin with, the literature review was presented from a historical background and current initiatives regarding the

research study. The literature review was organized into three distinct sections of theory to support the theoretical framework and provided relevance for this review and the need for further research. Most articles used in this research were peer-reviewed. Coherence was implemented throughout this proposal to add to the readability of this document. Creswell (2014) stated that coherence in writing means that the ideas tie together and logically flow from one sentence to another and from one paragraph to another (p. 83). The findings from the literature review demonstrated credibility and trustworthiness as it applied to this research study.

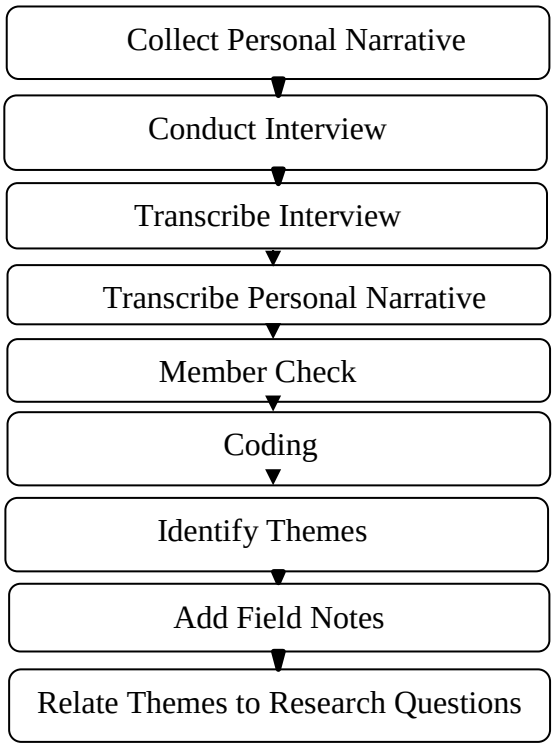
As part of the phenomenological method and qualitative methodology recognizing and attending to biases and values during the course of the research study was crucial. Bracketing was used during each interview. Bracketing is the recognition of personal bias in phenomenological research (Creswell, 2013). With bracketing, the researcher could identify innate bias and addressed the bias accordingly. It was important for the researcher to be aware of personal biases. Personal thoughts and feelings of the researcher were set aside during the interview process to minimize bias. Furthermore, to provide trustworthiness or validation, the researcher kept appraisal of all data collection, including personal narrative writing, individual interview transcripts, session field notes, and correspondence with the participants (Creswell, 2013). Additionally, a research audit trail was implemented for this research study. A research audit trail ensured thorough collection of all data aspects of this research and enhanced the trustworthiness of this qualitative research study.

Finally, to determine the accuracy of the qualitative findings, triangulation was achieved with the use of multiple and different methods of data analysis locating evidence for essential themes (Creswell, 2013). In addition, member checking was implemented to ensure the accuracy of the data from the transcribed interview. This process ensured validity of the study.

Data Analysis

Data analysis for this qualitative study followed guidelines set forth by Creswell (2013). The Ritzdorf model for data analysis process (Figure 4) included steps such as organizing the data by reading the transcripts, memoing field notes of the interview in the margins of the notes, coding the data, and identifying themes within the data. The researcher had the data professionally transcribed and organized the data into files on the computer. This allowed the researcher to read through the text and form codes or categories that helped describe, classify, and interpret the data (Creswell, 2013).

Figure 4: Ritzdorf Model: Data Analysis Procedures



Coding of the data from the interview, personal narratives, and the field notes allowed the researcher to disaggregate the text into small categories of information and look for common themes and subthemes. The process of open coding, as described by Leedy and Ormrod (2010),

allowed the researcher to find those themes that are essential to the understanding of the factors that influenced and affected women in leadership positions, specifically, STEM careers and disciplines, and how women attained and retained their positions. Creswell (2013) suggested that the themes and subthemes be collapsed into five or six themes that were used for the narrative of this research. These themes or codes were consistent phrases, expressions, or ideas that were common among research participants. The researcher analyzed the interview and the narrative for emerging themes and patterns. This process assisted the researcher in drawing conclusions from the data which then reflected a critical reasoning process (Elder & Paul, 2010).

Chapter IV: REPORT OF THE FINDINGS

It is more than mentioned in chapter one, women are vastly underrepresented in STEM careers. This has been identified by various organizations such as the National Science Foundation, National Council of Teachers of Mathematics, and under the dissemination of President Obama, the U.S. Department of Commerce Economics and Statistics Administration *Women in STEM: A Gender Gap to Innovation* (August, 2001) and U.S. Department of Education *Gender Equity in* Education (June 2012). Throughout the review of literature, influences pointed to several factors that related to this underrepresentation of racial minorities and women in science, technology, engineering, and mathematics (STEM). This phenomenological study was established to examine the lack of evidence showing a relationship between successful women in STEM leadership positions and the impact stereotypes have had in preventing women from going into or attaining success in STEM careers. The results from the research investigation showed a detailed understanding of the central phenomenon of how women attained STEM leadership roles and how they retained their positions.

In a qualitative study, data collection is centered on obtaining responses to open ended questions (Creswell, 2014). The data must be analyzed with respect to answering the research question(s). The analysis process included various steps, such as organizing the data, coding the data, identifying themes, interrelating themes, and finally interpreting the meaning of the themes (Creswell). This process assisted the researcher in drawing conclusions from the data which then reflected a critical reasoning process (Elder & Paul, 2010). This research study showed a complex picture of the problem of stereotype as it related to women in STEM leadership roles and the overlapping relationships of intelligence, efficacy, and communication. It gave a holistic

account as it pertained to the phenomenon of women in STEM leadership roles (Creswell, 2014, p.186).

Research Questions and Findings

At the beginning of the study, the participants were asked to complete a personal narrative (Appendix D) to obtain data to substantiate information for the research study. Those narratives were collected at the time of the interviews to elicit further information from the participants' formative years, and were used for data analysis as they pertained to the research questions. Throughout the interview process, participants were asked each of the three research questions with subquestions for each of the main questions (Appendix E). The research questions in this study began with the overarching question of: what is the impact of stereotype on women in leadership roles in STEM careers? Specifically, three research questions were addressed. The first question was: The first question was: how do implicit theories of intelligence affect self-regulation in women from Midwestern metropolitan cities in STEM leadership roles regarding achievement motivation and how they attain and retain their professional STEM careers while influenced by stereotypes? The second question addressed was: does self-efficacy affect how women from Midwestern metropolitan cities in STEM leadership roles attain and retain STEM careers while influenced by stereotypes? Finally, the third question addressed was: how does message design logic from home, school, and/or work encourage or discourage women from Midwestern metropolitan cities in STEM leadership roles toward attaining and retaining STEM careers while influenced by stereotypes? The study's theoretical framework provided the basis for Steele and Aronson's (1995) concept of *stereotype threat* and the overarching question for this study. Question #1 was supported in the framework by Dweck's (1999) implicit theories of intelligence. The framework continued with question #2 and the Social Cognitive Theories of

Bandura (1986) and the psychology of women. Finally, the theoretical framework for question #3 addressed O'Keefe's (1988) implicit theory of communication. The collection of this data provided the researcher a substantial amount of information that addressed the research questions for this study.

Research Question #1

The first research question was: how do implicit theories of intelligence affect self-regulation in women from Midwestern metropolitan cities in STEM leadership roles regarding achievement motivation and how they attain and retain their professional STEM careers while influenced by stereotypes? To further elicit data collection, each participant was asked five subquestions: 1) what motivated you to learn as you were going through your college experience; 2) what motivated you to perform as you were going through your college experience; 3) what motivates you to learn or perform in your current leadership position; 4) explain how you would define your own intelligence during your college experience; and 5) explain how you would define your own intelligence in your current leadership position. The data collected produced the first major theme, as well as two subthemes.

Intelligence and achievement motivation has a significant effect on learning and performing for women in STEM leadership roles.

Academics and love of learning are a critical component for achievement. During the interviews, all seven of the participants discussed academics and love of learning. The character trait of achiever, or high achiever was prevalent throughout the interviews with the participants. Maggie stated that she had achiever as one of her top five strengths. She continued by saying, "I get a lot of self-worth, I guess, out of being good at things or learning new things." The character trait of achiever was one of the driving forces for academics and good grades. During

the formative years, the participants discussed having inquisitive minds and excelling in school. Maggie indicated that she excelled at a quick pace while Janice specified that she read at a 4th grade level in kindergarten. The participants wanted to learn as much as they could and get the best grades possible. As achievers, the participants had the ability to complete tasks and often studied above and beyond to earn the grades. In wanting to earn the best grades possible, Shelly invested more time in studying if she wasn't achieving the grades. Her motivation for excelling in high school was to get into a prestigious college. This contributed to a college scholarship for her. Maggie revealed that she earned a decent Academic College Test (ACT) score and a perfect Grade Point Average (GPA) awarding her the Regent's scholarship.

During their college years, the character trait of over achiever continued. Along with making their parents proud and also knowing that their parents had faith in them, self-motivation was a driving force for high academics and learning. Janice stated she did not really apply herself in high school as much as she could. She had a wide variety of activities she liked doing in high school, but scored an extremely high score on her ACT test. She received a four year scholarship to college. She was also an over achiever and would do all the review and extra problems at the end of the chapter to do well on tests. Janice also revealed she had above average intelligence and would accept nothing less than an A for a grade. She graduated Magna Cum Laude. As an achiever Shelly always considered herself to be smart. From a very early age, she always felt girls were smarter than boys. She stated," I don't know if it was a good thing or a bad thing, but I never really felt like I was at a disadvantage." Although all seven participants discussed working hard and getting good grades in school, there was one very distinct contradiction to the relative ease and/or working hard for the good grades all participants achieved. The participants commented that college was tough. Table 2 demonstrates the

difficulties and struggles the participants had during their college years with their own intelligence.

Table 2

Difficulties and struggles with intelligence.

Participant	Contradictory statements to subtheme
Cindy	"I don't think I ever took credit [for my intelligence] nor did anybody come up to me and say, 'gee you are doing a good job or atta boy'…that just didn't happen."
Shelly	"I've always considered myself to be smart. I have always been able to take tough classes and get by. In college it never really came easy to me when I took those tougher classes."
Barbara	"I never really thought I was very smart. I always had to work really hard to get good grades, but I was willing to do that because the grades were very critical to me, out of necessity to succeed. It seemed like if you weren't studying and getting as good of grades as you could, you were really kind of letting yourself down."
Janice	"I just didn't ever think I would want to get less than an A in every class… I quit school and started working full-time….got married and had children. After four years I went back and college was a lot harder than if I had stayed in college."
Maggie	"I had a Regent's scholarship to the University…..so when I came into college, I thought I'd be pretty well prepared for it….I didn't have as much math background as a lot of the other kids did, so that was one place where I did struggle a little bit more…it was a big challenge."
Mary	"I think, my intelligence was sort of driven by needing to work hard, so it didn't come easily. However, once I did work hard and I really feel like I have common sense….the combination of just piecing together the working hard and being book wise really was to my advantage through college, and obviously it includes a little bit into my leadership position."
Laurie	"I'm not someone, however, that necessarily loved the act of learning. It was more about a means to an end."

