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A CONCEPTUAL MODEL FOR DETERMINING CAREER CHOICE OF CHROME ALUMNA BASED ON FARMER'S CONCEPTUAL MODELS

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A Dissertation Submitted to the Faculty of
Old Dominion University in Partial Fulfillment of the
Requirement for the Degree of

DOCTOR OF PHILOSOPHY

URBAN SERVICES

OLD DOMINION UNIVERSITY
December 2005

Approved by:

Dana Burnett (Chair)

Gail Taylor (Member)

Wendy Frazier (Member)

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ABSTRACT

A CONCEPTUAL MODEL FOR DETERMINING CAREER CHOICE OF CHROME ALUMNA BASED ON FARMER'S CONCEPTUAL MODELS

Lisa Simmons Moore
Old Dominion University, 2005
Director: Dr. Dana Burnett

This qualitative program evaluation examines the career decision-making processes and career choices of nine, African American women who participated in the Cooperating Hampton Roads Organization for Minorities in Engineering (CHROME) and who graduated from urban, rural or suburban high schools in the year 2000. The CHROME program is a nonprofit, pre-college intervention program that encourages underrepresented minority and female students to enter science, technically related, engineering, and math (STEM) career fields. The study describes career choices and decisions made by each participant over a five-year period since high school graduation. Data was collected through an Annual Report, Post High School Questionnaires, Environmental Support Questionnaires, Career Choice Questionnaires, Senior Reports, and standardized open-ended interviews. Data was analyzed using a model based on Helen C. Farmer's Conceptual Models, John Ogbu's Caste Theory and Feminist Theory. The CHROME program, based on its stated goals and tenets, was also analyzed against study findings. Findings indicated that participants received very low levels of support from counselors and teachers to pursue STEM careers and high levels of support from parents and family, the CHROME program and financial backing. Findings of this study also indicated that the majority of CHROME alumna persisted in STEM careers. The

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most successful participants, in terms of undergraduate degree completion and occupational prestige, were the African American women who remained single, experienced no critical incidents, came from a middle class to upper middle class socioeconomic background, and did not have children.

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This dissertation is dedicated to my mother, Esther M. Simmons, without whom none of this would have been possible. Her self-less sacrifice for her family, friends and loved ones inspired me and continues to inspire me daily. Her love of education, which was instilled in me as well as each of my siblings, also inspired me to complete this task. It is my only hope that she will look down from heaven and smile at this accomplishment for this was her dream as well.

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ACKNOWLEDGMENTS

First and foremost, I thank God for His calling on my life that I would be of service in the field of education. This journey, with its many twists and turns, is a testimony to what God can do.

Many people contributed to the successful completion of this dissertation. I thank my family, dissertation committee, editor, close friends, educational support personnel and the CHROME program.

My parents, Samuel D. Simmons, Sr. and Esther M. Simmons, instilled in me a lifelong joy of learning. In addition to setting high academic standards, they also encourage me to aspire to be the best in whatever I choose to pursue. I also thank them for their financial support and many prayers.

My siblings, Angelia Abadeey, Samuel D. Simmons, Jr., Karen Simmons and Lois Simmons, have without a doubt, encouraged and assisted me in this journey. I could not have accomplished this without them. A special thank you to my sister Lois who gave me extra love and support during my final year of writing my dissertation.

My husband, Jeffrey D. Moore, kept me strong through this process with his love and support. I will always cherish his many special acts of kindness.

I also extend many sincere thanks to my dissertation committee for their patience and guidance with the research and editing of this manuscript. Dr. Dana Burnett, the chair of the committee, is especially thanked for his commitment to chair my dissertation and his expertise in the field of higher education. Dr. Gail Taylor, a committee member, is especially thanked for her mentorship and her expertise in the field of multicultural

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education. Dr. Wendy Frazier, a committee member, is especially thanked for her mentorship and her expertise in the field of science education. Their combined expertise helped me to hone my research skills.

I also thank Carla Turner, my editor and friend, whose commitment to this project as well as her technical writing abilities often left me speechless. I also thank Carla's family for their support during this process.

When I needed divine inspiration and renewed strength, I could depend on friends and family members to pray on my behalf. Those friends include Julia Gill, Janice Justice, Veronica Haynes, Eloise Murphy, Sylvia Gaffney, Brenda Bell and Michone Lane. My family includes Frankie Moore, Lisa Gobert, Paula Wedell, and Virginia Ruff.

I am grateful to the educational support personnel who helped me along this journey. Ms. Stella Mims is especially praised for scheduling my many appointments with the chair of the committee. I also thank Dr. Burnett's staff Barbara Webb, Diane Pieper and Barbara Cuffee for their support. The library staffs at Old Dominion University and Norfolk State University are especially thanked for their assistance in obtaining books and other research materials.

I thank the CHROME staff for their support. Mrs. Eleanor Wilson, former CHROME Executive Director now deceased, approved and supported this research on the CHROME program. I also thank Sharon Waters, Chair, CHROME Board of Directors, Theodosa Wyatt, CHROME Program Manager, and Rodney Davis, current Executive Director, for their support in the completion of this project.

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Finally, I thank the nine women participants who made this study possible. I appreciate their time and commitment to completing all questionnaires and interviews. May God bless each of them abundantly.

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CHAPTER ONE

INTRODUCTION

According to the National Science Foundation (NSF), "The national need for a larger, more science-and computer literate and skilled, and diverse workforce is ever greater, as we progress toward an increasingly technological job market and a scientifically complex society" (NSF, 2003, p. 1). These science-related jobs require more women and men to be trained in response to these inadequacies. "One can hardly open a science journal... without finding hand-wringing projections of a shortage of scientists and engineers" (Harding, 1991, p. 4). The impact of these shortages reverberates through school hallways, hospital corridors and scientific laboratories.

In 1981, the Equal Opportunities for Women and Minorities in Science and Technology Act stated that it is "in the national interest to encourage all groups to participate in science and engineering" (NSF, 2003, p. 1). However, instead of preparing women and minorities in the United States (US), the US often has had to recruit professionals in science and engineering from other countries. Thus, the movement began to identify and train increased numbers of minorities and women in science, technology, engineering and math (STEM) related careers.

In an effort to track its success, the Equal Opportunities for Women and Minorities in Science and Technology Act, further mandated that the NSF report statistics on underrepresented groups, and initiate programs fostering more proportionate representation. In 1993, the NSF created the Program for Women and Girls, funding about a dozen projects for approximately seven million dollars over the course of three years. As a major contributor, the NSF program was the "largest public

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or private funding source for efforts expressly addressing the need to broaden girls' and women's participation" (2003, p. 1) in STEM related careers. After an assessment of the program's effectiveness was conducted from 1993 to 1996, the program was determined to be very successful.

Although the NSF was the largest funding source, numerous non-profit K-12 programs have emerged across the US with similar goals of increasing the numbers of young women entering STEM careers. Many programs provided a variety of support systems to young women such as pairing them with mentors who provided support by keeping in contact with students; fielding technical questions; and boosting student confidence (Wilson, 2003). Young women also benefited from support systems such as increasing teacher training, providing mentoring programs, providing tutoring services, providing stipends and other financial incentives, creating internship opportunities; providing grants, scholarships and/or fellowships; apprenticeships and summer training camps (Barton, 1998; Chesler & Chesler, 2002, Burger & Sandy, 1998).

Despite these efforts, some research concluded that many of the programs that existed to introduce young women to STEM careers were not enough to enable young women to persist with in-depth study, required to complete degrees in STEM. Over the past 25 to 30 years, a number of programs have tried to help girls and undergraduate women feel comfortable in these male-dominated fields. Programs emphasized recruitment and retention in K-12 STEM courses, college majors and careers (Burger & Sandy, 2003; Wilson, 2003, Wilson; 2005).

However, women often have not remained in these male-dominated careers, many leaving disenfranchised. Rhonda J. Hughes, a professor at Bryn Mawr College,

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studied the small number of women completing graduate degrees in math. She concluded, "These students [women] had been stars, and they'd go to graduate school and fall through the cracks" (Wilson, 2003, p. A11). Lenore Blum, a computer science professor at Carnegie Mellon University, lamented that, "even successful programs come and go, depending on the federal government's willingness to sponsor them" (Wilson, 2003, p. A11). This often contributed to the inconsistency of program support for girls and women. Even if women entered the STEM careers, many still did not fill top ranked positions. Kara Helander, a professional who tracks women executives, stated that although women are encouraged to enter engineering, they are not encouraged to enter the senior ranks. As a result, women filled less than 10% of high-ranking technology positions (Konrad, 2003).

Thus, researchers in higher education as well as the industry identify the need for more programs. In many cases, young women usually benefited from supportive faculty and special college programs, especially in the more rigorous and male –dominated fields such as pure math, physics and engineering (Burger & Sandy, 1999; Sanders & Tescione, 2002).

This study seeks to explore the effectiveness of one program and its ability to increase opportunities for young women to learn about careers in science, technology, engineering and math and to assist young women in career choice and decision making.

Background of the Problem

Compared to the numbers of women in the workforce, the representation of women working in STEM careers remains comparatively low. For example, in 2001, the NSF still confirmed that the under-representation of women and minorities in

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computer science was a "serious national problem" (2001, p. 4). Due to the shortage of computer scientists, many jobs were unfilled or were filled by professionals from other countries. Baker, Tancred, and Whitesides (2002) found, "the low rate of participation of women in engineering deprives the profession of a larger talent pool and a wider range of viewpoints, skills and values" (p. 41). Further, Baker et al (2002) contend that " The presence of women is particularly important, not only to widen viewpoints, but also provide professional role models to attract women into engineering, including its professioriate" (p. 41).

In 2000, the NSF reported that the number of women completing bachelor degrees in computer science peaked in 1984 at 37 percent and dwindled to 28 percent by 1996 (Burger & Sandy, 2003). The shortage of professionally trained female computer programmers also affected American businesses. According to a report from the Bureau of Labor Statistics in 2001, women comprised only about 26.5% of computer programmers. Researchers at International Business Machines (IBM) (2000) stated that women comprised 47% of the United States work force but only earned 22% of the computer science and engineering degrees. In 1995, women earned 17% of engineering and engineering technology degrees (Frehill, 1997).

Even though women comprise a larger percentage of the overall workplace, the gender gap in the information technology (IT) industry has steadily increased, especially in computer science and engineering. According to a study done by the Information Technology Association of America, "the percentage of women in the tech [nology] work force dropped to 34.9 percent in 2002 from a high of 41 percent in 1996" (Konrad, 2003, p. D2). Burger and Sandy (1999) state, "Therefore, it is important to

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identify the causes for women and minorities not entering, losing interest in or leaving the fields of computer science and other IT career paths during their early years. These high paying jobs offer much opportunity for career advancement for women and minorities" (p. 2).

In higher education, a significant difference occurs in the number of women who complete undergraduate degrees in STEM careers versus the number who complete doctorates in STEM careers. According to the American Mathematical Society, "In 2002, 42 percent of the undergraduate mathematics majors were women, but only 31 percent of those who earned PhD's in math that year were women" (Wilson, 2003, p. A12). The numbers of minority women with math PhDs were even lower. According to a survey of the mathematical sciences, convincing minority women to pursue and complete PhDs in math was a slow process. In 1991-92 no Black women received doctorates in math; in 2001-2, only six Black women earned doctorates in math (Wilson, 2003).

In addition to math, physics is another rigorous and male–dominated career field. In 1994, the National Science Foundation published that women earned 15 percent of bachelor of arts degrees and nine percent of doctorates in the career field of physics (Farmer, 1997). According to the American Institute of Physics, "less than 10 percent of America's physics bachelor's degrees, 20 percent of physics master's and 13 percent of physics doctorates are awarded to women" (Hite, 2004, p. 19).

CHROME Program summary

The CHROME program, founded in September 1983, is a regional, nonprofit, pre-college intervention program that strives to increase opportunities for

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underrepresented minority and female students in Southeastern Virginia to enter science, technically related, engineering, and math (STEM) career fields. The CHROME organization has a diverse membership that volunteer to meet with clubs, serve on committees and help with special programs. Members work as a consortium of 13 public school systems, 15 colleges and universities, 45 corporate and governmental agencies, 15 civic/community and professional associations and individual contributors (CHROME, 2002). Members contribute annual dues to support CHROME programs. The organization is primarily funded by the National Aeronautical and Space Administration, National Science Foundation, Old Dominion University and the State council of Higher Education in Virginia.

The program involves more than 3800 students and 400 teachers and counselors. It provides pre-college programs for students, teachers, counselors and parents; sponsors summer and Saturday programs at member universities and research facilities; coordinates internships through member organizations; funds scholarships and identifies candidates for local and national scholarships and provides teacher training workshops supplemental to and in conjunction with member school systems.

The goals, vision and mission for the CHROME program are described in Appendix A. The CHROME program has received numerous awards for its efforts to improve opportunities for minorities and women in the STEM fields. In 2001, CHROME received the "Program that Works" designation from the Virginia Math and Science Coalition; in 2001, the "Exemplary Partnership" award from Quality Education for Minorities in Engineering; and in 1997, the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring (CHROME, 2002).

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Funding from CHROME members helps the CHROME organization to operate club programs in over 140 elementary, middle and high schools. Though 48% of its program participants are African-American young women, the CHROME organization reported significant increases in overall student participation in its 1998-1999 CHROME Annual Report (2000). Thirteen Hampton Roads school divisions, two private schools and one community club supported 116 CHROME clubs. These clubs represented 2,989 students of which 34% were in high schools, 34% were in middle schools and 32% in elementary schools. The report also states that of the 152 high school seniors responding to the 1999 CHROME Senior Survey, 97% had already enrolled in college and 62% planned to major in a math or science related career field.

A typical CHROME participant will participate in activities at his/her school or community club. Active CHROME participants also attend CHROME main office sponsored events that are provided on a regional or state level (See Appendix A). Those participants tend to get more educational and awareness opportunities, and thus, receive more assistance in career choice and decision-making.

Purpose of the Study

The purpose of this study is to determine to what extent, if any, opportunities provided by the CHROME program influenced young women's career decisions and choices to participate in science, technology, engineering and math careers. A second purpose of the research is to determine which participant variables relate to career choices made by CHROME alumna. The conceptual model created to conduct this analysis is adapted from two of Helen S. Farmer's conceptual models. The model

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includes environmental, cognitive, demographics, academic achievement, post high school experiences and career choice sets of variables.

Farmer's models include a conceptual model for testing the contribution of background, personal, environment, and motivation factors to occupational choice (behavior) and a conceptual model for testing the contribution of demographic, cognitive, environmental, and behavior sets of variables to choice of a science or nonscience career.

Primary Research Questions

1. How do post high school experiences including changes in marital status, critical incidents, family/job involvement, college GPA earned and number of math / science courses taken affect CHROME alumna career choices?
2. How do environmental variables including parent, counselor, teacher, the CHROME experience and financial support affect CHROME alumna career choices?
3. How do academic achievement variables including number of elective math courses and elective science courses taken, and number of years participating in the CHROME program affect CHROME alumna career choices?
4. How do demographic variables including gender, family socioeconomic status and ethnicity affect CHROME alumna career choices?
5. How do cognitive variables including aspiration, math/science utility, math self-efficacy and math ability attributions affect CHROME alumna career choices?

Conceptual Framework

The mission of CHROME is to increase opportunities for underrepresented minority and female students to enter STEM careers. The CHROME program has a twenty-two year track record as a pre-college program dedicated to increasing minorities

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and women in STEM career fields. For the purposes of this study, the STEM careers included occupations that require formal college education, technically related apprenticeships, professional schools and/ or trades schools in STEM.

Summary of Theoretical Framework

The theoretical framework for this study is based on Helen Farmer's conceptual models about occupational choice. See Figure1. Farmer's model tests the contribution of background, personal, environment, and motivation factors to occupational choice. The model is " based in social learning theory, is focused on sex role socialization processes as these affect beliefs, attitudes, and self-concepts, which in turn affect motivation, choices, and behaviors, especially for women" (1997, p. 5). For the purpose of this study, the term "career choice" will be used instead of occupational choice or behavior to describe outcomes.

John Ogbu 's work describing racial discrimination and bias will also be reviewed as it pertains to young women's career choices. As a demographic variable, ethnicity will be examined to determine its role, if any, in influencing young women's career choices.

Feminist theories, as they relate to power, role and position in life, will also be incorporated to examine the social contexts of girls' career choice. Sandra Harding, who specializes in women in science issues, questions why so few women are directing the agendas of science (1991). Harding (1991) also questions what additional or special contribution women make, because they are women, to the growth of scientific knowledge. Work done by researchers Myra and David Sadker undergird this analysis to examine barriers, such as gender bias and self-esteem issues, which young women may

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encounter during their K-12 education. Researchers Carol Burger and Mary Sandy, who support the Sadker's research, emphasize the importance of school counselor in involvement in increasing young women's participation in STEM careers.

In addition, the most recent policies and practices in national science education reform will be explored utilizing the National Science Education Standards (National Research Council, 1996). The National Science Education Standards supports mechanisms to increase women's careers in science. Like prior reforms, the current science education reform emphasizes "science for all" students. However, the National Science Education Standards also provide specific goals, principles, processes, and recommended strategies to promote scientific literacy from K-12 to adulthood. Armed with content mastery and the ability to think independently, students will understand that science will help them to make decisions; debate uses of technology and may provide the basis for an economic opportunity such as a career.

Thus, these theories and practices will examine not only possible personal and professional barriers that young women face in preparing for and participating in STEM careers, but also probe to what extent young women's involvement in STEM careers benefits themselves and society. This study will attempt to capture young women's knowledge, beliefs, attitudes and practices as these relate to career choice.

Sample

The sample for this study is derived from a group of 81 young women who participated in CHROME and who graduated from high school in 2000.

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Limitations

The CHROME organization has over 140 different CHROME clubs in 13 school divisions and community based organizations. The organization allows each school or community CHROME club great flexibility in choosing which programs or services to offer their students. Thus, participant's experiences may vary.

Need for Study

Historically, young women have not received adequate input and early opportunities to make effective career decisions and set career goals, especially in STEM careers. The CHROME program increases awareness of STEM careers and other opportunities for young women. Burger and Sandy recommend that school counselors advise and encourage girls to enter STEM careers. Burger and Sandy suggest that girls in grades one through four are "testing their independence and are curious about the world. They are also making judgments about which jobs are suitable for males and which are the one that girls should choose." (2003, p. 2). The CHROME program is designed to foster and complement girls' natural curiosities.

The need for this study was based on national as well as international shortages in the number of highly trained and educated scientists, mathematicians, computer experts and other technical professionals. The CHROME program seeks to alleviate the shortage of available workers in these areas. As women increase their involvement in STEM careers, society will benefit from a larger pool of talented, resourceful and highly functioning workers.

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Overview of the study

This study is a qualitative program evaluation to examine contributors to young women's career choices. This study specifically seeks to determine if the support of the CHROME program influenced young women's career choices. Chapter I is the introduction which includes a review of the CHROME program. Chapter II is the literature review of the career-decision making process, the phenomena of career choice and the participation of women in STEM career fields. Pertinent gender issues will be discussed as they relate to the historic and current impact on the education of young women.

In Chapter III the methodology and the instruments that will be utilized is discussed. Chapter IV presents the data collected and provides an analysis and interpretation of the data. Chapter V discusses the results of the data analysis, identifies suggestions for utilization of the information obtained, and lists some suggestions for further research. Numerous appendices inform and clarify information about the study for the reader. Of note, an appendix is included to provide Internet references for those seeking information about programs that support the increase of the number of girls and women in STEM career fields.

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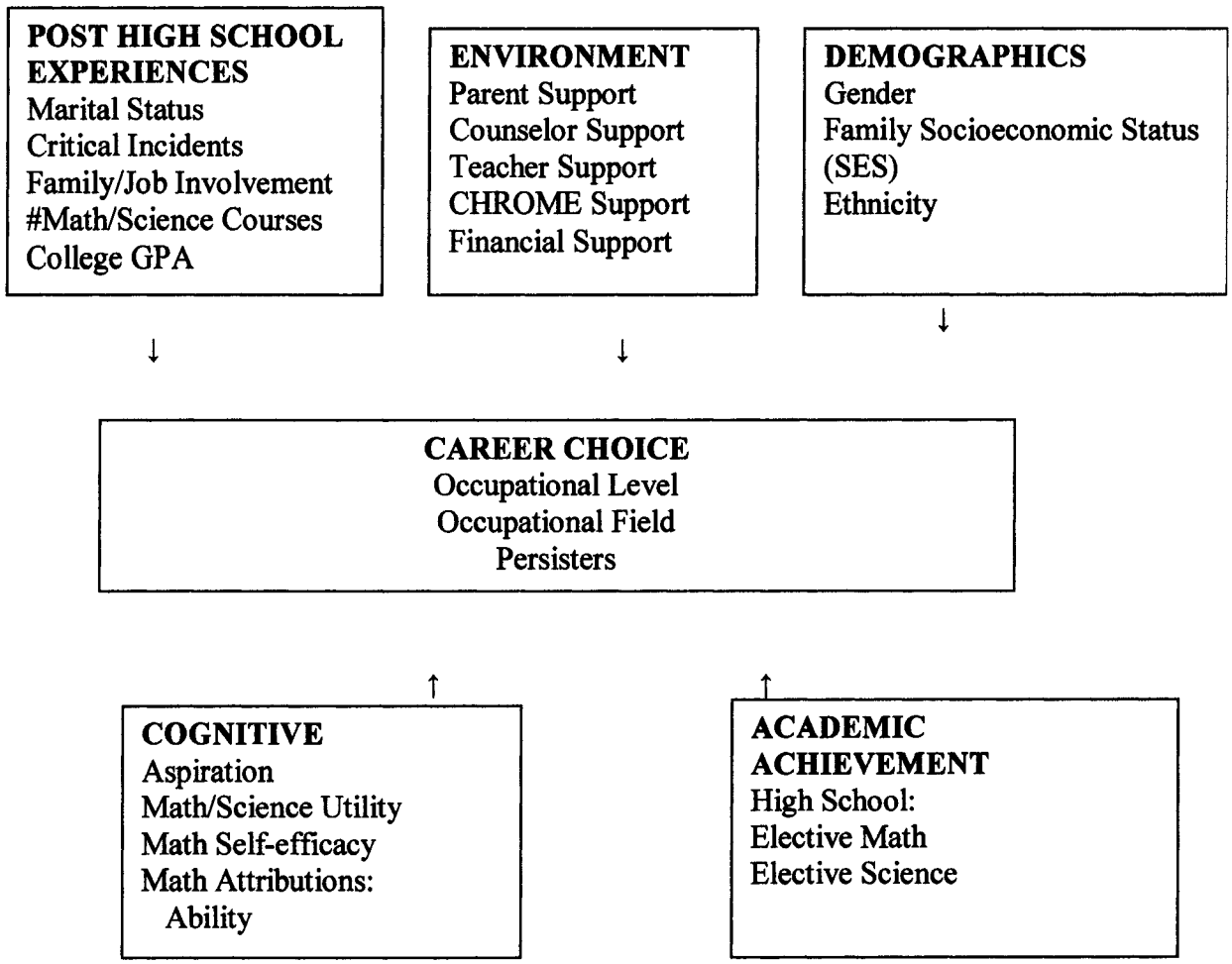
Figure 1. A conceptual model for testing contributors to career choice (*based on Helen Farmer's Conceptual Models)



***Adapted from Helen S. Farmer's conceptual model for testing the contribution of demographic, cognitive, environmental, and behavior sets of variables to choice of a science or nonscience career and Helen S. Farmer's conceptual model for testing the contribution of background, personal, environment, and motivation factors to occupational choice (behavior)**

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CHAPTER TWO

LITERATURE REVIEW

Introduction

This literature review discusses phenomena that contribute to young women's career choice. The review provides relevant literature on CHROME and other programs dedicated to increasing the numbers of women in STEM careers. Also provided are career decision-making theories, feminist theory and perspective, John Ogbu's Caste Theory and Helen Farmer's Conceptual Model for Testing the Contribution of Background, Personal, Environment and Motivation to Occupational Choice.

The phenomena of career choice as it pertains to historical and current barriers to women's participation in STEM career fields are also explored. Additionally, gender issues which impact career choice for young women are discussed.

Other intervention programs

As the need for people trained and educated in STEM careers have increased, organizations have improved their use of the media, targeting girls as a way to enhance their awareness of STEM careers. In 2003, the Girl Scouts organization launched radio, television and print advertisements with the campaign slogan, "Girls Go Tech." Noting that most girls lose interest in math and science at about age 12, the ads show "girls discussing math, science and technology with humorously clueless parents" (Konrad, 2003, p. D1). After watching the promotion, girls and their families can get a referral to a national program, Girls At the Center, which provides more specific information and other opportunities for girls to learn about STEM careers.

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Another program focusing on 12 and 13-year-old young women is the AWE + SUM: Attend ·Westminster· Explore ·Science ·Use· Math, which is a summer program held at Westminster College and sponsored by the American Association of University Women and the Mathematical Association of America. "The girls spent two days building model airplanes, examining water and insects and making their own wind chimes using calculus" (Wilson, 2005, A48). The young women also conducted research using the Internet and stayed overnight in a college dormitory.

In an effort to pique girls' interest in technology, many companies are starting their own camps. The International Business Machines (IBM) Corporation sponsors the Cinderella Project, which runs a program in Silicon Valley, California. In this program, female IBM engineers work with girls age 11-13 to build and design shoes to fit specific technical specifications. In 1999, the company founded the "Excite!" program that runs summer camps in over 30 cities. Also Hewlett-Packard and Microsoft companies have similar programs. Likewise, Texas Instruments has a summer program in which girl learn advanced placement physics while Intel's "Geek Chic" program pairs third grade girls with mentors in their labs and offices in Portland, Oregon (Konrad, 2003).

Although these companies are to be commended for their efforts to develop long-term mentoring relationships, none guarantee results and equally disconcerting "proponents worry that corporate America, driven by quarterly earnings, might lack the patience necessary to groom children for jobs they won't enter for a decade" (Konrad, 2003, p. D2). That is why programs like CHROME, which assist young women K-12 but are not primarily corporate sponsored, are critical to increasing the numbers of young women in STEM.

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According to Sandra Harding, a professor specializing in science and feminist theory, the shortage of individuals educated and trained in STEM careers has "gotten so bad, ... that in order to "keep America strong" they [intellectuals in science and technology] are even willing to develop special programs to recruit women and minorities to science, mathematics, and engineering departments" (1991, p. 4). For example, to combat the astonishingly low numbers of women who complete graduate degrees in math and become mathematicians, the Enhancing Diversity in Graduate Education (EDGE) program was created using funding from the National Science Foundation and the Andrew W. Mellon Foundation. This program counsels women through graduate school and provides mentors. The program also has a four-week math summer institute where women learn and reinforce math concepts and bond with each other. These connections enable young women to have "math girlfriends" to encourage each other as well as discuss math when they return to their respective schools (Wilson, 2003, A12) .

In addition to EDGE, three other major programs are in place to increase the numbers of undergraduate and graduate women who pursue math. The programs are Program for Women in Mathematics sponsored by Princeton University and the Institute for Advanced Study Summer Program for Women in Mathematics sponsored by George Washington University and the National Security Administration and Carleton College Summer Mathematics Program for Women sponsored by the NSF and the National Security Administration (Wilson, 2003).

Unlike the aforementioned recently initiated corporate programs, the CHROME program has been in existence since 1983. The program continues to address the needs

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that employers and educational institutions have identified, namely the lack of technically trained people to fill jobs. In addition, the CHROME program has expanded from its original station on the Old Dominion University campus, to include rural Southeastern Virginia communities and the cities of Newport News and Hampton. However, no comprehensive program assessment has ever been accomplished.

Historical background of the problem

In 1960, women comprised 7% of the U.S. physicians and surgeons; 10% of U.S. natural scientist and less than 1% of working engineers in the United States (Rossi, 1972). According to the1962 National Register of Scientific and Technical Personnel, even when women and men had about the same educational qualifications, men earned markedly larger salaries. Female scientists worked predominantly in educational institutions while men were primarily employed in industry or self-employed (Rossi, 1972). Historically, women's promotions in STEM careers occur as White men move upward to fill positions of higher authority and responsibility (Rossi, 1972). Thus, the cycle persists with women lagging behind in subsequent new opportunities.

Sharon Hussey, who was senior vice-president of the Girl Scouts in 2003, describes the dearth of effort to attract women to STEM fields compared to the numerous programs that were put in place in the 1960s and 1970s to help boost the number of women in medical and law schools. "We were so focused on the broad concepts of where girls are not getting involved-medicine and law- that right under our noses there was tremendous slippage happening in the computer and technology field" (Konrad, 2003, p. D2). Those programs supported the parity in media and law that women and men now

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approach in 2003. Unfortunately, women's participation in the computer and technology fields is still lagging behind men (Konrad, 2003).

Theoretical Framework – Helen S. Farmer's Conceptual Models

Dr. Helen S. Farmer, now retired from the University of Illinois Department of Educational Psychology, focused her research on projects related to women's career choice that provided information which can be utilized to "help women optimize their career potential" (Farmer et al, 1997, p. 8). While conducting several research studies, Farmer et al created a conceptual model for testing the contribution of background, personal characteristics, environment and motivation to occupational choice (Farmer, 1997). Her conceptual models also analyze the contribution of demographic, cognitive, environmental, and behavioral variables to choice of a science or nonscience career (Farmer, 1999).

Farmer wrote (Diversity & Women's Career Development, 1997) that she disagreed with D. E. Super's theory of growth and development (1953). He later expanded his theory in 1980 to the life-span-life space model (Phillips and Pazienza, 1988). Farmer criticized his theories because they all were based on experiences of middle-class White boys and men and did not necessarily fit the needs of "persons from poor families, persons of color or women" (Farmer et al, 1997, p. 3). Farmer sought to create models that could more accurately assess and explain phenomena that impacted women's career choices.

In 1977, Farmer together with Tom Backer, published the book, New career options for women: A counselor's sourcebook. Farmer then pondered a way to help explain women's career motivation. In 1978, Farmer created A Conceptual Model for

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Understanding Inhibited Academic/Career Motivation in Women. This model described environmental and personal elements that contributed to motivation for academic study and career. Environmental aspects included family socialization, resources in the community and work; and discrimination in community and work. Personal elements were home-career conflict, sex role orientation, risk taking behavior, academic self-esteem, vicarious achievement motive and fear of success. Farmer's model theorized that personal and situational factors influence women's achievement and some of the factors help while others hinder optimal career motivation (Farmer, 1997).

Farmer's broad theoretical work is based on Albert Bandura's Social Learning Theory, which is also known as Social Cognitive Theory. Bandura's work is a cornerstone for the explanation of human behavior and thought. In short, Bandura's theory emphasizes the "prominent roles played by vicarious, symbolic and self-regulatory processes in psychological functioning" (1977, p. vii). He theorizes that human behavior is a "continuous reciprocal interaction"(Bandura, 1977, p. vii) in which people can, to some degree, influence their destiny by self-directing themselves. People are also influenced by external forces (Bandura, 1986; Farmer et al, 1997).

Farmer incorporated Bandura's Model of Reciprocal Transactions to express her belief that "psychological functioning involves a continuous reciprocal interaction between behavioral, cognitive, and environmental influences"(Bandura, 1978, p. 344). Farmer created a new model, Conceptual Model for Testing the Contribution of Background, Personal, Environment, and Motivation Factors to Occupational Choice (Behavior), for use in her 1980 longitudinal study. Farmer believed that behaviors, self-concepts, and experiences influence achievement, motivation, and career choice and that

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"over time a broad range of interacting influences shape interest in and selection of a career" (Farmer, 1997, p. 9).

In 1990, Farmer improved her Conceptual Model for Testing the Contribution of Background, Personal, Environment, and Motivation Factors to Occupational Choice (Behavior). Background variables include gender, social status, school location, ethnicity, age with the following subcategories: science ability, verbal ability and math ability. Personal variables include academic self-esteem, math/science self-efficacy, expressive, instrumental with the following subcategories: cooperative, competitive, success/failure attributions, success/failure attributions in math, achievement values, math/science utility, math study skills, personal unconcern, homemaking and ideal family/work role. Motivation variables include aspiration, mastery, career and role satisfaction. Environment variables include parent support, counselor support, teacher support with a subcategory of support for women working, financial support and critical incidents. Behavior variables include college major, number of math/science courses, marital status, family/ job involvement with the following subcategories: occupational level, occupational field and persisters.

Farmer's model emphasized the sex role socialization processes. Farmer believed that sex role socialization, which are experiences that shape girls in their early years to learn what roles are appropriate for girls and what roles are not, impacts attitudes and beliefs and ultimately career motivation, choice and behavior. She believed the model could be used to investigate, "behaviors, self-concepts, and experiences that influenced ...achievement motivation and career choices. The model assumes that over time a broad

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range of interacting influences shape interest in and selection of a career" (Farmer, 1997, p. 9).

Farmer used the aforementioned models to conduct a longitudinal study in three phases from 1980 to 1993. In Phase 1 (1980), the purpose of the study was to examine career motivation aspirations and why women don't contribute as much to arts, humanities and sciences. Farmer et al sent questionnaires to about 2082 students of various ethnicities: White, African-American, Hispanic and Asian. Only 1, 863 questionnaires were returned and usable. The students were either in the ninth or twelfth grades and attended six different, randomly selected high schools in the Midwest. The sample represented a cross- section of students in suburban, rural and inner city high schools. Of note, the inner city high schools were actually parochial schools, which required tuition payments. All African-American students were in the inner city schools.

In Phase 2 (1990), Farmer et al narrowed the focus of the study to "science, especially the factors related to women's persistence in a science career if they had expressed interest in such a career... in high school" (Farmer, 1997, p. 15). Farmer's rationale for narrowing the focus was women's participation rates in natural science and engineering were still lagging significantly as compared to humanities and arts.

In 1990, Farmer planned to collect data from the same subjects in the 1980 study, but her team could only verify 1500 mailing addresses from the original list of 1,863 subjects. From those 1500, her research team only received 459 usable questionnaires. Farmer surmised that the low return rate was due to undelivered mail and extreme length of the questionnaire, 54 pages. Out of the 459 responses, Farmer assessed the number of participants who persisted with science careers; however, she also found a subsample of

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students who in 1980 did not express an interest in science but who were now working in science related career fields. They also found that less than half of the students expressing aspirations in science or technology had persisted in those careers 10 years later. Also significant findings from the 1980 and 1990 questionnaire data was that "the most important predictor of persistence in a science-related career for women was the number of elective science courses they had taken in high school" (Farmer, 1997, p. 47). Chemistry and physics were found to be the course most often taken.

As part of the 1991-1993 survey, Phase 3, Farmer's research team added qualitative research and thus conducted two 1- to 2 hour interviews with subjects over a two and half year period. The interview subsample was selected from those respondents, "who had, in 1990, agreed to be interviewed from among those we identified as persons who had aspired to a career in science or technology in 1980" (Farmer, 1997, p. 29). Farmer chose the sample to increase understanding of "what had occurred during the intervening 10-year period that sustained some of these persons in their science choice and discouraged others (Farmer, 1997, p. 29). Farmer found 173 respondents to meet the subsample criteria, but only 153 respondents agreed to be interviewed. The subsample was further narrowed to 105 participants after 47 were deemed too far away geographically to interview.

After the interviews were analyzed, the findings showed that 21 women persisted in science careers, and these "women were more highly educated than the U.S. population as a whole for their age group and gender"(Farmer, 1997, p. 46). They also took more than double the amount of elective science courses compared to the other women in the study.

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Like Farmer's, my study will examine contributors that influence high school students' persistence to continue in STEM careers. My conceptual model will combine aspects from both of Farmer's conceptual models. The focus of the study is on young women who are CHROME alumna from the 1999-2000 school year.

Theoretical framework – John Ogbu's Caste Theory

John Ogbu, a world renowned expert on the African American experience, now deceased, provides a framework to understand the impact of race, class and minority status on career choice. Ogbu's Caste theory, also known as Cultural-Ecological Theory of School Performance or the Cultural-Ecological Theory of Minority Schooling, is considered the prevailing theory that explains the many challenges of underrepresented minorities living in an oppositional culture. The theory incorporates socioeconomic, cultural, historical, social, linguistic and dialectal concerns in the minority population (Foley, 1991; Nunes, 2000; Ogbu, 2003).

Ogbu asserts that African Americans in particular receive inferior status based on caste stratification. Caste occurs when one's lifetime position is determined at birth by factors such as race and/or skin color.

African Americans as involuntary minorities

To provide a distinction among minority groups, Ogbu classified minorities as autonomous, voluntary or immigrant, and involuntary or nonimmigrant minorities based on the power relations between groups (Ogbu & Simons, 1998). African-Americans are involuntary minorities who "have a negative dual frame of reference with respect to status mobility" (Ogbu and Gibson, 1991, p. 14). Though African-Americans may achieve elements of middle class status such as education, wealth and jobs, they will

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often still be perceived as inferior (Johnson, 1999). Caste based on skin color and stereotypes, involuntary minorities, unlike immigrants, see discrimination as "permanent and institutionalized" (Ogbu & Gibson, 1991, p. 14). Ogbu explained:

> In contrast, *involuntary* (or *castelike*) *minorities* are those who were brought into U.S. society involuntarily through slavery, conquest, or colonization. Such minorities resent the loss of their freedom, their displacement from power, and the deprivation of property; they tend to perceive present barriers against them as institutionalized and have difficulty in seeing future improvements without a collective struggle against their "white oppressors." American Indians, [B]lack Americans, Mexican Americans in the Southwest, and native Hawaiians fall into the category of involuntary minorities (Ogbu, 1990, p. 6).

African Americans (Blacks) and Education

African-American student performance in school is impacted by numerous contributing factors. Ogbu contended one such contributing factor is the prevalence of permanent institutional racism in educational institutions. This type of racism shaped the school experiences of minority students in two main ways. One is the systemic treatment of minorities. The other is how minorities respond to the systemic treatment. Ogbu asserted that another significant contributing factor to low school performance is school segregation. Segregation, previously enforced by law, now often occurs due to residential segregation. John Ogbu researched historical and current nationwide minority underachievement, and he provided subsequent explanations for the phenomenon. The "Differences between Black and White students are not limited to the gap in grade point average; they are found in course level enrollment, performance in specific courses, rates

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of participation in gifted programs and in special education placement" (Ogbu, 2003, p. 3). According to Ogbu's research, African Americans overrepresent the number of students who are not performing at grade level. African Americans historically have not performed as well as whites on standardized tests, and thus, have appeared less qualified for college admission (Ogbu, 2003). When middle class African-American students are compared to similar middle class White students, African-American students typically perform less well in school. In fact, Ogbu wrote, " when Blacks and Whites from similar socioeconomic backgrounds are compared, one sees that Black students at every class level perform less well in school than their White counterparts" (Ogbu, 2003, 35). However, middle class African-American students scored higher academically, on average, than lower class African-American children (Ogbu, 2003).

Ogbu's study in Shaker Heights

The African American students in Shaker Heights performed "considerably better than other Blacks in the rest of the state of Ohio and in the rest of the nation" (Ogbu, 2003, p. 4). In 1995-1996, the students earned more credits in math, science and foreign languages and scored higher on the Scholastic Aptitude Test than other African American students in the state of Ohio and the nation (Ogbu, 2003).

Though these students were doing well academically compared to other African American students, Ogbu found startling evidence of achievement gaps between Shaker Heights African American and White students. Ogbu and a team of researchers, were asked by a group of concerned African Americans to come to the Shaker Heights suburb in Ohio and assist them in finding out why the African American middle to upper middle class students were not performing as well academically as their White counterparts.

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Ogbu and his team conducted a qualitative study and conducted observations, focus groups, and interviews. Ogbu summarized some of his findings:.

> From our observations in almost every school work situation, our discussion with groups of students and school personnel, and our interviews, we can confidently say that Black students in Shaker heights from elementary school through high school did not work as hard as they should and could to make better grades than their records show. The students themselves knew and admitted this (Ogbu, 2003, p. 18).