Continuing into their leadership roles, the participants felt like there was always something new to learn. This thought process supported Dweck's (1999) second theory of intelligence, the incremental view theory and 'learning goals'. These participants saw

satisfaction coming from the process of learning and often found opportunities to get better. They also had the belief that their intelligence was malleable, fluid, changeable, and could be increased through effort (Dweck, 1999). Barbara indicated that in her leadership position there was always something new to learn such as new policies or new government regulations. She continued by saying she felt as though you might not retain your current position if you didn't learn the information and know it. Both Maggie and Mary discussed learning as a part of their intelligence. Maggie spoke to the fact that she learned every day. In her position she realized there were people that were technically much better than she was in a lot of different areas, but she also kind felt that she had to be a jack-of all-trades. This was difficult for her as she liked to be an expert in a lot of things, but realized she did not need to be an expert in everything. Mary indicated that much of her leadership position today required her to learn. She continued by saying because she is in technology, she had to learn and grow with things that obviously didn't exist when she was getting her education. She stated that a lot of her job was also problem solving, trouble shooting, and addressing a problem in the short-term. "I can intelligently look at anything and adapt to the situation."

The findings associated with the first major theme and the corollary subthemes were consistent with the literature on Steele and Aronson's (1995) consequences of stereotype threat, specifically, *Self-handicapping.* If barriers undermined performance, individuals could point to the barriers rather than deficiencies in ability or effort (Steele & Aronson, 1995). In addition, these findings supported Dweck's (1999) theories of intelligence. Dweck (1999) investigated how self-concept affected student achievement, motivation, goal-setting and sense of intelligence (Moore & Shaughnessy, 2012).

Credibility and respect promote outcomes. In the literature review, Dweck's (1999) implicit theories of intelligence discussed the impact on women in STEM. Dweck, a social scientist identified two theories of intelligence, or self-theories. These theories or views exposed the reasons why some students or women are motivated to work to the best of their ability and why other students take on self-defeating behaviors of learning. The two classes of competence were learning goals and performance goals. During the interviews with the participants, several of the participants discussed goals as it related to their intelligence. During their formative years, the participants did not comment to learning or performing as it related to Dweck's (1999) theories of intelligence. Speaking about their college years and current leadership positions, several participants discussed 'performing' as it related to credibility and respect. According to Dweck's theories, these participants would be categorized as entity view theorists. People who identified with the entity view theory were often concerned the most about how they would be judged. During their college years the motivation to learn or perform had to do with credibility. Shelly discussed the fact that credibility is what motivated her to learn during college. She wanted to perform well to get the end result of either getting into pharmacy school or graduating with her degree. She continued by saying she was going to be taking on this role which was highly regarded and she wanted to be able to have credibility in her role. She stated, "Credibility is always big with me. I want to look credible in front of other people." This supported Dweck's (2006) theory which specified that people who are consumed with the goal of proving themselves in the classroom, in their careers, and in their relationships called for confirmation of their intelligence, personality, or character. "Will I succeed or fail? Will I look smart or dumb? Will I be accepted or rejected? Will I feel like a winner or a loser?" (p.6). Barbara wanted people to look up to her and to be respected by her peers as well as customers. Shelly continued

by saying that her motivation to learn was her desire to be credible in front of everyone and get their buy-in. She did not want to be viewed as a pushover and someone who doesn't have good control on things. In another statement, Janice discussed being able to motivate others and having the leadership skills to produce outcomes of her employees by using the 'multiplier effect.' The multiplier effect is, "where you can multiply your work product because you can make five people work as hard as you do, and being able to have everybody on the same page. Getting the buy-in is very, very important." Cindy discussed wanting to succeed. In her case, it was more about proving to herself she could succeed rather than proving to anyone else. She was a driven person and wanted to prove she could get through her college experience. The literature review supported that entity theorists tend to be more concerned with besting others in order to prove their intelligence (performance goals), leaving them highly vulnerable to negative feedback (Chiu, Hong, & Dweck, 1997). When asked about stereotype in her position, Cindy replied, "All the females in leadership roles in this organization are well respected and when you come to the table, you feel like a team member versus just a female at the table. We're treated equally, which is a wonderful feeling."

Research Question #2

The second research question was: does self-efficacy affect how women from Midwestern metropolitan cities in STEM leadership roles attain and retain STEM careers while influenced by stereotypes? To further elicit data collection, each participant was asked six subquestions: 1) what best describes your self-efficacy as you were going through your college experience; 2) what best describes your self-efficacy in your current leadership position; 3) explain any obstacles in your self-efficacy you had to overcome while in college; 4) explain any obstacles in your self-efficacy that you have had to overcome in your current leadership position;

5) who was/were the most influential person(s) in your life as you were going through college; and 6) who has/have been the most influential person(s) in your life in your current leadership position? The data collected yielded the second major theme, as well as three subthemes supporting Bandura's (1986) contributions to the fields of psychology, including Social Learning Theory, Social Cognitive Theory, and the theoretical construct of self-efficacy.

Encouragement and support promotes self-efficacy in women in STEM leadership roles.

Influential people affect self-efficacy. A reoccurring theme of influential people affecting women's self-efficacy was apparent with all participants. Bandura (1994) focused on four main sources of influence for self-efficacy. Those were; mastery experiences, vicarious experiences provided by social models, social persuasion, and somatic and emotional states.

Bandura's second way of creating and strengthening self-beliefs of efficacy was through the vicarious experiences provided by social models. Bandura contends that seeing people similar to oneself succeed raises the belief that they too can succeed. Bandura was referring to modeling influences. In the research, Jackson (2013) elaborated that the encouragement from both home and school helped to develop self-confidence in women and reported teachers, counselors, and others who work in educational settings had a critical influence on women who aspire to be in STEM careers. The most influential people affecting women's self-efficacy were family members. According to Ma (2011) girls' achievement and interests in STEM disciplines were often shaped by the environment around them. The findings reported that not only were family the most influential people during adolescence, but continued to be the motivation for the participants to learn or perform in college. During adolescence, the participants in this study were inspired by their parents to excel in school. Parents instilled a strong work ethic in the

participants and were very supportive. Because of this strong work ethic and inspiration, Barbara stated that she had the desire to make her parents proud by doing her best in school. She specified, "There were no limitations with my parents about my future." Cindy felt her parents had faith in her. Shelly continued by saying, "I didn't want to disappoint my parents, especially my dad." Throughout the interview process, of the two parents, fathers were discussed the most as an influential person during the formative years on learning and performing. Fathers were referred to as "the biggest cheerleader," whereas mothers showed unconditional love, "no matter what." Shelly remembered her mom saying, "She's going to have some enemies, because she has a strong personality, she has leadership skills, and she's smart." Combined, the participants' parents recognized that they were natural born leaders. All of the participants were raised by both parents.

The participants continued to discuss the influence that their parents had on their self-efficacy during their college years. However, their parents were discussed for a variety of other reasons. Family pressure to do well for a comfortable future was reiterated upon. Several sets of parents in the research were not educated past high school or had advanced degrees. This was a motivational factor in and of itself. Mary wanted to better herself and go further than her parents. She wanted to put herself in a better situation than her parents. Barbara also shared that her parents had no education and it was expected for her to go to college. Again, her dad encouraged her and gave her "no choice." Parents often invested money in the participants' schooling to ensure the participants would have a good future. As a child of immigrant parents Mary stated, "My parents motivated me to learn and perform. As immigrants with little schooling, they instilled that [learning and performing] at a very young age."

The next most influential persons were teachers. Teachers were reported as being a major influence to participants' self-efficacy. During the formative years and into college, both male and female teachers motivated and encouraged the participants to learn. Shelly indicated, "I had some pretty influential teachers." At the elementary level, teachers in first, third, and 6th grade were mentioned as motivators for learning. Janice specified that her high school bookkeeping teacher helped her find her calling. In college, Barbara had a math and marketing teacher who encouraged her to get her MBA. Laurie had influence from her math teacher who convinced her to go into a science and technology field.

Finally, bosses have an instrumental role with women with in leadership roles. When probed specifically about bosses in leadership, both male and female bosses had an impact on participants' self-efficacy. The data showed there was an equal mix of male/female supervisors at the work place. Many of the supervisors had expertise in their field and encouraged and supported the participants. Laurie reported her chief operating officer, who was a female, encouraged and motivated her. Maggie felt that her boss, who was also female, also had a ton of knowledge and expertise. She continued by saying her current male boss, who was the Chief Operating Officer, was supportive of her and women in technology. Shelly reported that her male supervisor had a similar leadership style to her own. She added, "My boss…he had a big impact on me because I think he came into the role during a time when I was really questioning myself, like 'is this the person I want to be?' He came into my career at a time when I kind of needed that pick-up." When discussing her bosses who were both male, Janice felt like one of her bosses, in particular, spent time on talent development with their employees and was a visionary. She continued by saying, "He's very…it's about people, you know, making sure the right leaders

are in the right place. He continues to help me with my development plans to look five and fifteen years into the future." Finally, Cindy reported,

> "In my career currently…. I would say they [influences] were the best of my bosses and the worst of my bosses. And the reason I am saying that is because the best of my bosses taught me who I wanted to be and the worst of my bosses taught me who I didn't want to be. I learned so much from both of them and I hope I've been able to utilize that in my current position."

These comments by the participants showed a clear indication of the impact that family, especially fathers, teachers, and bosses have had influencing women in leadership positions.

Determination is a significant factor for self-efficacy. In the literature review, Bandura's (1977) ideas on behaviorism continued with the elements of cognitive control through the learning process. He introduced the idea of reciprocal determinism which revealed that an individual's behavior is influenced by their environment and the environment is influenced the individual's behavior. A reoccurring theme of determination was obvious with the participants. Table 3 illustrates the data as it relates to determination and self-efficacy in women.

Table 3: Ritzdorf Table for Determination

	Determination	
Cindy- Driven toward success and something that I built; Wanted to prove the naysayers wrong; wanted to succeed.		Shelly - Always wanted to do better at the end of the day; Needed to be disciplined and prioritize; Was a strategizer and efficient.
Maggie - Self-motivated and driven to succeed; Wanted to expand my career and my responsibilities.	Mary - Wanted to insure that I could prove myself more than I do today; Motivated to do my best, less about proving.	Laurie - Driven to make a difference; Believes in the mission of the company.
Barbara - Constantly challenged; constantly felt like you had to do better just because you were unusual.		Janice - As a commuter, you're not there unless you are serious...you must be driven.

Another aspect of determination the participants discussed was independence and investing in their future. Maggie wanted to get a good job and earn a good living. She often took her own initiative during her formative years. In her college years and her current leadership position she felt her self-motivation had driven her to expand her career and responsibilities. Mary also discussed her determination to better herself and put herself in a better situation than her parents. The financial investment of paying for her own education was a motivation for her future and an incentive to be independent. Shelly recounted making sacrifices during her college years to make herself financially comfortable for her future. These findings associated with determination were well representative of Bandura's (1994) theory of self-efficacy and people who have a strong sense of efficacy and person well-being. They set challenging goals for themselves and uphold a strong commitment to them.