Ogbu described the phenomenon as "low-effort syndrome" (Ogbu, 2003, p. 18), and explained that "By low-effort syndrome we mean that students were not highly engaged in their schoolwork and homework" (Ogbu, 2003, p. 18). Many high school students explained that they preferred basic skills and college prep classes since they required less work.

Ogbu also found that parents, usually due to work obligations, did not review homework like their White counterparts nor participate in school events. Ogbu explained, "It was said that working- class parents held two or three jobs. In our comparative observations of White and Black neighborhoods we often saw more White mothers with elementary school-age children during working hours than Black mothers with similar school-age children" (Ogbu, 2003, 234).

In the Shaker Heights study, Ogbu found another reason that students were not highly engaged in their school work was due to low teacher expectations. In his research he observed:

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> For example, some teachers did not give homework in their college prep and skills classes which had mostly black students. When asked, they would say that the reason they did not assign homework was that students would not do it. Teachers also expected and demanded less work from these students during lessons than they did from their honors and AP students...teachers' perceptions and assumptions that students in skills and college prep classes were not hardworking influenced not only their homework policies but also their toleration of certain behaviors in class (Ogbu, 2003, p. 17).

Researcher Lisa Delpit concurred with Ogbu that many teachers who are responsible in the education of African American children often expect less from these students, and therefore, do not motivate and engage students in class work and homework. Delpit, the author of Other people's children (1995), wrote that children of culturally diverse backgrounds are often educated in schools which are institutions of isolation. Delpit explained that many teachers, "harbor unexamined prejudices about people from ethnic groups or classes different from their own" (1995, p. 179). She explained:

> We foster the notion that students are clients of "professional" educators who are met in the "office" of the classroom where their deficiencies are remediated and their intellectual "illnesses" healed. Nowhere do we foster inquiry into who our students really are or encourage teachers to develop links to the often rich home lives of students, yet teachers cannot hope to begin to understand who sits before them unless they connect with families and communities from which their students come (Delpit, 1995, p. 179).

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Thus, one way to bridge the achievement gap would be to train teachers in their teacher education programs that they must keep the same expectations for all students that they can learn and be successful in all academic areas. Teachers can also motivate students to learn by making courses culturally diverse and interesting (Ferguson, 2005; Ogbu, 2003).

In addition to lower teacher expectations, Ogbu found that peer pressure among the students at Shaker Heights contributed to low-effort syndrome. Students perceived that, "it was not cool to be successful" (Ogbu, 2003, p. 24). Teachers also responded that the African American students appeared to be more influenced by their peer groups and often worked part-time jobs so that they could maintain their status.

Some students did want to do well in school, but they were unsure of how to study to properly to prepare for class requirements. Ogbu found that many African American students had poor study habits. These findings were derived from his interviews, observations and discussions with students (Ogbu, 2003).

In summary, though African American students in Shaker Heights scored higher in many academic areas than other African American students in their state during the 1995-1996 school year, they did not demonstrate a work ethic that was indicative of their abilities and typically were not on par with their White counterparts. Ogbu found this phenomenon consistently from elementary school through high school, and he found it to be true even when African American and White students had approximately the same household income.

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African American family socioeconomic status

Like Ogbu, other theorists found that defining household income and subsequent family socioeconomic status of African Americans is not just about household income, but also the effects of historical and current discrimination, and its subsequent impact on social mobility. To fully capture socioeconomic status of African Americans requires discussion of the combined impact of physical characteristics of race, racism, ethnicity, misconceptions about middle class America, and perceived lack of power. For the purpose of this study, this description of family socioeconomic status for African Americans will provide a framework to analyze how socioeconomic status may have shaped the career choices of African American women.

Race, ethnicity and racism

An understanding of race is important to fully comprehend its impact on African American household socioeconomic status. According to Bhikhu Parekh, Professor of Political Theory at the University of Hull, race can be defined in one of two ways:

> The term race is commonly used in two senses...it refers to the division of humankind into static and quasi-natural groups on the basis of their phenotypical features. Races are supposed to be homogenous, separate, unchanging, and easily distinguishable by their shared physical features. In its second sense, the term refers to ethno-cultural groups, that is, those based on a combination of shared physical and cultural characteristics, a common history, real or imaginary homelands, a shared sense of collective identity, and their own and others' perception of them as distinct groups (Parekh, 2005, 608).

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To assist in capturing the African American experience, this study will use the second definition. In many instances, African Americans are often associated with the first definition of race based on the color of their skin and facial features; however, race goes beyond physical features. Race includes the common history of slavery; no real sense of ancestry from Africa; a collective sense of assumed prejudice and judgment as inferior; and a constant struggle to enjoy individual recognition and freedoms without the stigma or assumptions assigned to African Americans.

Ethnicity further expounds upon the definition of race and adds the lens to observe populations in terms of their interactions among themselves and how they interact within and among institutions in the society at large. According to Min Zhou, a researcher from the Department of Sociology at UCLA,

> Ethnicity emerges from a paradoxical process... it develops in the context of frequent association and interaction with others of common origin and cultural heritage in a community setting... [and] it depends on the interaction of the group with structural conditions that characterize the group position in American society (Zhou, 2005, p 141)...Ethnicity is also defined as "a manifestation of the way populations are organized in terms of interaction patterns, institutions, personal values, attitudes, lifestyle, and presumed consciousness of kind" (Yancey, Juliani and Erickson, 1976). (Zhou, 2005, p. 141).

According to R. Jeffrey Lustig, Professor of Political Science at California State University, Sacramento, "The first point to understand is that race and ethnicity affected class formation in America from the beginning" (Lustig, 2004, p 49). For the African American race, a sense of stigma and loss of identity is shared due to racism which began

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as early as the Middle Passage. Other examples include acts such as slavery, which wasn't abolished until 1863, and the Jim Crow system, which legalized racial separatism and supported the ideology of white supremacy (Ferguson, 2005). Even though African Americans have been in America for over 400 years, the reports of the 2000 census reflected "The continued presence of what appears to be an almost lower caste composed of the black race" (Glazer, 2005, p. 50). Negative assumptions persist that African Americans, as a distinct group, are not as good as other American workers and contribute less to society.

Lustig stated that racism is aptly described in the *Dred Scott vs. Sanford* legal decision, "Blackness for its part drew its meaning...from the fact that whites had "stigmatized them... with ...deep and enduring marks of inferiority and degradation" (Lustig, 2004, p. 50). This type of marginalization contributes to how African Americans are trained, educated, nurtured, employed and mentored in various careers. Lustig further described being Black as a "badge of servitude" (2004, p. 50) not, that is, because of anything intrinsic to African heritage, but because of the physical oppression to which African Americans have been subjected to for economic purposes. Lustig concludes:

> ...membership in the white race, a sociological group that was " neither a biological nor a cultural category, but...a cross-class alliance between the capitalist class and a section of the working class" [22] The precondition for membership in that race was what people were not—they were not black, the hue of the now-paradigmatic Other (Lustig, 2004, p. 50)...Negroes wound up not just as noncitizens but as "*anticitizens*" [22] The Other against whom citizenship defined

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itself. And race, since its origins, has thus been an artifact of economic oppression and political decision (like the *Dred Scott* decision itself)(Lustig, 2004, p. 50-51).

Thus, African Americans, unlike other minorities who have mainstreamed into the white race, have endured racism and continue to receive inferior treatment. This caste treatment of African Americans also contributes to class discrimination.

Class

American class is very difficult to define. Michael Zweig, Professor of Economics and founder of the Center for Study of Working Class Life at State University of New York at Stony Brook, states that, "Even though 'class' is an abstract category of social analysis, class is real." (2004, p. 1). He explained:

> Class is central to our everyday lives. Yet class has not been as visible as race or gender, not nearly as much a part of our conversations and sense of ourselves as these and other "identities." We are of course all individuals, but our individuality and personal life chances are shaped-limited or enhanced-by the economic and social class in which we have grown up and in which we exist as adults (Zweig, 2004, p. 1).

Issues of class extend beyond monetary earnings and in fact are shaped by one's race and gender. African Americans, who are involuntary minorities, have made economic gains, but they still do not receive equal treatment. Their social and economic accomplishments are colored by the negativity of caste.

Middle class

Dividing Americans, in general, and African Americans in particular into classes is tricky at best since many Americans describe themselves as middle class. Zweig

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concludes that the American middle class comprises only about 36 percent of the United States labor force. "When class is understood in terms of income or life style, these workers are sometimes called 'middle class'" (Zweig, 2004, p. 6). Zweig explained:

> In between the capitalist and the working class is the middle class. The "middle class" gets a lot of attention... in the United States, but this term is almost always used to describe people in the middle of the income distribution. People sometimes talk about "middle class workers" referring to people who work for a wage but live comfortable if modest lives. Especially in goods-producing industries, unionized workers have been able to win wages that allow home ownership, paid vacations, nice cars, home entertainment centers, and other consumer amenities (Zweig, 2004, p. 6).

Thus, for many Americans, the perception of what it means to be middle class in America is earning a decent wage with benefits and having the ability to enjoy some of the fruits of their labor. For African Americans, attaining middle class status may also mean overcoming barriers and stigma to attain those same opportunities. In terms of opportunities to pursue higher education, an African American family's socioeconomic status as middle class or upper middle class may provide greater means to assist children to attend college and consequently enter a professional career.

Power

Opportunities to work in the profession of one's choosing and enjoy the benefits of one's efforts often contribute to the occupational prestige of a job. Although African Americans have jobs, and subsequent careers, their ability to harness power and make changes is limited. Zweig expounded, "Power doesn't exist alone within an individual or

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a group. Power exists as a relationship between and among different people or groups" (2004, p.4). As Ogbu suggested, African Americans are impacted for life by caste, and consequently, their power as a group is also marginalized. Zweig explained that, "Understanding class in terms of power throws a different light on the subject" (2004, p. 6). Zweig theorized:

> In this view, middle class people are in the middle of the power grid that has workers and capitalists at its poles. The middle class includes professional people like doctors, lawyers, accountants, and university professors. Most people in the "professional middle class" are not self-employed. They work for private companies or public agencies, receive salaries and answer to supervisors. In these ways, they are like workers (Zweig, 2004, p. 6)

Thus, the American middle class is segmented by occupation, and African American middle class workers, like the rest of the American middle class, have a professional middle class. The perception that African American middle class is of lower status is also directly related to lack of power, both real and perceived.

Gender and racial inequality

Gender together with race impacts power, social mobility and class, especially for African American women. According to Zweig, "Gender and race are abstractions, yet they are powerful, concrete influences in everyone's lives. They carry significant meaning despite wide differences in experience within the populations of men, women, white, blacks" (2004, p. 2).

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Conclusion

The application of Ogbu's Caste theory and other theorists will help to capture the unique factors of the African American experience as they pertain to the participants in this study. Although capturing demographic data regarding African American family socioeconomic status and ethnicity is complex, it is necessary to fully examine possible influences to the subject's career choices.

Feminist theories and perspective

This study incorporated a feminist perspective that is appropriate and conducive to fieldwork using an entirely female sample. Patton stated that, "A feminist perspective presumes the importance of gender in human relationships and societal processes and orients the study in that direction" (2002, p. 129). Patton continued, "Moreover, feminist inquiry provides not only conceptual and analytical direction but also methodological orientation in emphasizing participatory, collaborative, change-oriented, and empowering forms of inquiry" (2002, p.130). Patton referenced noted feminist scholars:

> Principles of feminist inquiry (Guerrero, 1999a:15-22; Thompson, 1992) can include .... participatory processes that support consciousness-raising and researcher reflexivity; and going beyond "knowledge generation for its own sake," to engage in using knowledge for change, especially "knowledge about women that will contribute to women's liberation and emancipation" (Guerrero 1999a, p. 16-17). (Patton, 2002, p. 129).

Feminist inquiry attempts to make connections between sociological, political and economic concepts.

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When women pursue careers, especially STEM careers, they are often victims of sexual discrimination (Benokraitis, 1997). Sexual discrimination is the unequal and harmful treatment of people due to their sex; many feminist theorist(s) believe that sex discrimination starts at birth (Benokraitis, 1997; Sadker & Sadker, 1994). According to Nijole Benokraitis, "Being a woman is frequently a better predictor of inequality than such variables as age, religion, intelligence, achievements, or socioeconomic status"(1997, p. 6).

Even though "almost all women will be treated unequally simply because they are women..." (Benokraitis, 1997, p. 6), this study seeks to explore if and how participants perceive they were the victims of sexual discrimination while preparing for and/or participating in their career choices. Not all women know that they have been the victims of sexual discrimination.

Sexual discrimination "varies along a continuum in terms of visibility, intent, and remedies" (Benokraitis, 1997, p. 7). In general, types of discrimination include blatant, subtle and covert. A detailed description of each type is contained in Appendix F. Blatant discrimination is an intentional and harmful form of sex discrimination. In particular, unequal treatment in education could include sexual harassment such as a teacher using overt, derogatory comments in the classroom. Or discriminating acts can be more subtle such as ignoring women during classroom discussions. Subtle discrimination is less visible and less obvious than blatant discrimination. Examples include women learning to play golf to gain acceptance within male dominated, STEM careers and young women reading science textbooks with no information about famous women in STEM careers. Covert discrimination is hidden yet intentional. Examples may include

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sabotaging a woman's project or manipulating the work schedule so that a woman gets the least desirable times and routes (Benokraitis, 1997; Sadker & Sadker, 1994).

Myra and David Sadker are prominent international researchers who specialize in explaining sexual discrimination involving girls in schools from K-12. Sadker and Sadker examine issues such as gender bias, adolescent self-esteem issues and gender communication styles. They also address how and why girls' needs for career decision-making and counseling are different than boys.

According to Sadker and Sadker, the phenomenon of "female invisibility" (1994, p. 13) segregates classrooms by gender and often steers girls away from participation in STEM career fields. The Sadkers suggest that young girls are shortchanged further, in sex- integrated classes, when teachers are pulled to the more talkative, more disruptive male section of the classroom.

For minority women, female invisibility is quite prevalent. According to researcher Jacqueline Jordan Irvine, Black girls are active, assertive and participatory in the primary grades, but as they move up through elementary school, they became the most invisible members of classes. She also finds that Black females were the least likely to receive clear academic feedback (Sadker and Sadker, 1994). This phenomenon may contribute to the low numbers of African-American women in STEM careers.

In 1973, Myra Sadker and Nancy Frazier published Sexism in School and Society, the first textbook to describe sexism in schools. This text documented unfair teaching practices, textbook bias, biased and short-sighted counseling and sex-segregated courses. Prior to this publication, Myra Sadker found few publications to address the educational needs of girls.

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Some thirty years later, sexism still exists. Teacher expectations still play a significant role in contributing to disparities in the quality of education that young women receive. Described by Geneva Gay as "gender interactions" (2000, p. 29), the manner in which teachers communicate their expectations to male and female students is a site in which an opportunity exists to support or diminish academic achievement (Gay, 2000; AAUW, 1995). Sometimes teachers practice this behavior unknowingly.

In 1994, Myra Sadker and David Sadker published Failing at Fairness which is internationally recognized as a cornerstone work in gender equity discussions. It is also a primary source for the American Association of University Women's internationally acclaimed report, "How Schools Shortchange Girls" (Sadker & Sadker, 1994).

Sadker and Sadker stated that girls in elementary and lower middle school(s) have a "strong sense of self-esteem" (1994, p. 77). This self-esteem is "not only a vital sign of mental health, it is also a connection to academic achievement and a direct link to career goals and hopes for the future" (1994, p. 77). The Sadkers also concluded that, "girls and boys who enjoy science and math consider themselves more important, like themselves more, and feel better about their schoolwork and family relationships. They are also more likely to hold professional career goals" (Sadker and Sadker, 1994, p. 97).

Thus, the application of feminist theories to analyze data collected provided a framework in which to understand the influence, if any, of sexual discrimination to young women's career choices. These theories assisted also with understanding the young women's choices in choosing or not choosing to participate in STEM careers.

The quality of career counseling can also have a significant impact on young women's career choice. Carol Burger and Mary Sandy, project directors of their NSF

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sponsored research Counseling for Gender Equity, find that there is a difference in the career counseling that one receives based on gender, race or ethnicity. Their research shows that few guidance counselors have taught math or science and fewer than 10% were from minority cultures. The authors suggests that "counselors lack of a STEM background coupled with culturally acceptable perceptions about appropriate gender roles and careers can lead to less than helpful advice to female and male students about potential career goals." (Burger & Sandy, 2003, p. iv).

Gender bias also exists in the form of perceived manners of gender communication. Gay et al in their research on gender and communication report that "feminine communication styles" are associated with less intelligence, passivity, and submissiveness, while "masculine styles" evoke notions of power, authority, confidence, and leadership (2000, p. 108).

Girls face numerous barriers to obtaining needed information and engaging in opportunities to make career choices. In the K-12 classroom, girls experience gender bias in varying forms. They also are less likely than boys to be encouraged to choose careers in STEM.

Conclusion

This chapter reviewed the literature related to young women's career choice in general and to careers in science, technology, engineering or math related careers specifically. The review included literature related to the CHROME program and other intervention programs dedicated to increasing the numbers of women in STEM careers. The chapter offered a new conceptual model for testing contributors to career choice which is based on Helen S. Farmer's conceptual models. The review examined feminist

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theory and perspective, and John Ogbu's Caste Theory as these inform about the relationship of gender and ethnicity to career choice.

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CHAPTER THREE

METHODOLOGY

Purpose

The purpose of this study is to determine to what extent, if any, opportunities provided by the CHROME program influenced young women's career decisions and choices to participate in science, technology, engineering and math careers. The second purpose of the research is to determine which participant variables relate to career choices made by CHROME alumna. The goal of this qualitative program evaluation is to improve the CHROME program by gaining insight as to variables that influence young women's career choices and career decisions.

Research Design

The research design is a qualitative program evaluation design. The unit of analysis is the cohort of young women who were CHROME participants and high school seniors in the 1999-2000 school year. The unit of analysis was selected by the researcher to receive feedback and insight about the different experiences of the young women who had been enrolled in the CHROME program.

A qualitative program evaluation is a form of formative evaluation that serves to improve specific programs, policies, groups of a particular staff, or a product. According to Patton (2002), formative studies usually use process studies, implementation evaluations, evaluability assessments and case studies. Formative evaluations rely on qualitative methods.

This qualitative study utilized some of the strategies of the case study design since the researcher will only be studying one intervention program.

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> The researcher explores a single entity or phenomenon ("the case") bounded by time and activity (a program, event, process, institution, or social group) and collects detailed information by using a variety of data collection procedures during a sustained period of time (Merriam, 1988; Yin, 1989) (Creswell, 1994, p. 12).

Population

The population was determined using data from the 1999-2000 CHROME End of Year Senior Reports. Historically, the CHROME office asked high school seniors involved in the CHROME program to submit their End of Year CHROME Senior Reports by May of each year. In the school year1999- 2000, 81 young women submitted End of Year CHROME Senior Reports (henceforth referred to as Senior Reports).

In May 2000, when their Senior Reports were submitted, the majority of the 81 women were aged 17 and 18. One woman was age 16 and one was 19. All of the women identified themselves as African-American on their Senior Report. Their career interest spanned several disciplines: Architecture, Aviation Electronics, Biochemistry, Biology, Business Administration, Child Psychology, Computer Analysis, Computer Information Systems, Computer Science, Computer Engineering, Computer Science, Corporate Law, Elementary Education, Engineering, Forensic Pathology, History (African- American and Hispanic), Interior Design, Lawyer, Medicine, Network Engineering, Nursing, Pharmacy, Physical Therapy, Psychiatry and Psychology.

The women in the population came from 15 different schools in nine school divisions. The school divisions included the cities and/or counties of Chesapeake, Gloucester, Hampton, Portsmouth, Newport News, Southampton, Smithfield, Suffolk and

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Virginia Beach. This diversity within school divisions should also provide depth and insight into this investigation. Schools have been given pseudonyms for confidentiality.

Table 1 provides an analysis of the number of women per high school and the type of school division. The school divisions have been designated as Rural, R; Urban, U; or Suburban, S.

Sample

Purposeful sampling (Patton, 2002) produced a homogeneous sample of nine women derived from the population of 81 who submitted their Senior Reports. The participant's Senior Reports were separated based on their attendance at a rural, urban or suburban school division. To create a database, the researcher assigned each type of school division a category number. Suburban schools were assigned category number one; urban schools were assigned category number two; and rural schools were assigned category number three.

To increase validity, a stratified random sample was utilized. Using Microsoft Access random number generator, a random number field was created, and thus, random numbers were assigned to each subject. After random assignment, a query and sort by group was conducted. Then a second sort assigned random numbers in descending order.

The sample was selected by choosing the first three subjects from each category in descending order. If a subject in a particular category was unwilling to participate, then the next name from the same category was be selected. The sample consisted of nine willing participants.

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Data collection

Subjects were purposefully selected for this study. Data was collected from each subject. Data was derived from Senior Reports, standardized open-ended interviews, CHROME Annual Reports, Environmental Support Questionnaires, Post High School Experiences Questionnaires, and Career Choice Questionnaires.

Procedures

After the sample had been selected, the researcher attempted to contact each sample participant by telephone using the personal information listed on the Senior Report. If a number was out of service, the researcher utilized electronic mail (E-mail) and/ or the United States postal service to make initial contact.

The purpose of the initial contact was to determine each young woman's interest in participating in this study. The researcher sent each participant a Letter of Introduction (Appendix B), Letter of Support from the CHROME Board of Directors, Chair, (Appendix C), an Informed Consent Agreement (Appendix D), a Career Choice Questionnaire (Appendix E), Post High School Experiences questionnaire (Appendix F) and a double-sided Environmental Support Questionnaire (Appendix G) and a copy of the participant's Senior Report (A blank copy can be found in Appendix I.).

The Letter of Introduction explained and described the rationale and purpose of the study. The letter also informed participants that the investigator would contact them at a later date to conduct individual standardized oral interviews.

Next, participants were directed to sign the Informed Consent Agreement. This one-page form outlined the purpose of the research, participant expectations and their rights. As described in the Informed Consent Agreement, participants and the schools

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they attended were referred to by pseudonyms. Neither participant's names nor the schools that the participants attended are revealed in this study.

Participants were asked to review their Senior Report for accuracy. In order to not changes made by each participant, the researcher provided each participant with a red ink pen. Participants wrote changes and previously omitted information in red ink directly on their copy of the Senior Report. Once the Senior Reports were returned, the researcher analyzed the documents to determine the level of academic preparation in high school of each participant. The researcher then identified the number and types of math and science courses completed, advanced placement courses taken, class rank, and final grade point average received.

Research showed that the number of elective science and math classes taken in high school is a valid predictor that the person will pursue a math or science related career and persist in degree completion (National Science Foundation, 1994; Adelman, 1999; Farmer, 1997). According to Clifford Adelman (1999), Senior Analyst at the U. S. Department of Education, the highest level of mathematics taken in high school, has a strong correlation to bachelor's degree completion. His research concluded that students who finish Algebra 2 or its equivalent have twice the chance of completing a bachelor's degree as do those who do not.

A Career Choice Questionnaire provided a means to record career data obtained from each participant. An example of this form is located in Appendix E. The Career Choice Questionnaire was analyzed to identify and categorize each participant's work history. Each job listed was coded in accordance with the Occupational Information Network (O*NET) Dictionary of Occupational Titles (DOT), which is the database used

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to collect data on wages, job growth and job training and education requirements (Farr and Lunden, 1998). This system was chosen for this study since, "Most occupational information sources will rely on cross reference to the O*NET as the standard for detailed, reliable information on occupations"(Farr and Lunden, 1998, p. xxxii).

The database used to create the O*NET system was first developed by the U.S. Department of Labor (DOL). The DOL has a classification system for categorizing jobs based on DOT, which was last updated in 1991.

The questionnaires also provided work histories, which were analyzed to note trends, if any, in career choices among the participants. Using the O*NET system enabled the researcher to assign each job listed to its O*NET occupation code which is a unique number. The O*NET occupations are grouped according to related jobs. For example, Section 2 includes Scientists, Engineers Mathematicians and Social Scientists. The O*NET occupation code for a Computer Engineer is 22127; All other engineers, 22199; and Biologists, 24308B (Farr & Lunden, 1998).

After analyzing each Career Choice Questionnaire, the researcher conducted standardized open-ended interviews with each subject. The interview questions are listed in Appendix H, which served as an interview guide. Patton describes an interview guide as a "list of questions or issues that are to be explored in the course of an interview" (1987, p. 343-344). Qualitative studies usually rely on the interview as one of the primary sources of data collection (Patton, 2002). During the standardized oral interviews, study participants were asked questions which complement each other and allow the researcher to investigate different perspectives.

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Data Coding

The researcher utilized the concept-indicator model, which directed the coding process: data collection, coding, coding categories, theoretical sampling, comparisons, integration of the theory, theoretical memos and theoretical sorting.

Data Analysis

Data from all of the aforementioned sources was read and analyzed to determine if patterns or themes evolved. After the interviews, the transcriptions were read in their entirety. Transcripts were then reread and open coded with summaries written on the right side margins to designate node names or topics (Strauss and Corbin, 1990; Bogdan & Biklen, 1998). Node names (topics) were axial coded to create category names (Strauss & Corbin, 1990). Category names were grouped into themes via selective coding (Strauss and Corbin, 1990) and assigned a specific color to designate each particular theme. Any other categories that evolved, but were not necessarily expected, were also assigned a specific color (Frazier, 2001).

Triangulation of sources and theory/perspective triangulation were conducted to strengthen the study's conclusion and generalizations (Cook & Campbell, 1979; Patton, 2002). The purpose of triangulation is "to test for...consistency" (Patton, 2002, p. 556). Triangulation of sources refers to "comparing and cross-checking the consistency of information derived at different times and by different means within qualitative methods" (Patton, 2002, p. 559). For the purposes of this study, the researcher compared the standardized oral interviews against program documents, Senior Reports, Career Update Questionnaires and Career Counseling and Assessment Forms. Further, the perspectives and points of view of each subject were compared.

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Theory/perspective triangulation "involves using different theoretical perspectives to look at the same data" (Patton, 2002, p. 562). The researchers theoretical framework for this study includes Caste Theory, Feminist Theory, and Farmer's career decision-making and choice theories. The researcher reviewed and analyzed the data to determine if each theory was supported.

The analysis yielded themes. The themes were given to a colleague to perform a separate data analysis. This second analysis provided content validity and inter-rater reliability information regarding the designation of node names (topics), categories, and themes (Bogden & Biklen, 1998). Additionally, the researcher reviewed this second analysis to gain greater insight to the node names (topics), categories, and themes which may result.

Intended audience

Findings from this study may help CHROME program administrators and staff to improve program services and to assess needs of their CHROME clubs. Also, similar pre-college program administrators may gain valuable insight as to which contributors better prepare young women for STEM careers. In addition, school counselors and administrators at rural, urban and suburban school divisions may find ways in which to improve their career counseling services to young women.

Generalization

Generalization in this qualitative program evaluation is limited to the specific setting studied. According to Patton (2002, p. 220), "No attempt is made in a formative evaluation to generalize beyond the setting in which the evaluation takes place." Thus, this study is generalized to the CHROME program of 1999-2000.

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Summary

The researcher conducted a qualitative program evaluation to determine the effectiveness of the CHROME program in assisting young women in choosing STEM careers. This formative evaluation is designed to assist CHROME personnel in making program improvements. The nine member homogenous sample was selected by stratified random sampling and purposeful sampling techniques will be conducted to gain rich, detailed data.

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CHAPTER FOUR

DATA DESCRIPTION: THE COLLECTIVE EXPERIENCE

This chapter presents the results of the data collection and data description of this research study. As discussed in the methodology section, each participant was assigned a pseudonym to protect their privacy.

Sample selection results

The 81 women who comprised the population for the study were divided into three subgroups based on their attendance at a suburban, rural or urban school. The suburban subgroup consisted of 23 possible participants; the urban subgroup totaled 20 possible participants and the rural subgroup was 38 in number. A stratified random sample was then created for each subgroup, and participants were drawn randomly and asked to participate in the study.

A final sample of nine women was derived for this study based on those who completed both their questionnaires and interview. For the suburban population, the researcher attempted to contact 15 possible participants. Three participants completed their questionnaires and interview. The researcher attempted to contact all 20 of the possible urban subgroup participants. Two participants completed their questionnaires and interview. Three others agreed to participate in the study but never returned their questionnaires.

Four of ten possible rural participants completed their questionnaires and interview. Thus, the final sample is composed of nine women who attended three suburban high schools, two urban high schools and four rural high schools.

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The participants were assigned the following pseudonyms ANN, BETTY, CAREN, DEE, ELLA, FAY, GAIL, HOPE and INDIA. A brief description of each participant follows.

ANN, now age 24, stated in high school that she aspired to be a radiologist. ANN participated five years in CHROME. Since graduating high school, ANN has remained single, had no children and completed her baccalaureate degree. ANN is now enrolled in dental hygiene school.

BETTY, now age 22, stated in high school that she aspired to work in the business or technology career fields. BETTY participated five years in CHROME. Since graduating high school, BETTY has remained single, had no children and completed her baccalaureate degree. BETTY is now a manager trainee in the trucking industry.

CAREN, now age 22, stated in high school that she aspired to become a network engineer. CAREN participated four years in CHROME. Since high school, CAREN has remained single, had no children and completed her baccalaureate degree. CAREN is now enrolled in a graduate electrical engineering program.

DEE, now age 23, stated in high school that she aspired to enlist in the United State Navy. DEE participated three years in CHROME. Since high school, DEE has remained single. DEE is expecting her first child and is working toward completion of her baccalaureate degree. She now serves on active duty as a Cryptology Technician in the United States Navy.

ELLA, now age 23, stated in high school that she aspired to enlist in the Armed Forces. ELLA participated five years in CHROME. Since high school, ELLA has

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married and had one child. She is working toward completing her baccalaureate degree. ELLA now works as a paralegal.

FAY, now age 22, stated in high school that she aspired to be a forensic pathologist. FAY participated five years in CHROME. Since high school, FAY has remained single, had no children and completed her baccalaureate degree. FAY is now pursuing her law degree.

GAIL, now age 23, stated in high school that she aspired to work in disease research career field. GAIL participated one year in CHROME. Since high school, GAIL has remained single, had no children and completed her baccalaureate degree. GAIL is now working as an Environmental Health and Safety Specialist.

HOPE, now age 22, stated in high school aspired to work in the biomedical research career field. HOPE participated five years in CHROME. Since high school, HOPE has remained single, had no children and completed her baccalaureate degree. HOPE is now enrolled in a graduate public health program.

INDIA, now age 23, stated in high school that she aspired to become a general practitioner medical doctor. INDIA participated four years in CHROME. Since high school, INDIA has divorced and had one child. She is working toward completion of her baccalaureate degree. INDIA now aspires to become a psychologist.

Data collection results

The data collected from each participant was first obtained by mailing each participant their Senior Report, an Environmental Support Questionnaire, a Post High School Experiences Questionnaire, and a Career Choice Questionnaire. The researcher then scheduled and conducted standardized open-ended interviews with each participant

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separately. Participation in an interview was essential for inclusion in the results of the study. Those who failed to participate in an interview were not included in the results of the study.

Information obtained from the Senior Report included grades, types of math and science courses completed during high school, including advanced placement courses and/ or dual enrollment courses, number of years in CHROME, and birth date. Additionally, responses to the Environmental Support Questionnaire provided information related to the amount of support each participant received from counselors, teachers, parents, CHROME program and financial backing. Participants explained their experiences with these individuals and institutions in narrative form.

Responses on the Post High School Experiences Questionnaire included information about each participant's marital status, number of children, critical incidents, number of math and science courses completed in college and college GPA. Participants were given a definition of critical incidents, and they were allowed to elaborate about their particular critical incident, if any.

The Career Choice Questionnaire elicited information about each participant's current contact information, math/science related work history and postsecondary education. Participants were also asked about plans for graduate school.

The standardized open-ended interviews elicited information about each participant's career choices and decision-making process. The information included demographic variables related to gender, ethnicity, and family socioeconomic status; environmental variables describing levels of support from parents, teachers, counselors, CHROME program and financial backing; cognitive variables including math self-

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efficacy and math and science utility; post high school experiences variables including critical incidents, marital status, math/science courses; and academic variables including elective math and elective science. The interviews were utilized to triangulate the data from the Career Choice Questionnaire.

To further validate each participant's family socioeconomic status prior to high school graduation, the researcher used participant enrollment in the National School Lunch Program, which was expanded by the National School Lunch Act in 1946 (USDA, 2004). The United States Department of Agriculture (USDA) coordinates the National School Lunch Program, which is a meal program that provides low-cost or free lunch and snacks in public schools, non-profit private schools and residential child care facilities. The USDA uses Income Eligibility Guidelines (IEG) to determine a child's eligibility to participate in the lunch program. In the 1999-2000 school year, the federal poverty guideline for a family of four was set at an annual household income of $16,700. For a child to receive reduced lunch, the household family income could not exceed $30, 895 (income between 130 to 185 percent of the poverty level) (USDA, 2005).

Responses to each research question

The data collection was done using qualitative research methods as described in Chapter 3. The results are provided in the order of the five primary research questions.

Primary Research Question 1

How do post high school experiences including changes in marital status, critical incidents, family/job involvement, college GPA earned and number of math/science courses taken affect CHROME alumna career choices?

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The responses for Primary Research Question 1 were obtained from the standardized oral interview and the Post High School Experience Questionnaire. Table 3 lists college GPA and number of college math and science courses completed.

Marital Status, Critical Incidents, family/job involvement

Table 2 describes in detail the marital status, critical incidents, family/ job involvement (number of children) and college degree completion. Six of the nine participants completed four year degrees. Those who completed their degrees were single and did not report any critical incidents.

Three participants did not complete their bachelor's degree, but they are enrolled in college now. They each described critical incidents which slowed their progress toward degree completion. DEE, who is in the military and is pregnant with her first child, commented on her Post High School Questionnaire, "I was assigned to ... a naval ship for 3 years. Being deployed for 6-7 months will slow down anyone's life." ELLA, who has a small child and is also a military spouse, shared a similar view. In her interview she stated:

> I think the hardest thing about my career choice was after I had my son. I didn't know how I was going to go back to school. I didn't know how I was going to take care of the bills that I had already accumulated for school because I had to come out of work. That was basically the main thing that stopped me from really going back like I needed to. So, it took a while for me to regroup, and then come back and finish up some things. But, that was the main problem I had, after I had my son. That kind of like steered me away from even trying to develop a career because I didn't want to get stuck being the homemaker. So, that was my main concern.

INDIA, the only divorced participant, responded that she didn't have any critical incidents when asked on the Post High School Experiences. However, she explained in the interview:

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> The reason I said no. I had a little girl; throughout my pregnancy I was still in school. I had her and then I took two weeks off and then I was right back in school. So, like the whole time [pause] I have continued on. When I found out I was pregnant, I asked my professor if I could start my classess early. So, I made a way to make everything work out.

Eight of the nine reported their college grade point average (GPA). The GPAs ranged from 2.60 to 3.60. The GPAs are listed in Table 3.

All of the participants completed math and science courses in college with the exception of BETTY, who had met the requirements for her college level science courses through dual enrollment courses in high school. The number of completed math courses ranged from two to six and the range of completed science courses ranged from two to twenty-seven. The number of math and science courses each participant completed are listed in Table 3.

Summary of Primary Research Question 1

Six of nine participants completed their baccalaureate degrees within five years, and the other three participants are working their undergraduate degree completion. Those that completed their degrees were single, did not have critical incidents and did not have children. Those that did not complete their degrees had children and experienced critical incidents.

Primary Research Question 2

> How do environmental variables including parent, counselor, teacher, the CHROME experience and financial support affect CHROME alumna career choices?

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The responses for Primary Research Question 2 were obtained from questions posed on the Environmental Support Questionnaire and the standardized oral interviews. Environmental support variables are listed in Appendix M.

Parental support

Eight of nine participants reported high parental support as critical to career choice. CAREN had the most influence by a parent to pursue engineering. Her mother, who was an X-ray technician, died when CAREN was age one. Thus, CAREN was reared by her father. She explained:

> You know, like I said, my father has been my main influence. He preached school. You had nothing else to do, but go to school. You had to get good grades ... I've always liked science and engineering. It has to do with my Dad. I think the fact that he always had computers around; I think that was the main reason.

ANN stated, "My parents were very supportive. They never like tried to force me into any particular subject." Likewise, BETTY explained, "They [parents] always encouraged me to do something in math and science, or engineering and things like that, but I never really could see myself in any specific job. I never learned what kind of engineering jobs there were."

INDIA's parents were very hands-on with her education. She stated, "My parents were real supportive. The education part was very important...When I had a science experiment or something it was like they had the science experiment with me...They were real involved."

DEE, the only participant to state that she had very little parental support, explained:

> I've worked ever since the age that I could work just to take care of myself and my little sister. I helped the parents out as well. But as far as joining a lot of

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> clubs, I didn't do that. I basically took care of myself... I would have liked to go to a university, but I didn't want to depend on my parents for financial support.

DEE made career decisions very early in her young adult life based on her family circumstances.

Counselor support

Table 4 lists Environmental Support variables that include a generalization of participant responses to counselor support. Five participants stated that they received some level of counselor support. CAREN described having excellent support from her counselor. In her interview, CAREN said:

> My guidance counselor in high school is like the greatest person alive... She was the one that got me my full scholarship [application]...It was from her hand that I also got an internship with Dominion [Virginia Power], which was renewable every summer until I graduated... She didn't let me slip through the cracks.

None of the other participants described such a high level of support, but some did state that their counselor encouraged them to take STEM classes and discussed career options. FAY stated in her interview:

> My guidance counselor in my freshman, sophomore and junior years was very instrumental in me participating in science, math and technology fields... She encouraged me to look at...different fields...During my senior year, there was support, but it was more for putting paperwork together. She wrote recommendations.

Likewise, GAIL received support from her counselor to apply to college. She explained, "Well, I don't think that they so much helped with my career focus, but they were very supportive in applying for colleges."

Four participants stated that they received limited or negative support from their counselors. ANN explained in her interview:

> The counselors were just kind of there. They didn't really help you that much. They were like you got to figure it out for yourself.. my guidance counselor in my

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> senior year of high school kept telling me to go to historically black colleges. My parents kind of didn't like that. Why was he pushing me to go to an all black school, as if I couldn't make it in a white school.

BETTY stated, "They [counselors] didn't have any impact. They never really talked about careers." HOPE also said her counselors, "really didn't have much impact." She further lamented, "In fact, they were encouraging me to go to small schools and community colleges when that really wasn't on my radar screen as far as what things I was trying to pursue."

Teacher support

The amount of teacher support varied. ANN's positive experience with a science teacher improved her self-efficacy in science. ANN stated, "This science teacher was like the first teacher that showed interest in me...I guess by supporting me, it just made me feel better. I had more confidence in the field of science. She put me in the science fair." GAIL, who valued teacher input, states, "I had a lot of very good science and math teachers overall. I became friends with a lot of teachers. They helped me make decisions." GAIL also trusted the teachers to help her with career decision-making; she stated, "I felt they had a big impact on helping me make final decisions."

FAY also had positive teacher encouragement. FAY shared:

> My teachers always encouraged me. They looked at various grades and said, "Oh, you may be interested. I see you have good grades. I see you have this grade in Chemistry or this grade in Biology." They always nurtured what was going on at the time. They also encouraged me to participate in various activities.

FAY appeared to have good teacher support at school. Not only did they monitor her academic success, but they also nurtured her potential. They encouraged her to participate in extracurricular activities which would increase her competitiveness for college.

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Other participants describe limited support from teachers. BETTY stated, "I don't think there was any specific support or lack of support from my teachers." CAREN also stated that teachers provided general support but no real influence, " I don't think any particular teacher has ever influenced me to do something. I would say that any influence came from home, and was just facilitated at school."

ELLA acknowledged that her teachers tried to influence her to enter a STEM career. She explained:

> My teachers, they tried to influence me to become an engineer, because they thought that I had the will power to do so. But, at the time, I had low self-esteem. ... And, I really didn't want to go into something that I really didn't have a passion for.