Self-confidence is influenced by competitiveness and one's self. As discussed earlier, all of the participants were high achievers, were self-motivated, and had great support systems from home, school, and at work. Along with those factors, competitiveness had an additional vital impact on women in STEM leadership roles. Several of the participants discussed having strong work ethics. They claimed to be hard working and independent. They were perfectionists and had the desire to succeed. Two of the participants talked about their drive for success. They identified themselves as Type A personalities who were ambitious, organized and high-achieving. Cindy had the drive to succeed. If she had something due tomorrow, she would have done it a week ago. "I wanted to prove to myself I could get through it. I wasn't proving anything to anybody else, just myself." Shelly revealed that her profession catered to people with Type A personalities. She stated people in her profession liked things in black and white, kind of obsessive compulsive behavior. In addition, the company's mission and purpose had a place with

self-confidence and the influence of one's self. Mary shared, "We have a culture here that supports and actually encourages women in leadership." Table 4 illustrates how each of the participants was motivated by competitiveness in their current leadership position.

Table 4

Motivators of Competitiveness

Participant	Participant's Comments
Cindy	"One of the motivators you always hear is 'you can't' and 'you'll never succeed'. I think as I have said, I'm a hard A personality. So the more people tell me I can't, the harder it motivates me."
Shelly	"I work for a performance-based company. It is very competitive and everyone who works for the company is competitive. If my stores perform well then I get a better bonus at the end of the year….but I like to win. I like to see success through my teams."
Barbara	"…it became complimentary when someone would call from another region or territory to ask what I think about a loan, and how would you think about restructuring it. It was kind of an ego boost."
Janice	"It's not much about winning; it's about not losing…you don't want to do as well as some of your counterparts you want to do better than them. To me, it's not unnatural or doesn't feel unnatural to be competitive regardless of gender."
Maggie	"I got a lot of self-worth I guess out of being good at things, or learning new things…in technology you always have to learn, grow, and stay on top of different trends in technology. I need to do that just to be good at my job, too."
Mary	"… my motivation might have been early on that there were more males and I was always the only female in the group…and insure that I could prove myself. Later in my career, like I said, I was motivated about doing my best and not worrying whether the room was full with men or women."
Laurie	"I went into a field that not a lot of females were in, and so part of it [self-confidence] was proving that I could perform better than the males in the field. I have a strong belief and dedication to my company to show the employees that I do hard work and what good performance can achieve, and as well show my direct boss that I want to meet her goal and objectives she has for me as well."

Continuing, Mary stated, "I was taught early that everything is within your control, you make decisions and things so empowering for people to know that things are within their control, with encouragement." Contrary to being competitive is the concept of self-confidence as it pertains to encouragement and self-efficacy. In the literature review, a negative consequence to stereotype threat is distancing one's self from the stereotyped group. Shapiro and Williams (2012) discussed self-as-source stereotype threats. When in this situation, one's performance has the possibility of confirming, in one's own mind, the stereotype is true of one's own, or the group's abilities. Table 5 demonstrates a sampling of participants and their self-confidence as it applies to fear of failure and validation for not succeeding. The issue of failure and distancing is

Table 5

Fear of Failure

Participant	Fear of failure and validation for not succeeding
Shelly	"I put a lot of pressure on myself. I was unsure of myself. I still second guess myself. I have an innate fear of failure. I beat myself up and always want to do better. Honestly, I'm scared of failing."
Barbara	"If you didn't succeed, you were kind of giving validation that you can't do it."
Janice	"…not having enough confidence to try to take more advanced courses or to try. You'd be so afraid about getting something less than an A, not challenging yourself enough to take the hard class."
Maggie	"They put me into a math class that I barely tested into. So, I didn't set myself up for success in that either. So, getting through that was a little bit difficult…"

recognized in the literature review with Bandura's (1994) focus on the main sources of influence for self-efficacy as well as Steele and Aronson's (1995) stereotype threats.

Research Question #3

The third question addressed was: how does message design logic from home, school, and/or work encourage or discourage women from Midwestern metropolitan cities in STEM leadership roles toward attaining and retaining STEM careers while influenced by stereotypes? To further elicit data collection, each participant was asked two subquestions: 1) what was your perception of communication to you and with others in your life as you were going through your college experience; and 2) what is your perception of communication to you and with others in your life in your current leadership position? The data collected yielded the third major theme, as well as three subthemes.

Communication is a goal-directed process for women in STEM leadership roles and relationships.

Open and transparent expression. In the literature, O'Keefe's (1988) Message Design Logic theory assumed that communication is a goal-directed process. Communicators produced messages that were designed to meet objectives and gain insight to the goals of the other person. O'Keefe's theory suggested that there were three different views of communication. In their formative years there were very clear expectations for each of the participants and their communicators which included their parents and teachers. This way of communicating supported O'Keefe's expressive message design logic which was the easiest to attain. As a young child, Cindy felt that she was listened to and could speak her piece respectfully, but her parents always had the last word. She was spoken to as a child rather than an equal at home and school. Shelly always had positive affirmation at home and school. Her parents talked to her on the same level with clear expectations. She was not talked down to. Her teachers were also very positive and motivating. Along with Cindy and Shelly, Barbara doesn't ever remember being treated or

communicated to as ‘a kid’. In the research, Forrest (2008) conveyed that individuals using expressive message design logic believed listeners would understand the message, provided they spoke openly, directly, and clearly. This was affirmed with the statements by the participants. Janice felt she was spoken to positively and felt there were no boundaries due to her family’s strong work ethics and Christian values. Overall, all participants sensed they were communicated to like a child should be communicated with.

Articulating expectations and understandings. Articulating expectations and understandings is another subtheme for the main theme. In the literature, O’Keefe’s (1988) implicit message design logic, conventional message design logic was discussed. The primary purpose of conventional message design logic was to build an understanding that communication is a cooperative game to play, with socially conventional rules and procedures (O’Keefe, 1988). The participants in this research study continued talking about their college years as it applies to communication. Cindy recounted from her instructor perception, “I felt like I didn’t know anything and it was their way or the highway. Forrest (2008) reported that communicators who employed this message design logic try to say things they believe are appropriate and meaningful for the situation. Cindy continued by saying “…it [communicating] was a little bit frustrating…it was probably in my earlier college years. I didn’t have the stamina to be able to stand up and question or ask. I was just the student and that’s how we were made to feel.” In the beginning of her college years Shelly added, “I hope it’s not that way anymore, but it sure was for me in the beginning of my college years. Come to school, do your work, get good grades, and go away.” Janice discussed her experience with communication as she was going into school. Janice was from a farming community. She reported that half the girls didn’t go to college because they already had jobs or were going get married and live locally. The girls that were going into

college were given extra accolades. Janice felt that since she was at a teacher's college the instructors were trying very hard to keep women engaged in the school of business. She was in a math class with two other girls and 17 boys. According to the research, in a math classroom teachers using conventional message design focus on conventional practices for communicating with students. Teachers listen and evaluate students' responses and then the teacher says what is needed to move students in the appropriate direction (Forrest, 2008). On the other hand, Maggie and Shelly really felt like they were communicated to the same way as other students were. Maggie felt like the professors talked to everybody the same. There were definitely more men in her classes than women. She stated, "I never felt like I was talked to differently than anybody else." Shelly reported that she did not feel as if there was a difference because of gender bias even though her career was female heavy.

Communication is a negotiation of social selves and situations. The final piece to O'Keefe's (1988) message design logic is rhetorical message design logic. This is the most elaborate and most difficult to achieve. Persons employing this message design realize the intended meanings of his or her messages are not fixed, but are part of the social reality being created with others (Forrest, 2008). Cindy recounted her experience during her college years. She felt that she had the wherewithal, knowledge, and the background to be able to question what the instructors were teaching or question why they were teaching it. She considered herself a 'why' person. She indicated there was an opportunity for growth within her that she could ask questions. "Why can't you go this direction or why can't you go that direction? I would say through my college years and through the early stages of my career, I respected and almost was afraid of leadership because they were in the ivory tower and they were unapproachable." Cindy went on to say she felt that it's a bit standoffish and she wished for a lot of people that she had

the opportunity to ask questions and thought she would have learned a lot more if she could have asked more questions. In the literature, Forrest (2008) elaborated that communicators using rhetorical message design logic would modify their language so listeners could interpret and be motivated to give acceptable responses. Mary felt like most of the time she was treated like any other college student. However, she stated, "there certainly were times where there were definitely certain levels of instructors which certainly didn't seem like they were messaging in the same way. But overall, I felt the institution that I went to in college, I was communicated, I think, fairly." As the research continues into their leadership positions, Mary felt communication was open and transparent.

Research Question #4

The fourth question addressed the overarching question of: what is the impact of stereotype on women in leadership roles in STEM careers? To further elicit data collection, each participant was asked two subquestions: 1) how were you affected by stereotype as you were going through your college experience; and 2) how have you been affected by stereotype in your current leadership position? The data collected yielded the first major theme, as well as three subthemes. Although the overarching question of stereotype and the subquestions deal specifically with college experiences and leadership positions, it is important to establish how the formative years also impacted the participants in college and in their current leadership positions. The literature review helped establish the fourth major theme and three subthemes that related to the vulnerabilities and consequences of stereotype threat and the impact on women from their formative years, college experiences, and in their current leadership positions.

Social expectations create barriers that undermine learning and performance for women in STEM leadership roles.