While ELLA did not choose to become an engineer, she admits that she received support form her teachers. ELLA's career decision-making process placed value on having passion for her future career.

However, DEE, who was very independent at a young age, doesn't cite teachers as influential. She explained, "I didn't really get influenced by my teachers. I just did my work then went home and went to work." DEE made her own career decisions to enter the U. S. Navy; and consequently, she did not seek nor receive career input from her teachers.

Unlike the others, HOPE had very negative experiences with teachers. She explained:

> I was a pretty motivated student, so, I didn't necessarily need a teacher to push me. Often times, I actually found that teachers were obstacles for me because I would have to fight for certain grades that they wouldn't try to give me; grades that they gave other students, even though I had been working harder.

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CHROME support

Seven of nine participants reported support from CHROME as critical to career choice. ANN enjoyed the guest speakers that came to her CHROME club, but she disliked the fact that most of the speakers were engineers. ANN's career interest was in the health professions. She believed that she still benefited from having minority speakers. ANN explained:

> But I guess it was good that the speakers we did have were minorities. So, it was good to see that they were doing something. They let us know that we could go to college and get a higher education. They were like a role model. They set a good example of what we can attain. Kind of opened up doors about things I didn't even know of. Things that my friends didn't know of either.

ANN perceived that the support from the CHROME program helped her to focus on college and increase her career choices. She also noted that her friends appeared to be uniformed of many of the career choices that the guest speakers shared.

BETTY, who completed her bachelor's degree in Business Administration with a concentration in marketing, felt that CHROME also helped in her career decision-making process. She stated:

> They [CHROME] didn't really have an effect on what I chose, because I didn't choose a STEM career. But I think that it did somewhat encourage me to pursue those careers. I think CHROME is a great organization, and it gave me a lot of insight on math, science and different programs.

Betty acknowledged that she "somewhat" received guidance on STEM careers. CAREN responded in her interview:

> CHROME was like the confirmation... CHROME was like something that I had to do... It helped me a lot, especially with the college tours... and the different people coming to speak to us about their particular fields in the science and engineering fields. But mainly, with these college tours... we were talking to people from these different engineering programs. There are so many different engineering programs. It really helps you in your decisions... [Y]ou're actually talking to students who are in it already. You're finding out what they like or

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> don't like about the program. You're finding out what you need to do before you get there to make it. So, I think CHROME was a great influence.

CAREN stated that she benefited from the CHROME program's services which included college tours and guest speakers. CAREN also acknowledged that talking with engineering students at different colleges helped her career decision – making process.

Likewise, DEE stated in her interview:

> As far as the CHROME Club, we talked a lot about math, [and] some of the places we went. I remember one trip I think to a natural science museum, and we also saw open heart surgery sometime during the same year. It helps you see that you can do more than you think you can do regardless of your background.

DEE suggested that these visits increased her awareness of other opportunities for careers.

ELLA, who was indecisive about her career choice in high school, stated, "CHROME helped to make me understand later after high school I could do anything, but in school I didn't grasp that."

Financial support

Six of nine participants reported that they had financial support to pursue their career choice. One woman believed that increased financial support would have expanded her career choice options. BETTY states, "...the only reason financial support would impact my decision, would be if I had gotten a full scholarship to go to a bigger school or a school out of state, maybe I would have chose to do engineering." Thus, BETTY's career decision-making was influenced by her level of financial support.

Four women stated that the strong financial support from their parents was very important to their career choice and decision-making. CAREN emphasized her father's financial support throughout her academic career. CAREN stated:

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> I never really had any money issues or problems. Money has never been an issue for me in terms of school... My Dad was always there... I told my Dad that I know I was going to college, and that I was going to get a full scholarship. I ended up getting a couple of full scholarships, but I choose DNIMAS [Dozoretz National Institute for Mathematics and Applied Sciences]... Even now, I have a full scholarship for graduate school.

CAREN did not have any financial concerns in regards to her career choice.

FAY was greatly dependent upon her parents for financial support. FAY stated:

> I needed my parent's financial support to complete my undergrad as well as their support to pursue my career dream... Previously, I was a substitute teacher. Now, I'm at Widener University Summer Law Program... If it had not been for my parents, then I wouldn't be here.

As a result of FAY's parental support, she was able to pursue her goal of becoming a lawyer.

HOPE's responses exemplified how knowing that she had financial support made her feel secure. HOPE explained:

> Throughout high school, I kind of had the idea that no matter where I wanted to go, my parents would help pay for it. It turns out that I got a scholarship, and I didn't need their help. I always had that security that they would help me out; they wouldn't just leave me hanging.

GAIL explained, "I did have financial support going into college... that took a big burden off of everything so I could make my decisions more freely. I guess that led me to do exactly what I wanted to do." Thus GAIL's financial support encouraged her to pursue her career choice options.

INDIA emphasized the financial aid she received as important to her pursuing her career choices. INDIA explained, "Because with financial aid and stuff, I haven't run into a situation where I can't go because I can't afford to pay it." INDIA's comments support the importance of financial aid in pursuing her career.

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Conversely, three of the women described how lack of financial support affected their career decision-making. ANN explained that lack of money influenced her decision to attend dental school. ANN stated:

> I know often I thought about being a dentist or a dental hygienist. Money was a main factor. I completed college. I do have a degree, but still I'm not making any money... I already have loans that have to be paid back... So, I don't want anymore burden right now, even though it would be good to be a dentist.

Thus, ANN's concerns about funding have impacted her dental career.

On the contrary, DEE felt she had no financial support. DEE stated, "No financial support from anyone but myself working. Therefore, I chose the Navy where I was able to make money and do the things that I needed to do." DEE also stated that she would have like to attended college, but she couldn't depend on her parents' financial support.

Summary of Primary Research Question 2

The participants received varying levels of support. The majority of the participants stated that they received the most support from their parents and family, CHROME and financial backing. The majority also reported that they received the least support from teachers and counselors to prepare for STEM careers.

Primary Research Question 3

> How do academic achievement variables including number of high school elective math courses and high school elective science courses completed, and number of years participating in the CHROME program affect CHROME alumna career choices?

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The responses for Primary Research Question 3 were derived from each standardized oral interview and Senior Report. Table 5 lists the number and type of high school math and science courses completed.

Number of high school elective math and science courses

The number of elective science courses completed in high school ranged from one participant taking one elective science and no elective math courses to one participant taking four elective math and four elective science courses.

CHROME participation

Five participants completed five years in the CHROME program; two participants completed four years; one participant completed three years; and one participant one year. Table 6 lists the number of years each participant was in CHROME. Of the six participants who completed their baccalaureate degrees, four participated in the CHROME program for five years, one participated four years and one participated one year.

ANN, who spent five years in CHROME, stated in her Environmental Support Questionnaire:

> Visiting different companies and having minority speakers helped me learn about all the different types of science careers. Also attending the CHROME Summer Program at ODU gave me further exposure to the many avenues of science as well as college life. In my opinion, having the opportunity to associate with CHROME representatives and other minority peers helped me stay focused on wanting to pursue a career in the science. It also helped me to differentiate between what careers I though I would enjoy as well as which one I believe I would despise.

ANN's five year participation in the CHROME program increased her career exploration opportunities and influenced her subsequent career decision-making process.

CAREN, who spent four years in CHROME, stated in her interview that

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> I had a lot of fun. I met a lot of people. Even people that I still deal with today, I met through CHROME. We are at the same university now. Or we might meet at the engineering conference... [and] We're like, "Oh, yeah, we were in CHROME [together]!" It was great networking tool that I didn't even know about.

CAREN's CHROME experience helped her to network during her undergraduate and graduate programs.

FAY, who spent five years in the CHROME program, explained in her Environmental Support Questionnaire:

> My CHROME sponsor in high school was great. Her personal life inspired me to succeed. She was especially helpful during senior year.

FAY further explained her experiences in CHROME during her interview:

> I had an excellent CHROME sponsor. She was always willing to go the extra mile. She always informed me of things going on in the career world as far as science, technology and math careers. She was a math teacher. I had known her before coming to high school. She has encouraged me a lot in my personal life. She always promoted CHROME and pushed CHROME. And, like I wrote, her daughter was also going through the same things. So, the questions that I may have had, she [CHROME sponsor] was readily available to answer them. She was always available for CHROME, to talk about math, science, technology fields or about the application process for college.

FAY described her CHROME experience largely based on her relationship to her CHROME sponsor. FAY stated that her CHROME sponsor served as a role model and resource to help her in her college application process and career decision-making about STEM careers.

GAIL, who spent one year in the CHROME program, explained her CHROME experience during her interview. She said:

> Well, I think that the whole focus of the program was to [slight pause, as if thinking] Well, it was mostly people who were interested in the sciences. And they just brought up issues that were in the news maybe or just things to keep you interested. I guess to let you know that you could have a good career and that it was a good decision or a good path to follow.

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On her Environmental Support Questionnaire, HOPE explained how her five year CHROME experience impacted her career choice and decision-making:

> The availability of different science enrichment and leadership programs that CHROME sponsors announced, and I subsequently participated in during the summers of my middle and high school years. Actually, it wasn't the sponsors in particular, but rather CHROME itself, and its emphasis on minorities in science that shaped my career choices and decisions. It was CHROME that made me aware of the underrepresentation of minorities in science and it was the mission statement and focus of CHROME that oriented me toward science and made me feel almost obligated as a capable black female to fulfill my duty and compensate for the lack of minority professionals in science careers.

HOPE, motivated by the information that CHROME provided regarding lack of minorities in STEM careers, added more detail about how CHROME influenced her career choices stating:

> CHROME was pretty interesting in terms of that in that they provided different programs each summer in science and math, and I actually participated in a few. A few of those programs gave me insight, well not actually that much insight, but a feel [for the careers] because we didn't like really shadow too many people necessarily. But, it just emphasized that females could be leaders, and we could be involved in any type of career that we wanted to pursue.

HOPE reemphasized the importance of the summer science and math programs in helping her career decision-making process.

Likewise, INDIA, who spent four years in the CHROME program, explained during her interview:

> I don't really remember a lot on the CHROME program, but I do remember one trip that we took. It was like one of the programs that they had, and we went over to Christopher Newport [University] and had one of the science professors over there to take us through all of these experiments. It was so interesting to me. To go through all these processes and get the results even before you knew what was going to happen. I just thought that was so interesting.

INDIA's interest in science was heightened by her observation of hands-on, real world experiments.

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Summary of Primary Research Question 3

Seven of nine participants completed four to five years in the CHROME program. Of the six participants who completed their baccalaureate degrees, five participated in the CHROME program for four to five years.

Primary Research Question 4

How do demographic variables including gender, family socioeconomic status and ethnicity affect CHROME alumna career choices?

The responses for Primary Research Question 4 were derived from each standardized oral interview and Senior Report. Table 6 lists demographic variables which include family socioeconomic status, and Table 7 describes the influence of race on discrimination and career choice.

Gender

Each participant was asked two specific questions regarding gender. The first question was, "How do you believe your perceptions of your status as a woman has influenced the career choices you made? Five of nine participants believed that their gender did not influence their career choice. CAREN has had males influence her career the majority of her life. CAREN explained:

> I was raised by my father...my main influence has always been male... His [her father] degree is in physics, but he's always done computer related services for people... As far as being a woman, I can't really say how that affected me. I know that typically I am the only woman in my classroom. Except for now, in the graduate level, my professors are women. Even in high school, my computer science courses there were mostly White males. In the work force, with Dominion Power, my colleagues were mostly White males.

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CAREN did not perceive her gender as a barrier to achieving her career goals, though she acknowledged often being the only woman in many of her STEM related courses in high school and college.

FAY stated, "I don't believe that my perception of myself as a woman has influenced any of the career choices that I've made... I don't really look at careers as male or female. I just think if the person's qualified." Likewise, GAIL felt no career restrictions based on gender. GAIL explained:

> I don't think that's [gender] had a really big impact on it. Most of the jobs I've had have been in a mostly male environment, being mostly in the science background. I worked in an engineering company once that was mostly male... I haven't been deterred from; or I haven't seen any negatives or extreme positives either way.

Similarly, INDIA made career choices based on her personal preferences. INDIA explained, "I don't really think that my gender has influenced my career choices. I didn't pick my career because I'm a female. I just picked my career because I'm interested and that's what I want to do."

Three participants stated that their gender motivated them to achieve in non-traditional careers for women. BETTY responded that her gender, "somewhat influenced it [her career choice]. She further explained, "The field that I'm in there's not a lot of women, and I think it's more of a challenge to be a part of the trucking industry as a woman and as a minority at Ryder."

ELLA,a paralegal, was motivated to be in a male-dominated career field. ELLA stated:

> I work in law offices, which have predominantly men... I would say... working around males...influenced me to go into the law field... I feel like by being in the legal system, I'm just another woman who's showing other women... that they can accomplish and do anything they want to... hopefully, women will realize

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> that they don't have to be a lawyer or judge to have some power. A paralegal is like a mini lawyer.

ELLA appeared empowered by her work in the legal field.

HOPE was even more determined not to enter a traditional women's career field. HOPE explained, " I made sure not to pursue any of the stereotypical women's careers such as nursing or being a teacher because I feel like we are already well-represented in those fields."

The second question participants were asked specifically related to gender was, "How do you perceive that your status as a woman has impacted other's perceptions of your career choice options?" Four of nine participants shared experiences of negative or puzzled reactions from family, clients or coworkers regarding their career choice. BETTY, who is a management trainee at Ryder truck, explained:

> I think they kind of look at me as not the norm. A lot of people sometimes they make comments like, "I'm surprised to see you here." I think it makes them kind of realize that women can work in any industry.

FAY, who is enrolled in a summer law program and has been "wait-listed" at a law school, stated:

> I do feel that because of my gender that other people may think that I can't do certain career options. Or that they may think that it's harder for me to enter specific fields. But, I don't really think that it's negative, particularly. I just see it as a barrier.

FAY has rationalized her gender as a barrier to be overcome.

GAIL, who works as an Environmental Health and Safety Specialist, has experienced people questioning her choice of occupation. GAIL said:

> Well, I guess sometimes people may think or will ask, "Why do you want to do this? Or why do you have this job?" I guess everyone has a different perception, and everyone comes from different backgrounds. Overall, it's been fine. I haven't had any problems with it.

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While GAIL appeared determined to choose to her career regardless of what others thought. INDIA, on the other hand, who was formerly pre-med but now desires to be a psychologist, experienced negative feedback from her family regarding her career choice. INDIA explained:

> I think that, like, with some people in my family, when I was pursuing Pre-med or rather Biology curriculum, they asked if I was going to be a nurse. And I was like no, I'm going to be a doctor. And everybody kind of looked at me kind of strange. Like you know, you're a woman. And women aren't doctors.

INDIA stated later in the interview that her family's comments did not dissuade her from medicine.

CAREN, who is completing her masters degree in electrical engineering, believed that her career choice makes her a role model for young women. CAREN explained:

> Well, I think me being a female, has inspired other young people, other young girls to think engineering, computer science, and other male dominated field into deep consideration...The young girls are excited about CHROME. We most recently went on a college tour to Shaw and Central University. Before they [the mentees] went, they were asking questions like, "Tell me about your educational program." But after me and a couple of my friends talked to them, they started asking questions like, "Do you have computer science? Do you have engineering?"

CAREN's career choice and mentorship appeared to have an immediate impact on the lives of young women.

ANN, whose father is a dentist and mother is a medical technologist, described her strong family and peer support. ANN explained:

> ... my family, friends, and peers, I guess, they have always expected a lot out of me... It kind of motivated me to achieve... Like a lot of people say like, "Why don't you go on an be a dentist. You can do it. You're smart." Most people think I'm going to be a doctor one day, but I don't know.

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Although ANN had considerable support, she had self-doubt in regards to achieving her career goals.

The three remaining participants responded with varying comments. Neither DEE nor ELLA provided comments that specifically addressed others perceptions of their gender and career choice. HOPE, who is completing her masters degree in public health, stated, "I don't think people try to make you pursue a type of career such as a secretary...just because you are female...I don't think anyone tried to pigeon hole me or discourage my pursuits." Thus, HOPE appeared to believe that she as well as other women are free to choose pursue their career choices.

Family socioeconomic status

During the interview, the participants were asked two questions regarding their family socioeconomic status. The first question was, " How would you describe your family's socioeconomic status prior to your graduating from high school? (Prompt for annual family salary.)

ANN explained in her interview that her family household income was "$80,000 to $90,000" and that it was "mostly from [her] dad's [dental] practice." ANN also stated that she paid full price for lunch. Unlike ANN, BETTY was unclear about her family's socioeconomic status. BETTY explained in her interview:

> I'm not sure. My Mom, she's a housewife, and my Dad, he's retired from the post office... I would say we were middle class.

BETTY's family socioeconomic status changed from middle school to high school. BETTY explained:

> In middle school I was eligible for reduced lunch. I think because of my father's business; he sold clothes in New York then. In high school I paid full price.

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Unlike BETTY, CAREN's father and stepmother appeared to have earned consistent income. CAREN shared in her interview:

> I guess my parents, they were always the ones, like, I couldn't do a lot of things that I wanted to do because of the amount of money they made. Like I wanted to be in Upward Bound, which is a really good program, but I couldn't do it because I wasn't first generation college, and my parents made too much money. Or like I wanted to get a Bill Gates Scholarship. I couldn't get it because my parents made too much money. I don't really know what my parents make, but I figure that it's probably in the six-figure range together.

CAREN did not qualify for some federal programs or national scholarships based on her family socioeconomic status. CAREN also said that she paid full price for lunch.

Unlike CAREN, DEE's family socioeconomic status fluctuated. DEE explained in her interview:

> My stepfather is in the Navy as well. We do pretty well, and my mother works. We stayed upper middle class to middle class.

In response to question two regarding eligibility for free/reduced lunch, DEE explained, " [In] middle school it was reduced. In high school it was full price for me and my two brothers."

ELLA, unlike the other participants, stated that she came from a single parent home. ELLA explained in her interview:

> By being a single parent home, we always were in middle class. As I got towards high school, my mother went into the upper middle class status.

When ELLA was asked about her eligibility for free/reduced lunch, she stated:

> I was eligible for reduced lunch. And, I believe that I was eligible for that because my Mom didn't make over a certain amount of money.

ELLA provided conflicting data. If she was eligible for reduced lunch, she probably was not upper middle class.

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The second question asked regarding family socioeconomic status was, "Were you eligible for free lunch, reduced lunch or did you pay full price?"

Most participants reported their family socioeconomic status prior to graduating high school as middle-class. One of nine paid for reduced lunch and five of nine reported having to pay full price for lunch. The remaining participants experienced economic changes in their households throughout their K-12 years, which required them to fluctuate from paying full price to paying reduced lunch.

The researcher used United States Department of Agriculture (USDA) Income Eligibility Guides (IEG), which are set each new school year and are based on household size and income, to assist in describing the socioeconomic status of participants. The IEGs established a federal standard in which to assess eligibility for the USDA National School Lunch Program. For example, according to the IEG for the 1999-2000 school year, a family of four could not exceed household income of $30, 975 in order for a student to receive reduced lunch.

See Table 6 for description of participant self-described socioeconomic class status and level of participation in the school lunch program. One participant perceived herself as upper class even though she was eligible for reduced lunch.

Ethnicity

During the interview, participants were asked, "Do you believe that you have experienced racial discrimination in your educational pursuits and/or workplace? If so, how?" Table 7 lists whether the participants experienced discrimination at school or work and if race shaped their career choice. Their ages as of 2005 are also listed in Table 7.

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Two out of nine participants reported racial discrimination at school; and three out of nine reported racial discrimination at work.

DEE reported experiencing racial discrimination at school and work. DEE, whose work in Naval Intelligence requires her to attend numerous military schools, explained:

> In my field, you have a lot of schools, a lot of training, and they last a long time. Like, I was in school for about a year or so down in Florida... So, with there not being a lot of us [minorities] there, you do get treated differently. So, I have experienced it [discrimination] before.

DEE also stated that she thought this type of discrimination was not reflective of the entire Navy.

HOPE experienced racial discrimination as early as grade school. HOPE stated:

> Yes. I know that when I was in grade school, like elementary, middle school, and I was trying to test into the gifted program. They made me take the test twice. And, just small incidences with teachers where they would try to give me lower grades than other students, and I'd have to argue about it. They'd try to act like I was a behavior problem, and I wasn't.