Gaining trust. During their formative years the participants did not specify how they were impacted by trust issues. However, several of the participants expanded on gender specific issues that were elaborated on in subsequent subthemes. As stated earlier in the data analysis, the participants had very supportive parents. Three of the participants commented to the fact that they were from small farming communities. From a young age the participants didn't recognize that anyone was treated differently. Cindy indicated she came from a farming community. She continued by stating she did not know what stereotype was, everyone was treated equally. Janice, also from a farming community recalled that there was limited impact based on gender. "I grew up in a very small town and we competed with the boys alongside them and side-by-side on the ball team or whatever we were going to do." Maggie also did not feel impacted by stereotype trust issues. She also grew up in a small town. She commented that growing up she was always around more men than women. "My class was so small. There were twelve boys and six girls, so I don't know… I have never felt different." Shelly, who grew up in the city, often played outside with her brother and his friends rather than play with dolls and with girls. However, she did comment to moving to a new school and having to reestablish herself. She was formerly a leader at her public school, so the move to the private school created leadership and trust issues. As the participants continued into college and leadership roles, concerns about trust and the importance of trust became more apparent. Very often the participants in this study were the only women in meetings. Gaining trust from male counterparts became an issue. Cindy remarked that she thought there were always men out there who did not believe you should be in a leadership role because you are female. She continued by saying that she hadn't seen that within her organization which had been very pleasing to her. She did, however, give an example of trust in the building of the new hospital. Cindy gave an example of going into the first design meeting

for building the hospital. She asked for a set of the drawings [blue prints] and was told the drawings had already been done and there couldn't be any changes. She came away from that meeting and said, "I still want a set of drawings and I still want to talk to the people who are going to participate in this." The second meeting came several months later. She said to the men in the meeting, "Okay, we have to make a lot of changes in the design work that we've done." Again, they told her she couldn't. She replied with firmness, "Then you go talk to my boss because there are four walls I can't change and they are the four exterior walls. You're just going to have to deal with it." Cindy continued by saying she knew what she was doing and she was hired to do a job. "Just because I was female didn't mean I was going to be a push over." Janice reported that when she went into meetings, she too was the only female. She didn't think anything of the fact that she was the only female. When others on the peripheral were looking in wondering, "How did I break the [glass] ceiling to get into that group, or is she a token?" Continuing, Barbara felt she was stereotyped against. She recalls being left out of functions with customers because she was a woman. She recalled instances of 'men's day at the golf course', and being left out of business gatherings such as going to a basketball game. She recalls getting invited once. Barbara recounted, "I don't know what happened to my name, but I always felt like, there again, "am I going to do something horrible at a basketball game? Heaven forbid. Are women not supposed to watch basketball games either?" She felt that there is still a 'good ole boys club' in place.

Gender specific assumptions. The next subtheme is gender specific assumptions. This subtheme had many similarities to gaining trust and stereotype. In the literature Byrn-Doran (2012) indicated that women continue to challenge the socially constructed ideas of women's place and position in society. Women constantly struggle with work-family guilt. In Steele and

Aronson's (1995) stereotype threat, one of the consequences dealt with the impact of altered *professional identities and aspirations.* Shapiro and Williams (2012) reported that in addition to hindering performance, stereotype threat can also negatively influence career aspirations in women. In the study, as the women went through their formative years many times there were references to gender specific roles or jobs the women were associated with. To begin with, girls were often told what job choices they could do for their futures by their teachers. The social assumption would be for most girls or women to become hair dressers or secretaries. Barbara communicated that her high school principal thought she should take French class rather than Chemistry. He said to her, "Why are you doing that? You are just going to graduate and either be a secretary or a hair dresser and get married anyway." She continued by saying that the other socially acceptable careers for a women at that time were teaching or nursing. "You also had the option to stay home." As Barbara moved into starting her career in banking, she was often asked in interviews, "How fast can you type?" Her response was, "I don't think typing is very critical to what I'm going to be doing." Maggie also commented how stereotype affected her. During her formative years there were only a few jobs girls could have; working at the café or being a lifeguard. She also went on to share that in high school girls took Home Economics and boys took agricultural classes. She, however, took both. She joined both Future Farmers of America (FFA) and Future Career and Community Leaders of America (FCLA) which was formerly known as Future Homemakers of America (FHA). Janice shared during her formative years stereotype affected her also. She was told to prepare for college but take trade school and home economics class. The final gender specific subtheme the participants had to encounter was obstacles and vulnerabilities.

Obstacles and vulnerabilities. Aronson (2004) stated that everyone is vulnerable to stereotype. In addition, Gerstenberg, Imhoff and Schmitt (2012) indicated that stereotype threat has been identified as a pervasive phenomenon. Gersentberg et al. (2012) studied individuals with a fragile self-concept in the domain of performance and found them to be particularly vulnerable to stereotype threat. Gerstenberg Imhoff and Schmitt (2012) presented research that other social groups have shown declines in performance when negative stereotypes about their group's abilities were made salient. These groups have included men (Aronson, Lustina, Good, Keough, Steele, & Brown, 1999), people from low socio-economic backgrounds (Croizet & Claire, 1998), elementary and middle school girls (Ambady, Shih, Kim, & Pittinsky, 2001), and women (Spencer, Steele & Quinn, 1999). In the research, different obstacles and vulnerabilities surfaced with the participants as they were growing up and into their leadership positions. One of the most prevalent vulnerabilities was name-calling. Maggie recalled kids made fun of her and called her 'smarty.' She stated she had the typical awkward appearance phases that seemed to last much longer for her, 'probably until I was 14.' Shelly recalled that she was more of a tom-boy and would rather play outside with the boys. She was also called 'goody two-shoes' by the other kids. Another participant, Janice, was pegged as the 'teacher's pet' or 'the brain'. She said she deliberately tried to dummy down her image except at home and on tests. Along the same line, Barbara did not feel athletic. Sports were a downer to her. She was always chosen last for a sports team. As the participants continued into their college years three of the participants felt like a 'castaway.' Laurie explained that she did have a particular professor who told her, at one time, she was in the wrong field. He said, "Do you realize you're a female in a male-dominated world? Maybe you entered the wrong field." The comment by the professor motivated her more to prove him wrong and show him she could be the best in his class.

The final obstacle the participants had to deal with was being a full-time working mom. Cindy explained that in college she was married, had a full-time job, and two younger children. Working around all of that and trying to be a good mom, a good wife, and a good student were some of the obstacles she had, but she made it work. She had a husband who supported her, as well as her kids. Janice commented on a particular statement that affected her. The statement was, "She must have been 'one tough cookie' to live with." She continued by saying she felt that people must have thought she got to where she was professionally simply by dropping her kids off at daycare and never seeing them for a week. That stereotype haunted her. She commented,

> "Makes you want to talk a little bit more about your kids. Like hey, I've got three kids, none of them are in jail, they are all doing well, my kids turned out good, but yes they did go to daycare, and I'm just blessed I have a husband who was equally concerned about raising children and didn't have a job that required working 60 hours a week, so that you know, have a normal family and do all of this."

This was not the only obstacle Janice tackled. She continued to say the obstacle associated with stereotype for her was role reversal. The typical stereotype was that the woman was going to take care of the kids, and/or take them to daycare. She had a couple of incidences where the moms would go to decorate at a school function and she couldn't be there. She would volunteer her husband to come and help and the comment was, "Oh no. We don't want to bother him." Her reply was, "Can't he hold the ladder?" She finalized these thoughts by stating she felt that there was still a lot of peripheral stuff, even though the workplace was getting better and better, some of the peripheral stuff was still not quite caught up."

Summary

From the findings presented in Chapter 4, four main themes and corollary subthemes emerged: 1) *Intelligence and achievement motivation has a significant effect on learning and performing for women in STEM leadership roles; 2) Encouragement and support promotes self-efficacy in women in STEM leadership roles; 3) Communication is a goal-directed process for women in STEM leadership roles and relationships; and 4) Social expectations create barriers that undermine learning and performance for women in STEM leadership roles.* The data gathered was collected from seven women who were currently in STEM leadership roles. The main themes and subthemes emerged from the three main questions and one overarching question that were addressed in the participant personal narratives of their formative years, as well as the interview that addressed their college experiences and current leadership positions. The views and perceptions of the information came strictly from the participants and their experiences. Chapter 5 will follow with restating the purpose of the research, a detailed discussion of the findings, the significance of the findings, and recommendations for further research.

Chapter V: CONCLUSION AND RECOMMENDATIONS

Purpose of the Research

The primary purpose of this research was to provide valuable insight and information to identify the link between the influence stereotype threats have had on successful women in leadership positions and STEM careers. The question to be answered was, "What is the impact of stereotype on women in leadership roles in STEM careers?" This research was designed to connect stereotype threat to self-efficacy, intelligence and how it affected women's self-regulation in STEM careers as well as to examine the connection with communication from home, school, and/or work that encouraged or discouraged women from pursuing STEM leadership positions. Finally, this qualitative study was to identify the influential factors that affected women in leadership positions, specifically, STEM careers and disciplines in the education, business, medical, and political sector. The researcher examined the perceptions and opinions of seven women who were in leadership roles in science, technology, engineering, or math (STEM).

The design of this study included a participant personal narrative (Appendix D) and the one-on-one interview (Appendix E). The responses given by the participants and the analysis of the data from the personal narratives and the one-on-one interviews provided a detailed understanding on the central phenomenon of how women attained STEM leadership roles and how they retained their positions. The data was transcribed, analyzed and coded for themes that were thoroughly discussed in chapter four. Out of this analysis, four major themes were produced, each with subthemes that related the theories of stereotype threat, intelligence, self-efficacy and communication messages. The implications of the study were further discussed in chapter five, along with recommendations for further research.

Discussion of the Findings

Research Question #1: How do implicit theories of intelligence affect self-regulation in women from Midwestern metropolitan cities in STEM leadership roles regarding achievement motivation and how they attain and retain their professional STEM careers while influenced by stereotypes? The first theme to emerge was: intelligence and achievement motivation has a significant effect on learning and performing for women in STEM leadership roles. This theme focused on the participants' high levels of academics and love of learning from their formative years, through college, and into their current leadership roles. The subtheme that arose was: academics and love of learning are a critical component for achievement. All seven participants in this research study were self-acclaimed achievers and over achievers who loved academics and the act of learning. As little girls and then high school teenagers, the participants wanted to learn as much as they could and earn the best grades possible. Many of the women excelled in school at a very young age. The ability to learn at a young age and excel in high school earned the women many awards going into college proving their ability to achieve. They had self-motivation and were motivated to make their parents proud. Knowing their parents had faith in them, self-motivation became a driving force for high academics and learning. However, all seven of the women in this research study gave contradictory statements and discussed the difficulties and struggles they had during their college years with their own intelligence (Table 2). Having reported this information, the women demonstrated control over their thoughts, feelings, motivation and actions. This supported Bandura's (1994) theory on self-regulation. As the women continued into their leadership roles, the women felt like there was always an opportunity to learn. The women often saw opportunities to learn and believed their intelligence was malleable and could be increased through effort (Dweck, 1999), and determination.

At different times of their lives and in different situations, the participants in the research study showed signs of both the entity view for learning and the incremental view (Dweck, 1999).

The second subtheme for the main theme of intelligence and achievement motivation produced the idea of credibility and respect promoting outcomes in the participants' STEM leadership roles. During the interviews, the participants discussed 'performing' as it related to credibility and respect during their college experience and current leadership positions. During their college years the motivation to learn or perform had to do with credibility. Shelly discussed the fact that credibility was what motivated her to learn during college. She wanted to perform well to get the 'end result' and also wanted to look credible in front of people. Furthermore, the participants discussed wanting to succeed. This confirmed that during college the participants were more concerned with besting others in order to prove their intelligence (performance goals), leaving them highly vulnerable to negative feedback (Chiu, Hong, & Dweck, 1997). The discussion from the participants supported Dweck's (2006) theory with the goal of proving themselves in the classroom, in their careers, and in their relationships. These findings can also be associated with Steele and Aronson's (1995) consequence of stereotype, *self-handicapping* which is a defensive strategy by which individuals erect barriers to performance to provide attributions for failure. When the women in this study self-handicapped, they were building their own barriers for success. If barriers undermined performance, individuals could point to the barriers rather than the deficiencies in ability or effort (Steel & Aronson, 1995).

Research Question #2: Does self-efficacy affect how women from Midwestern metropolitan cities in STEM leadership roles attain and retain STEM careers while influenced by stereotypes? During this qualitative research study the data collected produced the second major theme related to self-efficacy. The second theme to emerge was

encouragement and support promotes self-efficacy in women, in STEM leadership roles. This reoccurring theme was consistent with all seven participants. Bandura's (1994) second way of creating and strengthening self-beliefs of efficacy was through the vicarious experiences provided by social models. The research with all seven participants produced the first identifiable subtheme: influential people affect self-efficacy. The research showed that the most influential people affecting women's self-efficacy were family members. During adolescence, the participants in this study were inspired by their parents to excel. Several participants mentioned the strong work ethic that their parents instilled in them. Janice felt there were no boundaries due to her family's strong work ethic. In addition to parents, teachers were reported as being another major influence to participants' self-efficacy. Teachers influencing students is consistent with the literature. Both male and female teachers motivated and encouraged the participants to learn. Teachers, counselors, and others who work in educational settings had critical influence on women who aspired to be in STEM careers (Jackson, 2013). Barbara and Janice specified that they both had influence from a math teacher who encouraged them to go into and Master's program and a science and technology field respectively.

The second subtheme to emerge focused on the participants' conviction to succeed. The overarching subtheme that was repeated with the participants was determination. Figure 5 showed clear representations of the determination for self-efficacy of the participants. The participants undoubtedly showed that they had a drive to be better, do a better job at work, and were self-motivated. Laurie stated that she was determined as a young girl. Four of the seven participants used the word 'driven'. The participants' drive and determination also gave the participants independence and the desire to expand their career and responsibilities. These

findings supported Bandura's (1994) theory of self-efficacy and people who have a strong sense of efficacy and personal well-being.

The third subtheme that materialized from the data analysis was: self-confidence is influenced by competitiveness and one's self. In the research, Jackson (2013) elaborated that encouragement from both home and school helped to develop self-confidence in women and reported teachers, counselors, and others who work in educational settings had a critical influence on women who aspire to be in STEM careers. As discussed earlier, the participants in this study were very ambitious and high achievers. Table 3 proved that each of the participants was motivated by competitiveness in their current leadership position. Their competitiveness was fueled by winning and having success in their field. However, four of the participants spoke to self-confidence as it applied to fear of failure and validation for not succeeding. Shapiro and Williams (2012) discussed self-as-source stereotype threat. In the literature, a negative consequence to stereotype threat is distancing one's self from the stereotyped group. Although these women were high achievers, they also inflicted pressure on themselves to succeed (Table 4). Barbara specified, "If you didn't succeed, you were kind of giving validation that you can't do it."

Research Question #3: How does message design logic from home, school, and/or work encourage or discourage women from Midwestern metropolitan cities in STEM leadership roles toward attaining and retaining STEM careers while influenced by stereotypes? The next theme to emerge that supported messages from home, school, and/or work was: communication is a goal-directed process for women in STEM leadership roles and relationships. The identifiable subthemes that were associated with communication were: open and transparent expression; articulating expectations and understandings; and finally

communication is a negotiation of social selves and situations. As young girls, the participants felt they were communicated to as young children should be, not as adults. They felt well respected in discussions, but understood that their parents had the last word. The participants felt that they were given positive affirmation with clear expectations. As the participants progressed into college, the participants recounted experiences they had with communication. The participants shared their experiences and stated that at times communication was a bit frustrating. Cindy stated that she didn't have the stamina to be able to stand up to college instructors and question or ask 'why'. Shelly continued by saying that she was to come to school, do her work, get good grades, and go away. However, as a college student, Janice felt that her instructors were trying very hard to keep women engaged in the school of business. The research supports that, in math class, teachers using conventional message design focus on conventional practices for communicating with students (Forrest, 2008). In contrast, Maggie and Shelly really felt like they were communicated to the same way as other students. Shelly did not feel as if there was a difference in communication because of gender bias or stereotype.

Research Question #4: What is the impact of stereotype on women in leadership roles in **STEM careers?** The fourth emerging theme supported Steele and Aronson's (1995) theories on stereotype threats. It was: social expectations create barriers that undermine learning and performance for women in STEM leadership roles. There were three identifiable subthemes; gaining trust; gender specific assumptions; and obstacles and vulnerabilities. Aronson (2004) stated that everyone is vulnerable to stereotype threat. During their formative years, the participants did not specify how they were impacted by trust issues. Three of the participants (Cindy, Janice, and Maggie) specified that they were from small towns or farming communities. These participants didn't recognize that anyone was treated differently. Not knowing what

stereotype was Cindy felt that everyone was treated equally. Janice also from a farming community spoke to the fact that she had limited impact based on gender. Maggie never felt any different. In contrast to the lack of stereotype and trust issues in a small community, Cindy, who grew up in the city felt trust issues as she moved from public to a private school. As the participants continued on to college and leadership roles, gaining trust from males became an issue. Cindy, Barbara, and Janice explained that in meetings, they were often the only females. All three participants felt the lack of trust by their male counterparts.

Being female, the participants often struggled with work-family guilt. Work-family guilt supported Steele and Aronson's (1995) stereotype characteristic with the impact of altered *professional identities and aspirations.* Morgan and King (2012) conveyed that work-family conflict has been linked with important job outcomes, including stress, well-being, and performance. When the women in the study were in their formative years, many were often told what gender specific roles or jobs they could attain and what classes to take in high school. Maggie proved them all wrong. She joined Future Farmers of America (FFA) and Future Career and Community Leaders of America (FCLA) which was formerly known as Future Homemakers of America (FHA).

The participants in this study often dealt with obstacles and vulnerabilities of being women. As they were growing up, the women often spoke to another obstacle that left them vulnerable, name calling. Classmates made fun of the girls for awkward appearances and were often chastised with names such as goody two-shoes, tom-boy, teacher's pet, and smarty to name a few. Two of the participants were called smarty or 'the brain'. As the women continued into their college years, they often felt like castaways trying to figure out where they belonged in this male-dominated world. Finally, the women in this this study had to deal with being a full-time

mom, wife, and student. As a successful female in the workforce, Janice was even referred to by a co-worker as, "one tough cookie' to live with. Janice felt that this referred to the fact that she was very successful and was associated with the stereotype of having a husband in a role reversal. That stereotype haunted her.

Significance of the Findings

The vision of engaging girls and other students, who were historically underrepresented in STEM education disciplines, in math and science has come to the forefront of education in America. The research has shown that many key organizations, as well as the Executive Office of the President have stepped up nationally and locally to help with this discrepancy. The research has supported the need to understand the lopsidedness of women in science, technology, engineering, and math (STEM). Through this research study, and consideration of the key questions, several significant themes emerged that supported the relationship between successful women in STEM leadership positions and the impact of stereotype on women in STEM careers.

The first area of significance is gender bias and environment, with which the participants are surrounded, and the impact they have on women in STEM. The findings in this research demonstrated that home, school and work environments have a definite impact on women attaining and retaining their leadership positions under stereotype threat. The first environment to consider was that of home. In this research study, it was found through the personal narratives and the one-on-one interviews, that parents had a significant impact on these women. The research showed that parents had a significant effect on their motivation to learn, achievement in school, and their self-efficacy. Throughout the study, it was revealed that the women were aware of the negative stereotypes about their gender's performance, especially in math and the negative connotations that were associated with women performing poorly. In this study, all seven

participants were raised by both parents. The parent that had the most influence was their fathers. This was noteworthy as several times throughout the research the participants discussed that fathers had the most influence and often were the biggest cheerleaders for their success. The participants repeated that the strong work ethic shown by their parents contributed to their success. The participants often stated that their parents had faith in them, their ability, and knew that they were self-motivated and high-achievers. They loved the act of learning. The women were motivated to make their parents proud. School environments also had an impact on women. During their formative years and into college both male and female teachers motivated and encouraged the participants. However, as stated earlier, there were male teachers who often made disparaging comments regarding the women's future in the job market and their opportunity to take challenging coursework and do well other than in old-fashioned traditional roles. Undeniably, these women proved them wrong. In their current leadership roles, the women's environment had a big impact on them. There were male and female bosses, good and bad, who encouraged them. It was very significant, however, that six of the seven women in this study pointed out that they worked for consciously progressive companies. The women mentioned that their companies motivated them to achieve and empowered them to succeed. The women felt like their companies were passionate about diversity and inclusion. They were given many opportunities to do well and were surrounded by great leadership teams.

The second area of significance was the influence of stereotype on women. Throughout this research, the women were aware of the vulnerabilities and consequences of being women in STEM leadership roles. As previously stated, stereotype threat took on different meanings other than gender stereotyping. The women in this study wanted trust in their leadership roles and to have the credibility and respect that they deserved. Credibility was a motivating factor for these

women. They wanted their coworkers to recognize that they could do their jobs, not because they were women, but because they were the best choice for the position. They also wanted to be trusted by their male counterparts and other employees. This was significant to the study because the research indicated that social groups have shown declines in performance when negative stereotypes about their group's abilities were made salient (Gerstenberg, Imhoff & Schmitt, 2012).

The final area of significance was the psychology of women in STEM careers. In the literature, Bandura (1977) introduced the idea of reciprocal determinism which revealed that an individual's behavior is influenced by the environment and the environment is influenced by the individual's behavior. This idea had a significant relationship to the participants in this study. The women in this study often set challenging goals for themselves and upheld strong commitment to them. They were aware of their vulnerabilities and were able to deal with the consequences that were associated with them. This was proof that the women in this study had a strong sense of efficacy and personal well-being. Overcoming obstacles in college and current leadership positions showed that, with determination, one can emerge stronger from adversity. The women in this study had viable mentors, such as both their male and female bosses, that encouraged them and helped them develop strong self-efficacy. Bandura (1994) referred to this as modeling influences and also stated that people who were persuaded verbally possess the competencies to master activities and were more likely to put forth greater effort and sustain it. This was exhibited by the women in this study. They were advanced learners, highly educated, and hold leadership positions of importance for their companies.

Recommendations for Future Research

Parents. As addressed earlier, the research for this study was especially important to key stakeholders: parents, educators, employers and policy makers. Research has shown that parents, as well as educators have an impact on children at a young age with regard to STEM education. During the interviews the researcher was surprised by the fact that the participants were all raised by two parents in a traditional household. Three of the participants were raised in a small town. Knowing that this cannot be generalized to the greater population, but it does leave room for further research. To develop a deeper understanding of women in STEM, comparing traditional environments with non-traditional environments and the effect it has on women in leadership is a topic to be considered. In the case of this research study, fathers most often were noted as being influential for motivation and self-efficacy. While it was not a topic for this research, role reversal was mentioned by one of the participants and its influence on the aspirations of women in the work force. Another possibility for future research and the impact it has on women in STEM leadership is investigating growing up in a small town versus the city. The impact of environment and living situations could add depth and breadth to this topic.