HOPE sensed as a child that her academic gifts and abilities were not considered normal for African American young women.

CAREN and ELLA explained their experiences of racial discrimination at work. CAREN stated that she experienced gender and racial discrimination:

> In the workplace, very much so, but I don't know if it's from me being Black, or female or if it was the fact that I came from an HBCU. That has really been a large issue, working for different companies. It's like they want to test your knowledge, test your skills, because you're not coming from Virginia Tech, or you're not from Georgia Tech. It seems like they doubt you, simply because. I think that's been the main issue. I have been in workplaces where my race has been a serious issue.

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CAREN's experiences exemplify the multiple types of discrimination that an African American woman may experience in a STEM career.

ELLA believes that others on her job feel she should not have her position. ELLA explained:

> Yes. It's a lot of discrimination in my workplace and my work environment so to speak. Just because I work for the person that I work for not too many people have had the opportunity to work for this person, especially an African American. So, by working for the District Attorney..., by being an African American and also being a woman, some other backgrounds of races may feel that they have more education and that they qualify more. Or, you can have the same education equal to someone, but they still don't agree that you should get the job....But, I went through the same course, the same education as they did.

ELLA, even though she has comparable training and education to her coworkers, believes that she has experienced racial discrimination.

When participants were asked, "How do you perceive that your status as a member of a racial minority has shaped your career choices?" six of nine responded affirmatively that race had impacted their career choice. CAREN stated:

> I think that was the number one reason that I decided to go this route. Mainly because all my life, I've heard there's a lack of minorities in the sciences, there's a lack of women in the sciences. I've always wanted to make a difference. So, I feel like if I go this route, then I'm like killing two birds with one stone... In ways, it's actually made my life a little more difficult but... I've learned a lot about different arenas of the world in this field.

Thus, CAREN appeared motivated by her race and gender to be successful in her STEM career.

DEE also described her experiences. DEE stated:

> As a minority, in the field that I am in Secret Intelligence, there are not a lot of us [African Americans]. There are very few. So, depending on where you go, people might try to look down on you as if you're not as good or you can't do as much. It's really about stereotyping.

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DEE has not been dissuaded to leave her career although she acknowledges the lack of minorities and stereotyping.

ELLA is also motivated to do her best at work. ELLA explained, "I work with a lot of different backgrounds, different races. So, it's important as an African American woman...that I set the example that I'm just as equal as the people I work around." ELLA believes it's important for African Americans to set a positive example at work.

HOPE noted that CHROME helped her choose a STEM career. HOPE stated, "Because I'm a minority, I really fed into CHROME's message that we're underrepresented in the sciences and science based fields. And, so I made that a priority that I pursue a science, a science career because of that." HOPE's knowledge of the shortage of minorities in STEM careers influenced her to pursue a STEM career.

INDIA, too, suggested that her race shaped her desire to excel. INDIA stated, "not a lot of African Americans even go that far to even graduate high school. It [her race] just makes me want to do more and be better at what I want to do." INDIA indicated that she wanted to be successful in her chosen career partly due to her race.

GAIL was one of three participants who stated that her racial minority status didn't shape her career choice. GAIL said:

> Well, I know it is an issue, but I try not to let it be an issue. When I make career choices, I try to make them from my own perspectives. I try not to look at that I'm the only African American. I try not to look at it as a negative. I try to look at every experience as positive and try to gain something from it.

Thus, GAIL expressed her desire to make her career choices without the influence of racial issues.

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Summary of Primary Research Question 4

Although most of the participants did not experience racial discrimination at work or school, the majority of them believe their race is perceived by others as a barrier to overcome. Many respondents stated in their interview that they had to be better and do more to be accepted. They also noted the importance of setting a good example as a representative of the African American community.

Primary Research Question 5

How do cognitive variables including aspiration, math/science utility, math self-efficacy and math ability attributions affect CHROME alumna career choices?

Responses to this Primary Research Question 5 were derived from the Senior Report and standardized open-ended interview questions.

Aspiration

See Table 8 which describes participant aspirations in the year 2000 during their senior of high school, and participant subsequent jobs from high school to current career aspirations. Six out of nine participants had similar career aspirations in the year 2005 as compared to their career interests stated in their Senior Report in the year 2000.

Math Science Utility

See Table 9 for quotes on each participant's math/science utility. Math/science utility described how the participant perceived the usefulness of math and science to their career choice. Seven of nine participants reported high math utility and two reported moderate utility. Six of nine participants reported high science utility, two reported moderate utility and one reported low science utility.

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Math/Science self-efficacy

See Table 10 for quotes on each participant's math/science self-efficacy. Math/science self-efficacy described how the participant perceived their ability to perform well in math and science subjects. Seven of nine participants reported high math self-efficacy and two reported moderate self-efficacy. Seven out of nine participants reported high science self-efficacy, one reported moderate science self-efficacy and one reported low science self-efficacy.

Math ability attributions

See Table 3 and Table 5 for number and type of high school and college math courses completed. In high school, six of nine participants completed Algebra II; three completed Calculus; and three completed Math Analysis. In college, two participants completed two math courses; two completed three math courses; three participants completed four math courses; one participant completed five math courses; and one participant completed six math courses.

Summary of Primary Research Question 5

The majority of the participants had similar career aspirations from the year 2000 to the year 2005. The majority also expressed high to moderate levels of math/science utility and math/science self-efficacy. In high school, the majority of participants completed Algebra II. In college, the majority of participants completed three or more math courses.

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CHAPTER 5

DATA INTERPRETATION: THEMES AND THEORETICAL RELATIONSHIPS

Coding

The standardized open-ended interview questions were analyzed for emerging themes using the coding technique described in the methodology section. Codes that emerged were 1) Sex role socialization; 2) Career decision-making; 3) Teacher and counselor support; 4) Parent and family encouragement; 5) Personal attributions; 6) CHROME partnerships; 7) Financial support; and 8) Ethnicity.

1) Sex role socialization

The sex role socialization code emerged as participants described concerns regarding self-efficacy and career choice. Some participants reported lack of confidence to take certain math and science courses in high school. Two expressed lack confidence and self-doubt in their ability to attain prestigious positions. One still had perceptions of men versus women's work. Several experienced negative or puzzled reactions from family, clients or coworkers regarding career choice.

2) Career decision-making and career choice

Participants reported lack of career exploration and career choice indecisiveness. Some stated that their career decision-making was influenced through college course work. The majority made career choices based on personal preferences. High school preparation for college and careers motivated students to complete additional course work and volunteer. Some took high school courses in preparation for college requirements though not for specific careers. Some completed college science requirements by taking AP courses and additional elective science courses. One sought

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career information by conducting her own computer search to assist in career-decision making. One cited her early exposure to technology as influencing her career choice.

3) Teacher and counselor support

The teacher and family support code emerged as majority of participants reported lack of counselor support in their career choice and decision-making. Two participants described extraordinary support from their high counselors. Most teachers were male who taught STEM courses in high school and undergraduate institutions. One participant's teacher increased her confidence in science.

4) Parent and family encouragement

The parent and family encouragement code emerged as participants reported high expectations from family, friends and peers. The majority of parents were the single best source of support. The majority of parents were described as role models.

5) Personal Attributions

The Personal Attributions code evolved as participants reported being goal oriented for career achievement. They also reported having high aspirations and having high self-esteem. Most participants demonstrated persistency to complete their baccalaureate degrees within five years. Others demonstrated resiliency to overcome critical incidents and pursue other career choices.

6) CHROME partnerships

The CHROME partnerships code emerged as participants reported about the importance of CHROME's guest speakers who served as role models. Participants also described the importance of guest speakers who encouraged participation in STEM careers. One described how the CHROME program helped her network in undergraduate

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and graduate school. The majority described the impact CHROME's summer programs at local universities had on their career choice and decision-making.

7) Financial support

The financial support code emerged as participants described how finances affected college attendance and college major. One participant stated that though she had a fully funded scholarship, the scholarship requirements limited her choices of college major. Another participant stated that she might have studied engineering if she had received a full scholarship to study at a larger institution which offered engineering. All participants said that they paid for college through parental support, scholarship and/or financial aid.

8) Ethnicity

The ethnicity code emerged as participants reported the importance that they serve as role models to other African Americans and younger African American women, specifically. Some stated that they wanted to represent the African American race positively. Several experienced racial discrimination at school or work. Some believe others perceive that their race is a barrier to overcome. Majority believe that acceptance into their career choice requires them to be better and do more than their colleagues.

Themes

The themes that emerged from the codes were 1) Support, 2) Career, and 3) Gender and Ethnicity. The Support theme combines codes from teacher and counselor support; parent and family encouragement, financial support and CHROME partnerships. The Career theme includes the codes career decision-making and career choice, and

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personal attribution. The Gender and Ethnicity theme combines codes sex role socialization and ethnicity.

Triangulation types used in study

Triangulation strengthens analysis. According to Patton, four types of triangulation are generally practiced in qualitative analysis. This study used two types of triangulation "(1) collecting different kinds of data on the same question...and (2) using different perspectives (or theories) to interpret a set of data" (Patton, 1987, p 161).

Triangulation using Adapted Farmer Model

Farmer, who created several conceptual models to analyze career choice and career decision-making, was convinced that other career choice and decision-making theorists like Super, Holland and Osipow did not use or design career development models that were effective for persons of color or women. Thus, the Conceptual model used in this study was created based on Farmer's models since the subjects were African American women. The model, which can be found in Figure 1, tests contributors to career choice and has five sets of variables. The variables include Post High School Experiences, Environment, Demographics, Cognitive, and Academic Achievement.

Post High School Experiences variable

Post High School Experiences variable includes examining marital status, critical incidents, family/job involvement, number of math and science courses completed in college and college GPA. The six participants who completed their baccalaureate degrees within five years were single, did not have children and did not report any critical incidents. Those same six participants completed a range of two to six college math courses with an average of 3.6 years of math course completion. Five of the six

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participants completed four to twenty-seven science courses with an average of 17.4 number of years of science course completion. One participant completed all of her college's science requirements while in high school, and she chose not to take any science courses in college. The remaining three participants who did not complete their baccalaureate degree within five years had children and other critical incidents which slowed their progress toward their career aspirations. They completed a range of three to four college math courses with an average of 3.6 years of math course completion. The same three participants completed two to eight college science courses with an average of four years of science course completion.

There was little variance in college GPA between those who completed their degrees and those who did not. The range of college GPA was 2.60 to 3.60 with an average GPA of 3.29 for those participants who completed their college degrees. The range of college GPA was 3.20 and 3.25 with an average GPA of 3.23 for two of the participants who did not complete their college degrees. One participant did not disclose her GPA.

The Post High School Experiences variable yielded results which indicate that differences exist between those participants who completed their college degrees and those who did not. Those who did not complete their degree had a child, experienced critical incidents, changed marital status and did not complete as many science courses as their peers that did complete their degrees. No real differences were found in college GPA or number of math courses completed.

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Environment variable

The Environment variable includes parent support, counselor support, teacher support, CHROME support and financial support. Eight of nine participants reported that parent support was critical to their career choice. The level of support from high school counselors was varied. Only two participants indicated that they had outstanding counselors who helped them with their career choice and decision-making. Three other participants said they received mostly college application assistance from their counselors with none to very limited career choice and decision-making support. Four participants stated that they received negative and/ or very limited support from their counselors. Likewise, the level of teacher support varied as well. Four participants stated that they had some level of support from their teachers to pursue a STEM career. The other five participants stated that teachers had very little influence in their career choice and decision-making. All nine participants reported that support from CHROME shaped their career choice and decision-making. Seven of nine participants indicated that they had financial support to pursue their career choice. Of those seven, four participants stated that they knew that their parents would help pay for college; thus, they felt freer to pursue their career aspirations. One participant stated that she always had enough financial aid to stay in college.

The Environment variable yielded results that indicate that support from parents, CHROME and financial backing, affected CHROME alumna career choices. In general, counselor support and teacher support did not influence career choice and decision-making as much as the other types of support.

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Demographics variable

The Demographics variable includes gender, family socioeconomic status (SES) and ethnicity. In regard to gender, five of nine participants indicated that their gender did not influence their career choice. Four of nine participants shared experiences of negative or puzzled reactions from family, clients or coworkers regarding their nontraditional career choice. Sex role socialization perceptions of men versus women's work still existed for one participant who expressed lack of confidence and self-doubt in her ability to become a dentist, even though her father is a dentist with his own practice. The participant, though she has a degree in biology, is now pursuing studies in dental hygiene.

In regard to SES, the majority of the participants state that their family was middle class. To further validate SES, participants were asked about their participation in the National School Lunch Program. One of nine participants paid for reduced lunch and five of nine reported having to pay full price for lunch. The remaining three participants experienced economic changes in their households throughout their K-12 years, which caused them to fluctuate from paying full price to paying reduced lunch. Of note, two who fluctuated from paying full price to paying reduced lunch also did not complete their degrees. The other participant who paid for reduced lunch also did not complete her degree. Although a specific question was not asked about parent occupation, numerous participants stated their parents had college degrees. The one participant currently on active duty in the Navy stated that her step- father was also in the Navy.

In regard to ethnicity, two out of nine participants reported racial discrimination at school, and three out of nine reported racial discrimination at work. Though the majority

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of the participants did not experience racial discrimination, they did communicate that they believed that their race was perceived by others as a barrier to overcome in order to achieve career goals and aspirations. Many respondents stated in their interview that they believed that they had to work harder and do more to gain acceptance from their colleagues. Participants also noted the importance of serving as role models to other African Americans, especially younger African American women. They also felt a responsibility to represent the African American race positively.

The Demographics variable yielded results that indicate that at least half of the participants choose their careers without regard to gender. One participant still believes in women's versus men's work. The majority of these African American participants take their ethnicity seriously and feel an obligation to mentor other young women and perform exceptionally in their chosen career. Although less than half reported discrimination at school or work, the majority expressed being judged negatively due to their race, and as a result, decided to work harder and more extensively to overcome perceptions of racial inferiority.

Cognitive variable

The Cognitive variable includes aspiration, math/science utility, math self-efficacy, and math attributions ability. During their last year of high school in the year 2000, the participants were asked to list their career aspirations on their Senior Report. ANN, who wanted to be a radiologist, has since completed a biology undergraduate degree and is now a full-time student at a dental hygiene school. BETTY, who wanted to work in the business and technology fields, has since completed a business administration degree and now works full time in the trucking industry as a manager trainee. CAREN,

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who wanted to be a Network Engineer, has completed a computer science undergraduate degree and is now studying electrical engineering at graduate school. DEE, who planned to serve on active duty in the Navy, did join the Navy and has worked for five years in the secret intelligence career field as a Cryptology Technician. ELLA, who originally planned to join the military, did not join the military ,but has since trained and worked as a medical assistant. Currently, ELLA works as a paralegal in a District Attorney's office. FAY, who planned to be a forensic pathologist, has since completed an undergraduate degree in Political Science and Legal Studies and worked briefly as a Special Education Teacher. FAY is now enrolled in a summer law program. GAIL, who planned to be a Disease Researcher, has since completed her undergraduate degree in Biology, and works full time as an Environmental Health and Safety Specialist. HOPE, who planned to be a Biomedical Researcher, has since completed an undergraduate degree in Ecology and Evolution and is now attending a graduate school in a school of public health. INDIA, who originally wanted to become a General Practitioner, has since completed a general studies associate degree and is now majoring in science at a four year university. INDIA has decided to become a Psychologist

Seven of nine participants reported high math utility and two reported moderate utility. Six of nine participants reported high science utility, two reported moderate utility and one reported low science utility. Thus, the majority of participants perceived the usefulness of math and science to their career choice.

Seven of nine participants also indicated high math self-efficacy, and two reported moderate self-efficacy. Seven out of nine participants indicated high science self-efficacy, one reported moderate self-efficacy and one reported low self-efficacy. Thus,

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the majority of participants liked math and science and felt confident about their ability to handle math and science related studies and pursue subsequent careers. A higher self-efficacy also implies the willingness of participants to persist at a task until it is mastered and to be actively engaged. Some participants reported lack of confidence when taking certain math and science courses in high school.

Math ability attributions, similar to self-efficacy, describe how participant's assign their success in math to their ability or lack of ability. Most of the women indicated that they had strong skills in math. Of note, ELLA felt that her math skills improved in college because her teachers took more time and interest in assisting her than did her high school teachers. Another participant stated that she didn't feel math was one of her strong suits; yet, she completed the most math courses in high school and in college of all participants in this study. In college, two participants completed two math courses; two completed three math courses; three participants completed four math courses; one participant completed five math courses; and one participant completed six math courses.

Academic Achievement variable

The Academic Achievement variable includes the type and number of high school elective math and high school elective science courses completed. In high school, six of nine participants completed Algebra II; three completed Calculus; and three completed Math Analysis. According to Adelman (1999), completion of Algebra II is a strong indicator of students that will complete college; five of the six students who completed Algebra II in high school also completed their baccalaureate degree within five years.

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The high school elective science courses that participants completed included courses such as Chemistry, Honors Chemistry, Biochemistry, Physics, Biology II, Physiology, AP Computer Science I and AP Computer Science II. Eight out of nine participants completed Chemistry, Honors Chemistry or Biochemistry; three completed Physics, and two completed Biology II or AP Biology.

Career Choice variable

Career Choice variables include occupational level, occupational field and persisters. The current occupational level of participants varies from enrollment in graduate programs to working full-time. Two participants are enrolled in graduate school; one is enrolled in first year law school; one is a first year manager trainee; one is in dental hygiene school, one works as a full-time paralegal; one works full time as a military member; one works full-time as an entry level Environmental Health and Safety Specialist and one is a full-time undergraduate student.

The current occupational field of participants varies from electrical engineering to psychology. One participant, attending on a full scholarship, is a second year graduate student studying electrical engineering. One participant is attending a graduate school of public health. One, who was "wait-listed" at a law school, is now enrolled in a different summer law program. One participant works full time in the trucking industry as a manager trainee. One, who has a degree in Biology, is now a full-time student in dental hygiene school. One, who is active duty Navy, works in secret intelligence as a Cryptologic Technician. One, who formerly worked as a medical assistant, now works in a District Attorney's office as a paralegal and aspires to become a lawyer. One, who has a degree in Biology, works full time as an Environmental Health and Safety Specialist.

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One, who originally wanted to become a General Practitioner, is now a full time undergraduate student studying psychology.

The persisters are defined as those who remained consistent with their stated career aspiration in 2000 as compared to their current career field in 2005. Seven of the nine participants are persisters in their chosen career field. Of those seven, six are persisters in the STEM careers. One non-persister originally wanted to enter the military after high school, but chose instead to become a medical assistant. She left medical assisting due to low wages, and she now works as a paralegal. The other non-persister stated an interest in forensic pathology in the year 2000, but now she is enrolled in law school and aspires to be a lawyer.

Triangulation of Theoretical Relationships

The theoretical framework for this study is based upon gender, ethnicity, and career choice and decision-making. Feminist theory and perspective regarding gender are addressed using works by Sadker and Sadker, Harding, Burger, and Sandy. Theories regarding ethnicity are addressed using John Ogbu's Cultural-Ecological Theory of Minority Schooling. Theories regarding career choice and decision-making are addressed using Helen Farmer's Conceptual Models.

Feminist theory and perspective

Feminist theory attempts to make connections between sociological, political and economic aspects. This study found that the majority of the women participants received positive support from parents and family, the CHROME program and financial backing to pursue their STEM careers. Participants received the least support from teachers and counselors in regard to their career decision-making and career choice. The results of

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this study will be compared to the theoretical perspectives of feminist researchers Burger and Sandy, Benokraitis, Harding, and Sadker and Sadker.

Benokraitis, an expert in the field of sexual discrimination, described varying types of discrimination such as blatant, subtle and covert. This study found that the majority of the women did not feel that they were victims of discrimination.

Researchers Burger and Sandy described the lack of counselor support to help young women enter STEM careers. This study confirmed their finding. The majority of the participants in this study received little career counseling or other services to assist them in their career decision-making and career choice.