Educators. As noted in this research, the participants in this study discussed the impact of positive parent communication. The participants were motivated to learn and work hard to achieve good grades. As the participants went through high school and into college, communication was not as encouraging. The researcher suggests that educators be trained and made more aware of the impact of communication and the repercussions it has on girls from a young age through college.

Employers and Policy Makers. Employers and policy makers are influential in hiring and supporting women for STEM related leadership positions and initiatives. It was especially noted in this study that companies with diversity and inclusion encouraged leadership within

their companies. Also noted was that women's environment played a big impact on women in leadership. During the course of this study, the participants felt stereotype influences that affected them on the job. Companies that were consciously progressive motivated women to achieve and empowered them to succeed. Another discovery made by the researcher was that employers needed to explore options on how to keep their talented women in the workforce before they burn out due to stereotype threats. Further research that focuses on workplace environment and the impact of stereotype effects on job performance could lead not only to qualitative information, but quantitative inquiry as well.

Conclusion

The design of this phenomenological research study guided the investigation to provide valuable insight and information identifying the link between stereotype threats, intelligence, self-efficacy, and communication as it related to women in STEM leadership positions. This study investigated the influence of stereotype with the implicit theories of intelligence, the psychology of women in STEM careers, self-efficacy and message design logic as it pertained to women in STEM leadership roles and how women attained and retained their positions. There were seven women from Midwestern metropolitan cities in STEM leadership roles who participated in this research and provided valuable information for further research. To that end, closing comments are best said by the women from whom we learn:

Cindy:

> "I just feel like if I can come to work, do my job, do a great job at it and have great outcomes, then I'm going to be successful. You don't have to have a title to be successful in my mind."

Shelly:

"I truly feel like you are assessed on your personal performance, your strengths, your opportunities, how you drive results. Whether you are male or female, we are all held to the same standard."

Barbara:

"I think there's still a lot of stereotype. It is not as blatant as it used to be, but I think there is still a lot of that same kind of thing going on like going golfing with customers, going out for a beer with customers. I just don't think, even to this day, women are perceived in the same roles."

Janice:

"Why are they (women) excusing themselves before they make it to the very top? What would it take to try and keep our very talented younger female executives engaged? What can we do to keep them engaged?"

Maggie:

"We need more of us. We need more women in instructional technology. We need to talk to girls younger so they can see themselves in these jobs and know that they are in a good career.

Mary:

"I was taught early that everything is within your control. You make decisions and things so empowering for people to know that things are within their control, with encouragement."

Laurie:

"I think there's just so much opportunity for both men and women, but particularly women that just don't understand what opportunities are available within STEM and the more we can break down those barriers and help them identify it, I think they'll see there can be such rewarding and fulfilling career. But, whether it is problem solving or leadership or project management, that it's what, you know, I think that anything we can do to help increase female awareness around STEM is great."

References

Ambady, N., Shih, M., Kim, A., & Pittinsky, T. (2001). Stereotype susceptibility in children: Effects of identity activation on quantitative performance. *Psychological Science, 12*, 385-390.

American Association for the Advancement of Science. (1989). Project 2061: *Science for all Americans.* New York: Oxford University Press.

American Association for the Advancement of Science. (1993). *Benchmarks for science literacy.* New York: Oxford University Press.

Ards, S., Brintnall, M., & Woodard, M. (1997). The road to tenure and beyond for African American political scientists. *The Journal of Negro Education, 66*(2), 159-171.

Aronson, J., Lustina, M., Good, C., Keough, K., Steele, C., & Brown, J.(1999). When white men can't do math: Necessary and sufficient factors in stereotype threat. *Journal of Experimental Social Psychology, 35*, 29-46.

Aronson, J. (2004). The threat of stereotype. *Educational Leadership, 62,* (3), 14-19.

Bain, O., & Cummings, W. (2000). Academe's glass ceiling: Societal, professional, organizational and institutional barriers to the career advancement of academic women. *Comparative Education Review, 44*(4), 493-514.

Bandura, A. (1971). *Social Learning Theory*. New York, NY. General Learning Press.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84,*191-215.

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

Bandura, A. (1994). Self-Efficacy. In V.S. Ramachaudran (Ed.) *Encyclopedia of Human Behavior, 4,* 71-81. New York: Academic Press.

Bandura, A. (2000). Exercise of human agency through collective efficacy. *Current Directions in Psychological Science, 9,* 75-78.

Beasley, M., & Fischer, M. (2012). Why they leave: The impact of stereotype threat on the attrition of women and minorities from science, math and engineering majors. *Social Psychology of Education, 15,* 427-448.

Blackwell, L., Trzesniewski, K., & Dweck, C. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Development, 78,* 246-263.

Boyer Commission on Educating Undergraduates in the Research University. (1998). *Reinventing undergraduate education: A blueprint for America's research universities.* Stony Brook: State University of New York at Stony Brook.

Brownlow, S., Jacobi, T., & Rogers, M. (2000). Science anxiety as a function of gender and experience. *Sex Roles, 42*(1/2), 119-131.

Burns, J. (1978). *Leadership.* New York, NY: Harper & Row.

Bursal, M. (2013). Longitudinal investigation of elementary students' science academic achievement in 4-8th grades: Grade level and gender differences. *Educational Sciences: Theory & Practice, 13*(2), 1151-1156.

Byrn-Doran, J. (2012). A Qualitative study of working mothers in Ireland: An exploration of 'lived experiences'. *The International Journal of Interdisciplinary Social Sciences, 6*(11), 101-113.

Camp, T. (2002). The incredible shrinking pipeline. *ACM SIGCSE* [Special Interest Group on Computer Science Education] *Bulletin, 34,* 129-134.

Cadinu, M., Maass, A., Rosabianca, A., & Kiesner, J. (2005). Why do women underperform under stereotype threat? *Psychological Science, 16*(7), 572-578.

Cash, R. (2011). *Advancing Differentiation: Thinking and Learning for the 21st Century*. Minneapolis, MN: Free Spirit.

Cheema, J., & Galluzzo, G. (2013). Analyzing the gender gap in math achievement: Evidence from a large-scale US sample. *Research in Education, 90*, 98-112.

Chiu, C., Hong, Y., & Dweck, C. (1997). Lay dispositionism and implicit theories of personality. *Journal of Personality and Social Psychology, 73,* 19-30.

Cohen, G., & Garcia, J. (2005). "I am us": Negative stereotypes as collective threats. *Journal of Personality and Social Psychology, 89*(4), 566-582.

Corbin, J., & Strauss, A. (2008). *Basics of qualitative research.* Los Angeles: SAGE Publications.

Cotter, D., Hermsen, J., Ovadia, S., & Vanneman, R. (2001). The glass ceiling effect. *Social Forces, 80*(2), 655-681.

Creswell, J. (2013). *Qualitative inquiry and research design: Choosing among five approaches* (3rd ed.). Los Angeles: SAGE Publications.

Creswell, J. (2014). Research design: *Qualitative, quantitative, and mixed methods approaches.* Los Angeles: Sage.

Croizet, J., & Clair, T. (1998). Extending the concept of stereotype threat to social class: The intellectual underperformance of students from low socioeconomic backgrounds. *Personality and Social Psychology Bulletin, 24,* 588-594.

Cuddy, A., Fiske, S., & Glick, P. (2007). The BIAS map: Behaviors from intergroup affect and stereotypes. *Journal of Personality and Social Psychology, 92,* 631-648.

DeJarnette**, N.** (2012). America's children: Providing early exposure to STEM (science, technology, engineering and math) initiatives. *Education, 133*(1), 77-84.

Dweck, C., & Elliott, E. (1983). Achievement motivation. In E.M. Hetherington (Ed). *Socialization, personality, and social development.* New York: Wiley.

Dweck, C. (1986). Motivational processes affecting learning. *American Psychologist, 41*(10), 1040-1048.

Dweck, C. (1999). *Self-theories: Their role in motivation, personality and development.* Philadelphia, PA: Taylor and Francis/Psychology Press.

Dweck, C. (2007, October). The perils and promises of praise. *Early Intervention at Every Age, 65*, 34-39.

Dweck, C. (2006). *Mindset: The new psychology of success.* New York: Ballantine Books.

Editorial Projects in Education Research Center. (2011, September 19). Issues A-Z: No Child Left Behind. *Education Week.* Retrieved from: http://www.edweek.org/ew/issues/no-child-left-behind.

Edwards, A., Rose, L., Edwards, C., & Singer, L. (2006). An investigation of the relationships among implicit personal theories of communication, social support, and loneliness. *Human Communication, 11*(4), 437-454.

Elder, L., & Paul, R. (2010). The thinker's guide to analytic thinking. Dillon Beach, CA: Foundation for Critical Thinking.

Erdly, C., & Dweck, C. (1993). Children's implicit personality theories as predictors of their social judgments. *Child Development, 64,* 863-878.

Executive Office of the President. (2013, June), *1-4*. Retrieved from: www.whitehouse.gov/ostp/women.

Fisher, B., Motowidlo, S., & Werner, S. (1993). Effects of gender and other factors on rank of law professors in colleges of business: Evidence of a 'glass ceiling'. *Journal of Business Ethics,* 12(10), 771-778.

Fiske, S., Cuddy, S., Glick, P., & Xu, J. (2002). A model of (often mixed stereotype content: Competence and warmth respectively follow from perceived status and competition. *Journal of Personality and Social Psychology, 82*, 878-902.

Fletcher, E. (2012). Predicting the influence of demographic differences and schooling experience in adolescence on occupational choice in adulthood. *Career and Technical Education Research, 37*(2), 121-139.

Forrest, D. (2008). Communication theory offers insight into mathematics teachers' talk. *The Mathematics Educator, 18* (2), 23-32.

Gerstenberg, F., Imhoff, R., & Schmitt, M. (2012). Women are bad at math, but I'm not, am I? Fragile mathematical self-concept predicts vulnerability to a stereotype threat effect on mathematical performance. *European Journal of Personality, 26,* 588-599.

Gervais, S., & Vescio, T. (2012). The effect of patronizing behavior and control on men and women's performance in stereotypically masculine domains. *Sex Roles, 66,* 479-491.

Ginther, D., & Hayes, K. (1999). Gender differences in salary and promotion in the humanities. *The American Economic Review, 89*(2), 397-402.

Good, C., Aronson, J., & Harder, J. (2008). Problems in the pipeline: Stereotype threat and women's achievement in high-level math courses. *Journal of Applied Developmental Psychology, 29,* 17-28.

Good, C., Rattan, A., & Dweck, C. (2012). Why do women opt out? Sense of belonging and women's representation in mathematics. *Journal of Personality and Social Psychology, 102*(4), 700-717.

Gunderson, E., Ramirez, G., Levine, S., & Beilock, S. (2012). The role of parents and teachers in the development of gender-related math attitudes. *Sex Roles, 66*, 153-166.

Halvorson, H. (2011). The trouble with bright girls. *The Science of Success*, 1094.

Hart, J. (2002). Cultural assumptions underlying message design logic: Premises of development, preference, and understanding. *Intercultural Communication Studies, XI* (4), 109-120.