Harding (1991) said that to combat the shortage of individuals trained and educated in STEM that America must have special programs to recruit women and minorities. The CHROME program specifically targets women and minorities to participate in their programs and activities. The CHROME program also provides STEM training to their CHROME sponsors, the majority of whom are African American women teachers.

This study found that CHROME provides a more comprehensive program to assist young women to pursue their career choice. Other programs, described in the literature review, have some components of the CHROME program, but they are limited in scope and duration.

Researchers Sadker and Sadker noted the phenomenon of "female invisibility" (1994, p. 13) in that female students were ignored in the classroom because teachers were teaching directly to boys or were handling boys' behavior problems instead of assisting

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young women with their questions or concerns. In this study, subjects did not describe feelings of being invisible in the classroom.

The Sadkers also theorized that girls and boys who like science and math have higher career aspirations, have stronger ties to family, have higher self-esteem and higher self-efficacy in schoolwork. The results of this study confirmed the Sadker's findings. The majority of the participants in this study completed their baccalaureate degrees within five years and persisted in the STEM careers.

In conclusion, feminist theorist provided a framework to more accurately assess and explain phenomenon that shaped women's career choices. Because of their research, the researcher was able to create the conceptual model for this CHROME study.

John Ogbu and others on ethnicity

John Ogbu, an expert on the African American experience, now deceased, provides a framework to understand the impact of race, class and minority status on career choice. Ogbu's Caste theory, also known as Cultural-Ecological Theory of School Performance or the Cultural-Ecological Theory of Minority Schooling, is considered the prevailing theory that explains the many challenges of underrepresented minorities living in an oppositional culture. The results of this study will be compared to the theoretical perspectives of Ogbu.

This study found that the majority of participants in this study did not identify with "low-effort " syndrome. The majority of participants were engaged in their school work and aspired to participate in STEM careers. Two participants are now enrolled in graduate school and one is in law school.

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Ogbu's in his findings from his Shaker Heights ethnography described the phenomenon of "low-effort syndrome" in which students did not perform their best work at school. Ogbu described students who identified with this syndrome as preferring basic skills and college prep classes as compared to more challenging courses such as Advanced Placement courses and elective math and science courses.

In regard to the Caste theory, the most prevalent comments made regarding race, ethnicity and racism occurred when the participants discussed feeling different because they were treated differently at school or work. Although most of the participants didn't feel that they were discriminated against, they did feel stigmatized or stereotyped as being inferior at school or work.

Ogbu (1990) describes that the phenomenon of "job ceiling consists of both formal statutes and informal practices followed by [W]hite Americans to limit [B]lacks' access to desirable occupations...and to channel narrowly the potential returns they can expect from their education and abilities"(Ogbu, 1990, p. 7). Making disparaging remarks or comments to involuntary minorities who aspire to more prestigious positions is an example of what Ogbu describes as instrumental exploitation of African Americans by White Americans.

This study combines the constructs of class, power, race, and ethnicity to define and describe African American socioeconomic status, which is different from American socioeconomic status. The majority of the participants stated that they were middle class and had to pay full price for lunch in high school. Some participants indicated that their family was the equivalent of professional middle class. For example, ANN stated that her father was a dentist in private practice, and CAREN stated that her father and step-mother

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probably earned about a six-figure combined income. The majority of these participants indicated that they had financial support to attend college. Most stated that they knew that their parents were willing and able to support them to achieve their career choices.

In conclusion, Ogbu's Caste theory provides a means to more accurately assess and explain phenomenon that impact African American women's career choices. Because of his research, the researcher was able to create the conceptual model for this CHROME study and include how ethnicity, race, class, power and racism shape choices.

Helen Farmer on Career Choice

The structure of Helen C. Farmer's theories and models greatly improve a researchers ability to capture women's career choice and decision–making. Farmer's models not only provide a framework to examine women's career choice but some also are designed specifically to examine women's career decision-making in regard to STEM careers. Farmer believes that career theories and models must meet the needs of "persons from poor families, persons of color or women" (Farmer et al, 1997, p. 3). Each of Farmer's models contributed to the formation of the model created for this study.

In 1978, Farmer created the Conceptual Model for Understanding the Inhibited Academic/Career Motivation in Women. Although the model comprised numerous variables, it is the specific Environmental variables of family socialization and discrimination in community and work and Personal variables of home/career conflict, sex role orientation, academic self-esteem and fear of success which best support this study. This study found that the majority of participants did not perceive careers or jobs as male or female, and they made their career choices based on their personal aspirations.

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The majority of participants remained single and did not experience critical incidents. The majority of the participants had high academic self-esteem and did not fear success.

Farmer originally used her Conceptual Model for Testing the Contribution of Background, Personal, Environment and Motivation to Occupational Choice in her 1980 longitudinal study and then revised it in 1990. Farmer's inclusion of these variables were key to the formation of the model created for this study: school location, ethnicity, math/science self-efficacy, math/science utility, parent support, teacher support, counselor support, financial support, critical incidents, number of math/science courses, marital status, family/job involvement, occupational level, occupational field and persisters. Like Farmer's study, this study identified schools as urban, suburban or rural. By aspiring to get a cross section of participants from different school divisions, the study became more representative of the population that the CHROME organization served. The urban cohort proved to be challenging as the majority of the former CHROME student's phone numbers were disconnected or reassigned. Ethnicity was important to identify because unlike Farmer's study who had a very small percentage of minority students, this study had all African American subjects. Math/science self-efficacy and utility; number of math/science courses were also helpful in discerning participants attitudes and abilities in the fields of math and science. The varying levels of support from parents, teachers, counselors, and financial support proved important in this study. This study added the variable of CHROME support. By having these variables, the researcher was able to determine which types of support were most helpful to participants in pursuing their career aspirations. The variables critical incidents, marital status, and family/job involvement were important to this study because they allowed the researcher

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to incorporate the impact of having children, divorcing, performing military service and being a military spouse into understanding women's career choice and decision-making. Finally, Farmer's variables of occupational level, occupational field and persisters were important to this study because she used codes from the Department of Labor to identify the occupations of her subjects. This study used the O*NET codes which are a more recent form of occupational classification. Further, Farmer identified subjects as persisting or not persisting in their chosen career fields. That was important to this study because it allowed the researcher to capture where participants were on their journey to their career choice. Though most had completed their college degrees, others were still persisting in their career choice and still others changed their career path.

In 1999, Farmer published the Conceptual Model for Testing the Contribution of Demographic, Cognitive, Environmental and Behavior sets of Variables to Choice of a Science or Nonscience Career. This model built upon Farmer's previous models but added the component of persisting or not persisting in a science career. Like Farmer's study, this study found that women in STEM careers compared to women who did not pursue STEM careers valued math and science for their future career goals. Women in science careers took more elective science courses, aspired to higher prestige careers, and attributed their math successes to their ability.

In conclusion, Farmer sought to create models that could more accurately assess and explain phenomenon that impacted women's career choices. Because of her longitudinal research and constant modification to her models, the researcher was able to create the conceptual model for this CHROME study.

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Triangulation with CHROME tenets and goals

The impact of the CHROME program on participant's career choice and decision-making will be analyzed against three of the tenets of the CHROME organizational model and the five CHROME program goals. Tenets and goals will be paraphrased, but complete descriptions can be found in chapter one and Appendix A.

1. Reach participants at earliest grade level and continue to monitor to maintain interest and motivation throughout their school experience.

All nine participants were active in CHROME during their high school years. Five of nine participants were involved in CHROME in middle school, four of which started in eighth grade and one in sixth grade. No participants reported being a part of CHROME at the elementary school level. The CHROME program should duplicate the success found in the high school level at the middle school and elementary levels to enhance awareness of the opportunities they provide.

2. Impact what and how a student is taught.

This study could not link participant's quality of instruction to the influence of the CHROME program. Most of the participants did not state that they received instruction from teachers who received training from the CHROME program. One participant stated that her CHROME sponsor was also her math teacher, but she mostly commented on the qualities of the sponsor as a role model.

3. Provide clear levels of intervention activities that build upon the previous year.

This study could not link intervention activities that built upon the previous year. Although most participants described significant activities and programs that they

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experienced as a result of their involvement in the CHROME program, no participants stated that their activities were somehow connected to prior learning or requirements.

The paraphrased CHROME goals are listed below and followed by the findings in this study:

1. Identify, nurture and assist participants to pursue STEM careers.

This study found numerous examples of the CHROME program's efforts in identifying, nurturing and assisting participants to pursue STEM careers. Some participants vividly recalled that their CHROME sponsors actively identified and recruited students to join the CHROME club so that they could learn about STEM careers and opportunities.

Participants also described the CHROME club's programs and activities such as meeting guest speakers who served as role models and encouraged them to participate in STEM careers; meeting other like-minded students who were interested in science and math; and attending CHROME summer programs at local universities. All of these events nurtured and assisted their growth to pursue STEM careers.

2. Provide training activities, programs and resources for teachers, counselors and parents to encourage participants to pursue STEM careers.

This study found no specific connection between comments reported by participants in regard to their participation in the CHROME program and the CHROME training activities, resources and programs received by teachers, counselors or parents. For example, the CHROME program provides a list of possible guest speakers for their CHROME sponsors; however, CHROME sponsors are free to get their own speakers.

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Thus, participants, while they enjoyed meeting guest speakers, would not necessarily know if the guest speaker came from a CHROME resource.

3. Establish and sustain partnerships with business, higher education, school systems, civic and professional organizations, government agencies, and other entities committed to the mission of CHROME.

This study found numerous examples of the CHROME program establishing and sustaining partnerships with CHROME supporters. By sending participants to summer programs at Old Dominion University and Christopher Newport University, the CHROME program maintained some of their higher education partnerships.

4. Support educational improvements in areas of STEM consistent with CHROME mission and goals.

This study found no specific connection between comments reported by participants in regard to their participation in the CHROME program and the CHROME program's support of educational improvements in the areas of STEM consistent with CHROME mission and goals.

5. Continue to be a pre-eminent model for the development of programs nationally and internationally, which is consistent with the mission of CHROME.

This study found that the CHROME program model has developed significant programs that other organizations may want to incorporate into their national and or international programs. Like CHROME, many of the programs that were discussed in the Literature Review of this study provide opportunities for young women to attend STEM summer camps, receive mentoring, and meet professionals in STEM careers. However, several key differences make the CHROME program model ideal for others

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organizations to emulate. The CHROME program provides more opportunities for K-12 students, reaches diverse and underserved populations and develops partnerships with other entities to diversify learning experiences.

Though none of the subjects in this study participated in CHROME during their elementary school years, the CHROME program does begin encouraging students to learn about STEM careers as early as elementary school. According to the 1998-1999 CHROME annual report, the CHROME program had the following enrollment: 947 elementary students; 1030 middle school students and 1012 high school students. These 2989 students were a part of 116 CHROME clubs across13 school divisions. These school divisions serve diverse populations in rural, urban and suburban settings. Further, even though the CHROME program is open to all students, the majority of participants in the CHROME program are African American women, unlike most other programs.

The CHROME program also has diverse partnerships among businesses and corporations, higher education institutions, school systems, civic and professional organizations, government agencies, and other entities committed to its mission. Thus, unlike other short term, intervention programs sponsored by big businesses like Intel, IBM, Microsoft and Hewlett-Packard, the CHROME program is not tied to corporate interests and provides more consistent opportunities for students to learn about STEM careers. Likewise, programs like Westminster College's AWE + SUM, partnered with the American Association of University Women and the Mathematical Association of America to produce a weekend summer program that only served about 40 young women age 12-13. The CHROME program partners with at least five higher education

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institutions and routinely creates and supports opportunities for students to attend summer residential, summer day camp and weekend programs at colleges and universities.

Because CHROME has a 22-year history in the state of Virginia, many local, state and national institutions ask them to serve as a clearing house for their STEM related opportunities. These opportunities include but are not limited to scholarships, internships, mentorships, college fairs, engineering competitions and summer residential programs. Also, CHROME has partnered with national organizations such as the Girls Scouts to sponsor programs and training. Thus, the CHROME program has numerous programs and activities which support their goal of being a pre-eminent model for the development of programs nationally and internationally, consistent with the mission of CHROME.

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CHAPTER 6

CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Summary

The young women who participated in this study were greatly influenced by a variety of variables. The majority of the women made their career choices based on their personal preferences and did not yield to sex role socialization or gender or racial discrimination. Parents, CHROME and financial support greatly shaped the participant's career decision-making process.

Conclusions

Conclusions to be drawn based on findings

The results of this study indicated that the majority of CHROME alumna are persisters in STEM careers. In the year 2000, six of nine participants stated that they aspired to enter STEM careers, and in 2005, they were employed and/or pursuing a STEM career.

The other three CHROME alumna, though they are not currently involved in STEM careers, are employed in other careers. BETTY, who aspired to work in business or technology in the year 2000, completed a baccalaureate degree in Business Management and is now a manager trainee in the trucking industry. ELLA, who aspired to join the military in the year 2000, did not join the military and is now a paralegal in a district attorney's office. ELLA, however, completed training at a technical school to become a medical assistant. After working for a year as a medical assistant, ELLA explained in her interview that she was not making enough money for the lifestyle that she desired. Thus, she changed her career goals to become a paralegal. FAY, who

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aspired to be a forensic pathologist in the year 2000, completed a baccalaureate degree in political science with an emphasis in legal studies. FAY is now enrolled in law school.

The most successful participants, in terms of undergraduate degree completion and occupational prestige, were the African American women who remained single, experienced no critical incidents, came from a middle class to upper middle class socioeconomic background, and did not have children. The women who have not yet finished their baccalaureate degrees, are enrolled in college and each have one child.

Impact of the study

Most of the participants described their involvement with the CHROME program as enjoyable and educational. An implicit value of the CHROME program may be in its message to minorities and women that they are underrepresented in the STEM careers, and they are needed to fill the shortage of personnel in STEM careers. Numerous participants stated that CHROME reinforced their desire to pursue STEM careers. CHROME, through its various outreach programs, provided opportunities for these African American women to engage in hands-on activities, and to network and discuss the shortages of STEM personnel.

Implications

Implications for professional practice and decision-making

The employment of women, African American women in particular, in STEM careers will help achieve what Farmer describes as "critical mass" (1998, p. 74). Critical mass is "The point at which the presence of a sufficient number brings about a qualitative improvement in conditions...defined as a strong minority of at least 15%" (Farmer, p.

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74). Women in many areas of STEM, especially the hard sciences, have yet to reach and maintain critical mass. This is true in academia as well.

According to Farmer, "For women and members of other minority groups, adequate representation in an occupation is one important factor than can help produce a work environment in which they are not marginalized' (1998, p.73). Women will need more than civil rights advocacy, gender based government policies and legislation, and affirmative action to increase their representation in STEM careers. They will need more programs like CHROME throughout the country to foster their natural inquisitiveness, enhance their problem solving abilities and provide counseling and information about training and education in the STEM careers.

Several changes must be made in order to increase awareness about STEM opportunities for young women Prekindergarten-12. The media must change so that they portray girls and women in all types of careers. Nonprofit programs like CHROME must be consistently funded. Programs must also partner with universities, government agencies, civic groups, other nonprofits, community leaders, Prekindergarten-12 school divisions, corporate entities and individual contributors to maximize opportunities for women.

Implications for theory building

This study contributed to the body of literature in women's career choice and decision-making. The new conceptual model created for this study allowed the researcher to incorporate unique characteristics of the CHROME program with key concepts from Farmer's tested conceptual models. This study also incorporated feminist theory to shape the perspective of this study to specifically address the needs of women in regard to

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career choice and decision-making, especially in the STEM careers. Ogbu's Caste Theory was essential to discuss possible inferences about ethnicity since the entire sample was African American.

Implications for future research studies

Perhaps future researchers may want to further validate this methodology by applying these three theories to their investigation. To see what really helps African American women and other involuntary minorities to persist in STEM careers, a researcher should have knowledge of the historical background of the minority group and knowledge of the family socioeconomic status.

Limitations

While results from this study can be useful for further research in the study of African American women's career choice, self-efficacy and ability in math and science, this study is specific to the CHROME program. Although the researcher made every attempt to get three participants from each type of school division, only two participants completed both their questionnaires and interview in the urban cohort. The potential list of urban participants was exhausted. Thus, there may be a possible skewing effect since the additional participant came from a rural school.

Recommendations for Further Research

Since the majority of women completed their baccalaureate degree within five years and stated that they remained single, it would be of further research interest to investigate why they perceived remaining single as important to their career choice and decision-making. Research questions that could be posed include: What impact, if any, did remaining single have on your ability to choose your career? To what extent, if any,

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do you believe that your single status was significant to your persistence in achieving your career aspirations? What factors, if any, contributed to your beliefs that remaining single would be essential to your career aspirations?

Second, further defining family socioeconomic status of CHROME participants would also be of research interest. By asking specific questions regarding parent occupation, type of parent education, parent highest level of education, and total household size, a more detailed background on each subject could be ascertained to provide greater insight as to career choice and family support. In addition to using the O*NET codes currently used in this study, parent occupations could be identified using the Duncan Socioeconomic Index, which measures the relationship of occupational prestige, education and income. Thus, increased description regarding family socioeconomic status would add more depth to the study.

Third, conducting the same study using an African American male sample would also benefit research. Although CHROME participants are primarily African American young women, many African American young men also participate in CHROME. Since Helen Farmer's original models were used with men and women, these models provide inherent validity and could be used in a similar study.

Fourth, conducting a study on the CHROME club sponsors would help CHROME officials to assess and improve sponsor training and delivery of CHROME programs and services. Since many sponsors are also teachers, this study would be able to capture how the sponsors incorporate the training received from the CHROME program. This study could also code and assess the types of activities that the sponsors implement within their CHROME clubs. Although participants in this study discussed many programs that

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helped them in their career choice and decision-making, the sponsor would be able to describe all opportunities they provided to their CHROME club participants as well as which programs and services they emphasized.

Recommendations for the CHROME program

Based on the responses of the majority of the participants, the CHROME program is effective in providing opportunities for students to gain awareness of STEM careers by designing and conducting hands-on K-12 programs focusing on STEM careers; partnering with other organizations so CHROME students have access to college and career fairs; providing African American guest speakers at club meetings who also serve as role models; and creating networking opportunities for students across school divisions. Of note, the networking piece of the program has additional long term outcomes in that one participant, who is now enrolled in a graduate electrical engineering program, reported that she was able to build upon her CHROME network when she reconnected and met other former CHROME students at professional conferences.

Recommendations to the CHROME program include:

1) Increase the number and depth of STEM programs to ensure students learn in detail about STEM careers, engineering careers in particular. Programs, which should begin as early in the K-12 school experience as possible, should also be clearly coded and participant attendance documented on Senior Report form.

2) Increase summer programs with higher education institutions to provide hands-on training and education for participants to learn more about STEM careers. Participants prefer to be actually engaged in learning about science and math.

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Thus, expanding partnerships with K-12 nonprofit, businesses, and government agencies to also provide internships for CHROME women participants would also be beneficial.

3) Develop literature and conduct classes to educate African American young women, their families and their teachers about sex role socialization as they pertain to STEM careers. Sex role socialization experiences shape girls' attitudes and beliefs about what roles are appropriate for girls and what roles are not.

4) Ensure that CHROME is serving economically disadvantaged students as well as middle class and upper middle class students. Develop a research based strategy to determine the family socioeconomic status of CHROME's female participants. Direct research to assess CHROME's effectiveness in providing services to students who receive reduced/free lunch to determine if CHROME is meeting their needs.

5) Create literature and conduct classes to educate elementary, middle and high school counselors and teachers about the importance of assisting young women in learning about STEM careers. Implement a marketing campaign to stress the role of counselors and teachers in assisting young women in their career choice and decision-making.

6) Increase CHROME sponsor training to ensure that they know the importance of providing guest speakers at their CHROME club meetings. Speakers should come from diverse STEM fields to assist young women with exploring career options, especially since young women, compared to young men, do not receive as much career exploration opportunities as men. Biannually update the CHROME speaker roster to ensure CHROME sponsors have new and diverse speakers.

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The CHROME program appears to provide a valuable service to CHROME women participants to explore careers, network with other students, nurture their math, technology and science interests, and speak to African American professionals in STEM careers.