Hernandez, P., Woodcock, A., Schultz, P., Estrada, M., & Chance, R. (2013). Sustaining optimal motivation: A longitudinal analysis of interventions to broaden participation of underrepresented students in STEM. *Journal of Educational Psychology*, *105*(1), 89-107.

Hill, C., Corbett, C., & Rose, A. (2010). Why so few? Women in science, technology, engineering and mathematics. Retrieved from: http://www.aauw.org/files/2013/02/Why-So-Few-Women-in-Science-Technology-Engineering-and-Mathematics.pdf

Hong, Y., Chiu, C., Dweck, C., Lin, D., & Wan, W. (1999). Implicit theories, attributions, and coping: A meaning system approach. *Journal of Personality and Social Psychology, 77,* 588-599.

Jackson, D. (2013). Making the connection: The impact of support systems on female transfer students in science, technology, engineering, and mathematics (STEM). *The Community College Enterprise,* 19-33.

Jackson, J., & O'Callaghan, E. (2009). What do we know about the glass ceiling effects? A taxonomy and critical review to inform higher education research. *Research in Higher Education, 50,* 460-482.

Johnson, H., Barnard-Brak, L., Saxon, T., & Johnson, M. (2012). An experimental study of the effects of stereotype threat and stereotype lift on men and women's performance in mathematics. *The Journal of Experimental Education, 80*(2), 137-149.

Keller, J. (2002). Blatant stereotype threat and women's math performance: Self-handicapping as a strategic means to cope with obtrusive negative performance expectations. *Sex Roles, 47*(3/4), 193-198.

Korpershoek, H., Kuyper, H., van der Werf, G., & Bosker, R. (June, 2011). Who succeeds in advanced mathematics and science courses? *British Educational Research Journal, 37*(3), 357-380.

Lambert, B., & Gillespie, J. (1994). Patient perceptions of pharmacy students' hypertension compliance-gaining messages: Effects of message design logic and content themes. *Health Communication, 6*(4), 311-325.

Leedy, P. & Ormrod, J. (9th Ed.). (2010). *Practical research, planning and design.* Saddle River, NJ: Prentice Hall.

Levy, S., Stroessner, S., & Dweck, C. (1998). Stereotype formation and endorsement: The role of implicit theories. *Journal of Personality and Social Psychology, 74*(6), 1421-1436.

Litmanovitz, M. (2011). Beyond the classroom: Women in education leadership. *Harvard Kennedy School Review, 11,* 25-28.

Ma, Y. (December, 2011). Gender differences in the paths leading to a STEM baccalaureate. *Social Science Quarterly, 92*(5), 1170-1190.

Mahoney, M. (2010). Students' attitudes toward STEM: Development of an instrument for high school STEM-based programs. *The Journal of Technology Studies,* 24-34.

Mangels, J., Butterfield, B., Lamb, J., Good, C., & Dweck, C. (2006). Why do beliefs about intelligence influence learning success? A social cognitive neuroscience model. *SCAN, 1,* 75-76.

Margolis, J., & Fisher, A. (2002). *Unlocking the clubhouse: Women in computing.* Cambridge, MA: MIT Press.

McIntyre, R., Pauslon, R., Taylor, C., Morin, A., & Lord, C. (2011). Effects of role model deservingness on overcoming performance deficits induced by stereotype threat. *European Journal of Social Psychology, 41,* 301-311.

Munro, N., (2009, July 4). Science faces Title IX test. *National Journal Magazine.*

Moore, T., & Shaughnessy, M. (2012). Carol Dweck's views on achievement and intelligence: Implications for education. *Research Journal in Organizational Psychology & Educational Studies, 1*(3), 174-184.

Morgan, W., & King, E. (2012). The association between work-family guilt and pro- and anti-social work behavior. *Journal of Social Issues, 46*(4), 684-703.

Morganson, V., Jones, M., & Major, D. (2010). Understanding women's underrepresentation in science, technology, engineering, and mathematics: The role of social coping. *The Career Development Quarterly, 59,* 169-179.

National Commission on Excellence in Education [NCEE]. (1983). *A nation at risk: The imperative for educational reform: A report to the nation and the Secretary of Education, United States Department of Education.* Washington, DC: Author.

National Research Council (NRC). (1996). National science education standards. Washington, DC: National Academy Press.

National Science Foundation. (1996). *Shaping the future: New Expectations for Undergraduate Education in Science, Mathematics, Engineering, and Technology,* (NSF 96-139). Arlington VA.

Nicholson, J., Warren, S.T., Oppenheimer, B., Goodman, M., Coding, J., Robinson, T., & Chung, J.Y. (2013). STEM research: What the pictures tell us. *The International Journal of Science in Society, 4*, 1-14.

Office of Science and Technology Policy. (2011, September 26). Retrieved from: http://www.whitehouse.gov/administration/eop/ostp/women.

Ohlott, P., Ruderman, M., & McCauley, C. (1994). Gender differences in managers' developmental job experiences. *The Academy of Management Journal*, *37*(1), 46-67.

O'Keefe, B. (1988). The logic of message design. *Communication Monographs, 55, 80-103.*

O'Keefe, B., & McCornack, S. (1987). Message design logic and message goal structure: Effects on perceptions of message quality in regulative communication situations. *Human Communication Research, 14*, 80-103.

Partnership for 21st Century Skills. (2004). Washington, DC. Retrieved from: http://www.p21.org.

Peterson, L., & Albrecht, T. (1996). Message design logic, social support, and mixed status relationships. *Western Journal of Communication, 60*(4), 290-309.

Seidman, I. (2013). *Interviewing as qualitative research: A guide for researchers in education and the social sciences* (4th ed.). New York: Teacher College Press.

Shapiro, J. (2011). Different groups, different threats: A multi-threat approach to the experience of stereotype threats. *Personality and Social Psychology Bulletin, 37,* 464-480.

Shapiro, J., & Neuberg, S. (2007). From stereotype threat to stereotype threats: Implications of a multi-threat framework for causes, moderators, mediators, consequences, and interventions. *Personality and Social Psychology Review, 11,* 107-130.

Shapiro, J., & Williams, A. (2012). The role of stereotype threats in undermining girls' and women's performance and interest in STEM fields. *Sex Roles, 66,* 175-183.

Silverman, D. (2004). *Doing qualitative research (2nd ed.).*Thousand Oaks, CA: Sage.

Smeding, A. (2012). Women in Science, technology, engineering, and mathematics (STEM): An investigation of their implicit gender stereotypes and stereotypes' connectedness to math performance. *Sex Roles, 67,* 617-629.

Spencer, S., Steele, C., & Quinn, D. (1999). Stereotype threat and women's math performance. *Journal of Experimental Social Psychology, 35,* 4-28.

Spencer, S. (1993). *The effect of stereotype vulnerability on women's math performance.* Unpublished dissertation, University of Michigan, Ann Arbor.

Steele, C., & Aronson, J. (1995). Stereotype threat and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology, 69*(5), 797-811.

Steele, C., & Aronson, J. (1995). Stereotype Threat. Retrieved from: http://www.reducingstereotypethreat.org/bibliography_steele_aronson.html

Steele, C., James, J., & Barnett, R. (2002). Learning in a man's world: Examining the perceptions of undergraduate women in male-dominated academic areas. *Psychology of Women Quarterly, 26*(1), 46-50.

Teaching Institute for Excellence in STEM. (2010). What is STEM Education? Retrieved from: http://www.tiesteach.org/stem-education.aspx.

Thelen, D. (1989, September 27). A new approach to understanding human memory offers a solution to the crisis in the study of history. *The Chronicle of Higher Education,* B1, B3.

Tierney, J. (2008, July 15). A new frontier for Title IX: Science. *New York Times.*

U.S. Department of Commerce Economics and Statistics Administration (July, 2011). STEM: Good jobs now and for the future, *1-10.*

U.S. Department of Commerce Economics and Statistics Administration (August, 2011). Women in STEM: A gender gap to innovation, *1-11.*

U.S. Department of Education. (June, 2012). Gender Equity in Education, *1-4.*

U.S. Department of Education. Retrieved from: http://www2ed.gov/about/ offices/list/ocr/docs/tix_dis.html

VonHippel, C., Issa, M., Ma, R., & Stokes, A. (2011). Stereotype threat: Antecedents and consequences for working women. *European Journal of Social Psychology, 41,* 151-161.

Walton, G., & Cohen, G. (2003). Stereotype lift. *Journal of Experimental Social Psychology, 39,* 456-467.

Wigfield, A., & Meece, J. (1988). Math anxiety in elementary and secondary school students. *Journal of Educational Psychology, 80,* 210-216.

Appendix A: Invitation to Participate

January, 2015

WOMEN IN STEM: ATTAINING AND RETAINING LEADERSHIP POSITIONS UNDER STEREOTYPE THREAT
IRB# CSM 1409

Dear Leader,

I am a student at the College of Saint Mary in Omaha, Nebraska working on my Doctorate of Education degree in Educational Leadership. I am preparing to conduct a research study on Women in Science, Technology, Engineering, and Math (STEM) leadership positions. The purpose of this study is to provide valuable insight and information identifying the link between the influential factors that affect women in leadership positions, specifically STEM careers and disciplines in education, business, medical, and political sector while under stereotype threat. You are invited to take part in a research study because you are a woman with a four year Science, Technology, Engineering, or Mathematics (STEM) degree and are currently in a leadership position. This research study is being conducted as part of the requirements for my Doctorate of Education program at College of Saint Mary. I am interested in meeting with you and interviewing you.

If you decide to participate in the study, you will be contacted by email or phone to arrange a meeting time at a convenient place of your choosing for the interview. You will be asked to complete a short personal narrative ahead of the interview that will be collected at that time. The one-on-one interview will take approximately one hour to complete. Your participation is strictly voluntary. Furthermore, your response or decision not to participate in this study will not affect your relationship with College of Saint Mary or any other entity. Please note that your responses will be used for research purposes only and will be strictly confidential. No one at College of Saint Mary will ever associate your individual responses with your name or email address. The information from this study may be published in journals and presented at professional meetings.

You may receive no direct benefit from participating in this research study, but the information gained will be helpful to key stakeholders: parents, educators, employers, and policy makers that are influential in supporting the under representation of women in STEM related leadership positions and initiatives.

Your response to this email will only indicate your interest in participating in this research study. Should you decide to participate, the email response will serve as your consent to participate and the personal written narrative will be sent. At the time of your interview, your signed consent form will indicate your informed consent to participate in the study.

You may withdraw at any time during the interview. This study does not cost you in any way, except the time spent on the short personal written narrative, time during the interview, and a follow-up review of the interview. There is no compensation or known risk associated with participation. If you have questions about your rights as a research participant, you may contact the College of Saint Mary Institutional Review Board, 7000 Mercy Road, Omaha, NE 68144 (402-399-2400).

Thank you for considering participating in this important research study. If you have any questions about the short written narrative or the interview process, please do not hesitate contacting me.