By incorporating these recommendations into the CHROME strategic plan, the CHROME organization can better serve their target population, support the interests of the stakeholders and help meet the national need for trained and educated professionals in the STEM careers.

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REFERENCES

AAUW Report: How schools shortchange girls. (1995). The AAUW [American Association of University Women] Educational Foundation, Wellesley College Center for Research on Women.

Adelman, C. (1998). Women and Men of the Engineering Path: a Model for analyses of undergraduate careers. Washington, DC: U. S. Department of Education and the National Institute for Science Education.

Adelman, C. (1999). Answers in the Tool Box: academic intensity, attendance patens and Bachelor's Degree attainment. Washington DC: Office of Educational Research and Improvement.

Bandura, A. (1977). Social Learning Theory. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

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

Bandura, A. (1989). Human agency in social cognitive theory. American Psychologist, 44, 1175-1184.

Banks, B. J. (1994). Explanations for academic progress: sources of undergraduate accounts. American Sociological Association, 100-105.

Bardwick, Judith (Eds) (1972). Readings on the psychology of women. New York: Harper and Row Publishers.

Barton, A. C. (1998). Feminist science education. New York: Teachers College Press.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Benokraitis, N.V. (1997). Subtle sexism: Current practice and prospects for change. Thousand Oaks, CA: Sage Publications, Inc.

Bouler, J. (1997, Sept). Reclaiming school mathematics: the girls fight back. Gender and Education, 9, 3, 285-305.

Browman, C. L. (1992, Summer). The Black experience: Attributing the causes of labor market success. *National Journal of Sociology, 6*, 1, 77-90.

Brown, D. & Brooks, L. (Eds) (1996). Career choice and development. San Francisco, CA: Jossey-Bass Publishers.

Burger, C.J. & Sandy, M.L. (1998). A guide to gender fair education in science and mathematics. Virginia space grant consortium. Arlington, VA: Eisenhower regional consortium for mathematics and science education.

Burger, C.J. & Sandy, M.L. (1999). Women and minorities in information technology forum: Causes and solutions for increasing the numbers in the information technology pipeline. Hampton, VA: Virginia space grant consortium

Burger, C.J. & Sandy, M. L. (2003). A guide to gender fair counseling for science, technology, engineering, and mathematics. Hampton, VA: Virginia space grant consortium

Chesler, N.C. & Chesler, M.A. (2002). Gender informed mentoring strategies for women engineering scholars: On establishing a caring community. *Journal of Engineering Education, 91,* 1, 49-55.

Cook, T.D. & Campbell, D.T. (1979). Quasi-experimentation: Design and analysis issues for field settings. Chicago: Rand McNally College Pub. Co.

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Creswell, J.W. (1994). Research design; Qualitative and quantitative approaches. Thousand Oaks, CA: Sage Publications, Inc.

CHROME: Cooperating Hampton Roads organizations for minorities in engineering. (2002). [Brochure]. Norfolk, VA: Author.

CHROME: 1998-1999 Annual Report. (2000). Norfolk, VA: Author.

Delpit, L. (1995). Other peoples children: cultural conflict in the classroom. The New Press: New York.

Farmer, H.S., Wardrop, J.L, Anderson, M.Z. & Risinger, R. (1995). "Women's career choices: Focus on science, math, and technology careers" *Journal of Counseling Psychology, 42*, (2), 155-170.

Farmer, H.S. (1997). Diversity & women's career development. Thousand Oaks, CA: Sage Publications, Inc.

Farmer, H., Rotella, S., Anderson, C. & Wardrop, J. (1998). "Gender differences in science, math, and technology careers: Prestige level and Holland interest type" *Journal of Vocational Behavior, 53*, 73-96. (Article No. VB971608)

Farmer, H.S., Wardrop, J. L. & Rotella, S.C. (1999). "Antecedent factors differentiating women and men in science/nonscience careers" *Psychology of Women Quarterly, 23*, 763-780.

Ferguson, R. (2005). Why America's black-white school achievement gap persists. In Loury, G., Modood, T. and Teles, S. (Eds). Ethnicity, social mobility, and public policy (pp 309-341). New York: Cambridge University Press.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Feuers, S. (1995). Student participation in mathematics and science program. In Gallon, D. P. (Ed.) Regaining the edge in urban education mathematics and science: A report of the commission on urban community colleges of the American association of community and junior colleges (pp 7-12).

Foley, D. (March, 1991). Reconsidering anthropological explanations of ethnic school failure. *Anthropology and education quarterly. 22*, (1), pg 60-86.

Forman-Brunell, M. (Ed.). (2001). Girlhood in America: An encyclopedia. Volume 1 and 2. Santa Barbara, CA: ABC-CLIO, Inc.

Fouad, N.A, & Dancer, S.L. (1992b) Rejoineder: Comments on the universality of Holland's theory. *Journal of Vocational Behavior, 4*0, 220-228.

Frazier, W. (2001). The effect of a science work experience program for teachers on the classroom environment: A qualitative program evaluation. Unpublished doctoral dissertation. Teachers College, Columbia University.

Frehill, L. (1997). Subtle sexism in engineering. Subtle sexism: current practice and prospects for change. Sage Publications, Inc: Thousand Oaks, California. Gallaher, J. and Pearson, F. (July, 2000). Women's perceptions of the climate in engineering technology programs. *Journal of Engineering Education, 89*, 3, 309-314.

Gay, G. (2000) Culturally responsive teaching: theory, research and practice. Teachers College, Columbia University. New York.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Glazer, N. (2005). American diversity and the 2000 census. In G. Loury, T. Modood. and S. Teles (Eds), Ethnicity, social mobility, and public policy (pp 50 – 66). New York: Cambridge University Press.

Guerrero, S.H. (1999a). (Ed.) Gender sensitive & feminist methodologies: A handbook for health and social researchers. Quezon City: University of the Philippines Center for Women's Studies.

Guerrero, S.H. (1999b). (Ed.) Selected readings on health and feminist research: A sourcebook. Quezon City: University of the Philippines Center for Women's Studies.

Hakim, C. (2000). Work-Lifestyle choices in the 21st century: Preference theory. New York: Oxford University Press.

Hall, C. M. (1990). Women and identity: Value choices in a changing world. New York: Hemisphere Publishing Corporation.

Harding, S. (1991). Whose science? Whose knowledge? Ithaca, New York: Cornell University Press.

Hite, M. (Winter, 2004). What really matters inside the lab and out. *Montpelier, 27*(1), 18-19.

Johnson. J. (1999). A comparison of cognitive development between Whites and African-Americans based on William Perry's scheme of intellectual and ethical development. Unpublished doctoral dissertation. Old Dominion University, Virginia.

Jones, M., Yonezawa, S., Ballesteros, E. and Mehan, H. Shaping Pathways to higher Education. *Educational Researcher, 31*(2), Mar 2002, 3- 10.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Konrad, R. Girls go tech. *The Virginian-Pilot*, July 14, 2003, D1-D2.

Kuhla, K. (1994) "Pre-College engineering intervention program alumni: A case study." Unpublished doctoral dissertation. University of Virginia, Virginia.

Lee, J. Racial and ethnic achievement gap trends: reversing the progress toward equity? *Educational Researcher. 31*(1), Jan / Feb 2002, p 3-12.

Leong, F. (Ed) (1995). Career development and vocational behavior of racial and ethnic minorities. Lawrence Erlbaum Associates: Mahwah, NJ.

Lo, Chun-Nai, Alsikati, M.H. The subjectivity of attribution in the context of expectation, motivation and self-esteem. Education and Society, 1992, 10, 2, Dec: 83-91.

Loury, G., Modood, T. and Teles, S. (Eds) (2005). Ethnicity, social mobility, and public policy. New York: Cambridge University Press.

Lustig, R. J. (2004). The tangled knot of race and class in America. In M. Zweig (Ed), What's class got to do with it? (pp 45-60). Ithaca, NY: Cornell University Press.

Miller, D. C. (1991). Handbook of research design and social measurement, fifth edition. Sage Publications: Newbury Park.

Miller, T. L. (1994). African-American Women's Career Development: Predicting nontraditional educational and career choices, educational and career aspirations, and career salience. (Master's Thesis, Old Dominion University, 1994). Masters Abstracts International.

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

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National Science Foundation. (1990). Science and engineering personnel: A national overview, special report (NSF Publication No. 90-310). Washington, DC: Author.

National Science Foundation (1992a). Indicators of science and mathematics education 1992 (NSF Publication No 93-95). Washington, DC: Author

National Science Foundation (1992b). Women and minorities in science and engineering: an update (NSF Publication No 92-303). Washington, DC: Author.

National Science Foundation (2001). Information technology workforce. Washington, D.C.: Author. (NSF 01-33)

National Science Foundation. (2003). New formulas for America's workforce: Girls in science and engineering. (NSF 03207) Washington, D.C.: Author.

Noguera, P.A. (November 2001). Racial politics and the elusive quest for excellence and equity in education. *Education and Urban Society, 34,* 1, 18-41.

Nunes, F. (May, 2000). Dissertation Abstracts International. Vol 60 (10-A), 3605. US: University Microfilms International.

Office of Technology Assessment. (1988a) Educating scientists and engineers: Grade school to grad school (OTA Publication No. OTA-SET-377). Washington, DC: U.S. Government Printing Office.

Ogbu, J. U. (1978). Minority education and caste: The American system in cross-cultural perspective. New York: Academic Pres.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Ogbu, J. U. (1990). Racial stratification and education. In G. E. Thomas (Ed.), U. S. Race relations in the 1980s and 1990s: Challenges and alternatives (pp. 3- 34). New York: Hemisphere Publishing Corporation.

Ogbu, J. U. (2003). Black American students in an affluent suburb: a study of academic disengagement. Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Ogbu, J.U., & Gibson, M.A. (1991). Minority status and schooling: A comparative study of immigrant and involuntary minorities. New York: Garland Publishing, Inc.

Ogbu, J.U. & Simons, H.D. "Voluntary and involuntary minorities: A cultural-ecological theory of school performance with some implications for education" *Anthropology & Education Quarterly* June 1998, 29 (2), 155-188.

Parekh, B. (2005). Achieving racial equality. In G. C. Loury, T. Modood & S. M. Teles (Eds.), Ethnicity, social mobility and public policy: Comparing the USA and UK. (pp. 602-617). New York: Cambridge University Press.

Patton, M.Q. (1987). How to use qualitative methods in evaluation. Newbury Park, CA: Sage Publications, Inc.

Patton, M.Q. (2002). Qualitative research & evaluation methods: Third edition. Thousands Oaks, CA: Sage Publications.

Perna, L. "Precollege outreach programs: characteristics of programs serving historically underrepresented groups of students" *Journal of college student development* Jan/Feb 2002, 43 (1), 64-8.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Polowczyk, C. (2001). Federal government support for mathematics and sciences pgs 13-16.Gallon, D. P. (Ed.) Regaining the edge in urban education mathematics and science. A report of the commission on urban community colleges of the American association of community and junior colleges.

Rossi, A. S. (1972). Barriers to the career choice of engineering, medicine, or science among American women. Thousand Oaks, CA: Sage Publications.

Sadker, M. and Sadker, D. (1994). Failing at fairness: How America's schools cheat girls. New York: Charles Scribner's Sons.

Sanders, J. & Tescione, S. (2002). Gender equity and technology. Center for Gender Equity. Seattle, WA: Washington Research Institute.

Strauss, A. L. (1991). Qualitative analysis for social scientists. New York: Cambridge University Press.

Tierney, W. G and Hagedorn, L. S. (Eds) (2002). Increasing access to college: Extending possibilities for all students. Albany, NY: State University of New York Press.

United States Department of Agriculture. (2005). Income Eligibility Guidelines. http://www.fns.usda.gov/cnd/Governance/notices.iegs/IEGs.htm

Wadia-Fascetti, S. & Leventman, P. G. (July, 2000). E-mentoring: A longitudinal approach to mentoring relationships for women pursuing technical careers. *Journal of Engineering Education,* 89(3), 295-300.

Wilson, R. (July 18, 2003). Strength in numbers. *The Chronicle of Higher Education*, A10-12.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Wilson, R. (August 12, 2005). Science, math, bubble gum and dreams. *The Chronicle of Higher Education*, A 48.

Zhou, M. (2005). Ethnicity as social capital: Community-based institutions and embedded networks of social relations. In G. Loury, T. Modood. and S. Teles (Eds), Ethnicity, social mobility, and public policy (pp 131- 159). New York: Cambridge University Press.

Zweig, M. (Ed) (2004). What's class got to do with it? Ithaca, NY: Cornell University Press.

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Appendix A

Additional CHROME program information

CHROME organizational model

The CHROME program incorporates two nationally known pre-college math, science and engineering intervention programs, the Southeastern Consortium for Minorities in Engineering (SECME) and the Philadelphia Regional Introduction to Minorities in Engineering (PRIME). The CHROME program models the SECME program's organizational structure. In addition, the CHROME program incorporates four primary characteristics from the PRIME program. The characteristics state:
All sectors of the community must be involved. Representatives from industry and government may provide program support, resources and expertise. Universities and colleges can train teachers, review curriculum, provide networking and present teaching innovations and student workshops. Schools and school systems can be instrumental in program implementation. Civic and professional organizations can provide program support and networking.

1. Children must be reached at the earliest possible grade level and continue to be monitored to maintain their interest and motivation throughout their school experience. This would include providing motivational activities such as role models, field trips, enhancing self-images, brochures, films and presentations. Another component would be to provide academic activities to include hands-on activities, projects, supplemental curricula, tutorials, course selection and workshops.

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2. Impact must be made not only on what the student is taught but how the student is taught. Curriculum and instruction are foci of concern. The following are potential sources affecting how the student is taught: teacher training and upgrading; curriculum support; linking industrial resources to the classroom; and developing new learning environments such as mentorships.
3. The program must provide clear levels of intervention activities that build upon the previous year.

Vision and Mission of CHROME

The vision of CHROME is to be recognized as the leading organization promoting students access to and achievement in, science, mathematics, engineering and related technical fields to meet future global requirements.

The mission of CHROME is to increase opportunities for underrepresented minority and female students to enter science, mathematics, engineering and related technical fields.

Goals of the CHROME organization

1. Identify, nurture and assist these students to pursue careers in science, mathematics, engineering, and related technical fields;
2. Provide training activities, programs, and resources designed for teachers, counselors and parents to encourage these students to pursue careers in science, mathematics, engineering, and related technical fields;
3. Establish and sustain partnerships among businesses and corporations, higher education institutions, school systems, civic and professional organizations, government agencies, and other entities committed to the mission of CHROME.

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4. Support educational improvements in the areas of science, mathematics, engineering, and technology consistent with the CHROME mission and goals; and, continue to be the pre-eminent model for the development of programs nationally and internationally, consistent with the mission of CHROME.

CHROME Computerized Database

The CHROME staff at the main office located at Old Dominion University maintains a CHROME computerized database of student participants. Information about each student participant is gathered from his or her registration form (SEE ATTACHED). The registration forms are updated annually and students and parents need only to review and make changes, if needed, then sign and date the form.

The registration form includes the student's name, address, telephone number, birth date, age, sex, race and social security number. Also each school is assigned a code number, which is placed at the top of each form by the CHROME main office staff.

The information from the forms is used primarily for communication purposes. Students receive mailings directly from the CHROME main office about certain events. These events often are funded by grants and are the result of collaboration between the CHROME Executive Director and various organizations. Often the club sponsors do not receive these mailings, only the students and their parents.

Further, each school is required to submit an end of year report which should include a date and summary of each CHROME Club activity to include meetings, fieldtrips, guest speakers and regional activities.

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Main Office Sponsored Programs

Student Teacher Annual Recognition Symposium (STARS)

The STARS program is similar to an annual meeting. Businesses, industries, various governments, CHROME Club members and sponsors and CHROME main office staff are invited to attend the meeting. The symposium consists of lunch, exhibits (usually provided by CHROME partners) and a program. Awards for previous year accomplishments are also distributed. Awards include: Sponsor and Runner-up of the year; Distinguished Sponsor and Runner-up of the year; Outstanding and Runner-up CHROME Club of the year; Volunteer of the year, Outstanding Support from a Member Organization, 5 and 10 year sponsor awards and other special recognitions.

Outstanding Student Celebration picnic

Usually held in June, the Annual CHROME picnic is usually cosponsored by other corporate and nonprofit organizations. Attendees from the top10% of each CHROME Club are selected by CHROME club sponsors based on their club participation. Selected students may invite up to two guests. Club sponsors are also invited. The CHROME office presents CHROME scholarships to high schools seniors at the annual picnic. The CHROME program typically gives a minimum of four $1000 scholarships to deserving students based on academics, CHROME Club participation and extracurricular activities.

Summer Programs for Elementary and Middle School Students

Junior Rangers at Sandy Bottom

This summer program is designed for rising third, fourth and fifth grade students. The program is held at Sandy Bottom Nature Park and Buckroe Beach in

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Hampton, Virginia. The day session program is from 9:00 a.m. to 2:00 p.m. and lasts one week

Students participate in nature crafts, tree identification, orienteering, water and soil testing, bird identification, mapping, animal tracking, hiking, canoeing, rowing, insect collecting, fishing and a work project.

Junior Beach Explorers at Buckroe Beach

This summer program is designed for rising fourth, fifth and sixth grade students. The program is held at Buckroe Beach in Hampton, Virginia. The day session program is from 9:00 a.m. to 2:00 p.m. and lasts one week

Students will paddle on the local waterways and learn about ecology. The will participate in orienteering, hiking and fishing. They will also participate in field trips.

GEMS- Girls Excited about Math and Science

This summer program is for girls in ninth and tenth grades. The girls participate in activities designed to be both fun and informative. Girls participate in math and science hands-on activities.

Engineering and Science Program (ESP)

The College of Engineering and Technology (COET) and CHROME partnered to host the Summer 2001 "Engineering and Science Program (ESP) for rising 10^{th}, 11^{th} and 12^{th} grade students who reside in both Hampton Roads and throughout the Commonwealth. The State Council of Higher Education for Virginia (SCHEV) underwrites the program under the auspices of its Pre-College Awareness Programs. Twenty-seven high school participants will engage daily (M – F) in coursework that addresses concepts in Mathematics, Language Arts and Laboratory Sciences (with an

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emphasis in mechanical engineering) during a three-week period from July 9 through July 27.

The purpose of ESP is to bridge students' academic years by providing intensive studies during the summer months, but also to heighten their awareness about the academic offerings of COET at ODU. The courses are designed to improve student's preparedness for standardized test taking such as the SAT and SOL.

Sponsor Workshops

SOL Portable Technology Lab

This is a new offering implemented in the summer of 2002, this grant supported program was written to provide teacher training related to the use of the Robolab and the Lego Dacta Mindstorm kits. The Mechanical Engineering Department at Old Dominion University provided undergraduate and graduate student assistants to serve as teachers and facilitators to instruct classroom teachers on building robots. Teachers and student assistants will work together throughout the regular school year to facilitate elementary through middle school students use of the Robolab. Students will be encouraged to enter Lego competitions.

Sponsor Launch

Usually held in October, this is a one-day event in which CHROME club sponsors are invited for training on various math and science related topics. The event is held at a local university in the Tidewater region.

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Appendix B

Letter of Introduction

Spring 2005

First and Last name of Participant
Street Address
City, State, Zip code

Dear Ms. (first and last name):

You have been selected to participate in a study that will be used in two ways. As a doctoral candidate, I will use the results to write my doctoral dissertation. Secondly, the data will assist the CHROME program in improving programs and services for their K-12 pre-college program. A letter of support from the Chair of the CHROME board of directors is attached.

I will conduct individual interviews at a time and place convenient for you. All data will be confidential and will only be presented in group form. I will be contacting you during the week of April 18 to set up individual meeting times. I would like to conclude all interviews no later than May 6, 2005.

I am required by Old Dominion University to have participants read and sign an "Informed Consent Agreement." This one-page form outlines the purpose of the research, what participants are expected to do, what their rights are, and how to withdraw from the study. Please read the "Informed Consent Agreement," then date and sign it.

Also enclosed is a copy of your "1999-2000 End of Year CHROME Senior Report," which you completed during your senior year in high school. Using the enclosed red ink pen, please update your form and complete any omitted information to the best of your recollection.

Please complete the