Sincerely,

Mary Ritzdorf, M.S.

(402) 630-8180

Appendix B: Adult Consent Form

IRB#: CSM 1409 Approval Date: December 3, 2014 Expiration Date: January 1, 2016

WOMEN IN STEM: ATTAINING AND RETAINING LEADERSHIP POSITIONS UNDER STEREOTYPE THREAT

You are invited to take part in this research study. The information in this form is meant to help you decide whether or not to take part. If you have any questions, please ask.

Why are you being asked to be in this research study?

You are being asked to participate in this study because you are a woman from a Midwestern metropolitan city with a four year Science, Technology, Engineering, or Math (STEM) degree, working full time in a leadership role.

What is the reason for doing this research study?

The reason for this research study is to examine the link between successful women in leadership positions and the gender inequities and underrepresentation of women in Science, Technology, Engineering, or Math (STEM) careers. The research for this study has been designed to investigate the influence of stereotype with the implicit theories of intelligence and women in STEM careers, as well as the investigating the psychology of women in STEM careers by examining self-efficacy and message design logic as it pertains to women in leadership roles.

The purpose of this research is to provide valuable insight and information identifying the link between these theories and successful women in leadership positions and STEM careers. Additionally, the purpose of this research study is to identify the influential factors that affect women in leadership positions, specifically STEM careers and disciplines in the education, business, medical, and political sector. The results of this research study will support a detailed understanding of the central phenomenon of how women attain STEM leadership roles and how they retain their positions.

Participant Initials _____

ADULT Consent Form - PAGE TWO

What will be done during this research study?
The procedures for this research study will include:

- The researcher will seek full IRB approval prior to conducting this research study.
- The participants will be invited to participate in the interview process through email and/or United States mail.
- Participants interviewed will be women from Midwestern metropolitan cities in STEM leadership roles, with a four year degree.
- The interview will be conducted face-to-face with 4-8 women in their natural setting as agreed upon by the researcher and the participant.
- The interview will last approximately 60 minutes.
- At the interview, the research participants will be provided ethical considerations for this research study.
- During the interview, the interviewer will use a computer with a built-in audio recorder to record the interview.
- The interviewer will read the Adult Consent Form, and The Rights of The Research Participants.
- The Adult Consent Form will be signed prior to any interview questions.
- The researcher will collect the Personal Narrative that was sent to the participant ahead of time for additional data collection.
- The researcher will ask the participants three main research questions with subquestions for each of the main questions.
- Two additional questions will be used as follow-up questions.
- At the conclusion of the study, the participants will be asked to review their own individual information for accuracy and member checking.

What are the possible risks of being in this research study?

There are no known risks to you from being involved in this research study.

What are the possible benefits to you?

You are not expected to get any direct benefit from being in this research study.

Participant Initials _____

ADULT Consent Form - PAGE THREE

What are the possible benefits to other people?

The research for this study is especially important and beneficial to key stakeholders: parents, educators, employers, and policy makers. Research has shown that parents, as well as educators have an impact on children at a young with regard to STEM education. Employers and policy makers are influential in hiring and supporting women for STEM related leadership positions and initiatives. Through this research study, the participants perceptions have the potential to impact the stakeholders and can help the stakeholders be made more aware of the impact stereotype has on women's view of intelligence and self-efficacy, as well as the impact that messages have on girls and women. This research has the potential to affect the underrepresentation of women in Science, Technology, Engineering, and Mathematics disciplines, careers, and leadership roles.

What are the alternatives to being in this research study?

Instead of being in this research study, you can choose not to participate.

What will being in this research study cost you?

There is no cost to you to be in this research study.

Will you be paid for being in this research study?

You will not be paid or compensated for being in this research study.

What should you do if you have a concern during this research study?

Your well-being is the major focus of every member of the research team. If you have a concern as a direct result of being in this study, you should immediately contact one of the people listed at the end of this consent form.

How will information about you be protected?

Reasonable steps will be taken to protect your privacy and the confidentiality of your study data. The only persons who will have access to your research records are the study personnel, the Institutional Review Board (IRB), and any other person or agency required by law. The information from this study may be published in scientific journals or presented at scientific meetings but your identity will be kept strictly confidential.

Participant Initials _____

ADULT Consent Form - PAGE FOUR

What are your rights as a research participant?

You have rights as a research participant. These rights have been explained in this consent form and in *The Rights of Research Participants* that you have been given. If you have any questions concerning your rights, talk to the investigator or call the Institutional Review Board (IRB), telephone (402)-399-2400.

What will happen if you decide not to be in this research study or decide to stop participating once you start?

You can decide not to be in this research study, or you can stop being in this research study ("withdraw") at any time before, during, or after the research begins. Deciding not to be in this research study or deciding to withdraw will not affect your relationship with the investigator, or with the College of Saint Mary (also add any other sites to this statement, if needed).

You will not lose any benefits to which you are entitled.

If the research team gets any new information during this research study that may affect whether you would want to continue being in the study, you will be informed promptly.

Documentation of informed consent:

You are freely making a decision whether to be in this research study. Signing this form means that (1) you have read and understood this consent form, (2) you have had the consent form explained to you, (3) you have had your questions answered and (4) you have decided to be in the research study.

If you have any questions during the study, you should talk to one of the investigators listed below. You will be given a copy of this consent form to keep.

If you are 19 years of age or older and agree with the above, please sign below.

Signature of Participant: Date: Time:

Participant Initials _____

ADULT Consent Form - PAGE FIVE

My signature certifies that all the elements of informed consent described on this consent form have been explained fully to the participant. In my judgment, the participant possesses the legal capacity to give informed consent to participate in this research and is voluntarily and knowingly giving informed consent to participate.

Signature of Investigator: Date:

Principal Investigator: Mary Ritzdorf, M.S. Phone: (402) 630-8180

Appendix C: Rights of the Research Participants

(Script to be read to research participants prior to obtaining informed consent)

AS A RESEARCH PARTICIPANT AT COLLEGE OF SAINT MARY YOU HAVE THE RIGHT:

1. TO BE TOLD EVERYTHING YOU NEED TO KNOW ABOUT THE RESEARCH BEFORE YOU ARE ASKED TO DECIDE WHETHER OR NOT TO TAKE PART IN THE RESEARCH STUDY. The research will be explained to you in a way that assures you understand enough to decide whether or not to take part.

2. TO FREELY DECIDE WHETHER OR NOT TO TAKE PART IN THE RESEARCH.

3. TO DECIDE NOT TO BE IN THE RESEARCH, OR TO STOP PARTICIPATING IN THE RESEARCH AT ANY TIME. This will not affect your relationship with the investigator or College of Saint Mary.

4. TO ASK QUESTIONS ABOUT THE RESEARCH AT ANY TIME. The investigator will answer your questions honestly and completely.

5. TO KNOW THAT YOUR SAFETY AND WELFARE WILL ALWAYS COME FIRST. The investigator will display the highest possible degree of skill and care throughout this research. Any risks or discomforts will be minimized as much as possible.

6. TO PRIVACY AND CONFIDENTIALITY. The investigator will treat information about you carefully and will respect your privacy.

7. TO KEEP ALL THE LEGAL RIGHTS THAT YOU HAVE NOW. You are not giving up any of your legal rights by taking part in this research study.

8. TO BE TREATED WITH DIGNITY AND RESPECT AT ALL TIMES.

*Taken from page 35 of the College of Saint Mary 2012 Institutional Review Board Application Guidebook.

Appendix D: Participant Personal Narrative

WOMEN IN STEM: ATTAINING AND RETAINING LEADERSHIP POSITIONS UNDER STEREOTYPE THREAT

IRB# CSM 1409

Participant: Please provide short narrative answers to each of the following questions. Answers to these questions should focus on formative years up through High School. These will be collected at the time of the scheduled one-on-one interview.

1. Achievement motivation and Intelligence:

   What motivated you to learn or perform as a young girl growing up?

   How would you define your own intelligence as a young girl growing up?

2. Self-efficacy:

   What did your self-efficacy look like or feel like as a young girl?

   Explain any obstacles in your self-efficacy you had to overcome as a young girl.

   Who was/were the most influential person(s) in your life as a young girl?

3. Messages and communication:

   How did adults communicate to you in your home environment as a young girl?

   How did adults communicate to you in your environment as a young girl?

4. Stereotypes:

   Recall how you were affected by stereotype in your life as a young girl growing up.

Appendix E: Interview Form

WOMEN IN STEM: ATTAINING AND RETAINING LEADERSHIP POSITIONS UNDER STEREOTYPE THREAT

IRB# CSM 1409

Time of Interview:

Date:

Place:

Interviewer: Mary A. Ritzdorf

Participant: A pseudonym and code number will be assigned to each participant. The pseudonyms will correspond with the letters of STEM, depending on which strand the participant comes from. The code number will correspond with which participant it is in the time order of interview.

Pseudonym_____ Code #_____

Current job position of participant:

Strand of STEM: Science ____Technology ____ Engineering ____ Math ____

Brief demographics of participant:

Degree earned:

Year degree earned:

Does the degree match current leadership position?

Years of experience in current leadership position:

Interview Questions

1. How do implicit theories of intelligence affect self-regulation in women from Midwestern metropolitan cities in STEM leadership roles regarding achievement motivation and how they attain and retain their professional STEM careers while influenced by stereotypes?

    What motivated you to learn as you were going through your college experience?

    What motivated you to perform as you were going through your college experience?

    What motivates you to learn or perform in your current leadership position?

    Explain how you would define your own intelligence during your college experience.

    Explain how you would define your own intelligence in your current leadership position.

2. Does self-efficacy affect how women from Midwestern metropolitan cities in STEM leadership roles attain and retain STEM careers while influenced by stereotypes?

    What best describes your self-efficacy as you were going through your college experience?

    What best describes your self-efficacy in your current leadership position?

    Explain any obstacles in your self-efficacy you had to overcome while in college.

    Explain any obstacles in your self-efficacy that you have had to overcome in your current leadership position.

    Who was/were the most influential person(s) in your life as you were going through college?

    Who has/have been the most influential person(s) in your life in your current leadership position.

3. How does message design logic from home, school, and/or work encourage or discourage women from Midwestern metropolitan cities in STEM leadership roles toward attaining and retaining STEM careers while influenced by stereotypes?

What was your perception of communication to you and with others in your life as you were going through your college experience?

What is your perception of communication to you and with others in your life in your current leadership position?

4. What is the impact of stereotypes on women in leadership roles in STEM careers?

   How were you affected by stereotype as you were going through your college experience?

   How have you been affected by stereotype in your current leadership position?

5. Do you have any other closing remarks regarding your experience(s) as a woman in a STEM leadership role?

Appendix F: Field Notes Observation Form

WOMEN IN STEM: ATTAINING AND RETAINING LEADERSHIP POSITIONS UNDER STEREOTYPE THREAT

IRB# CSM 1409

Date: _____ Time_____ Participant _____

Notes about the Setting:

Notes about the Participant:

Behaviors of the Participant:

Additional Information: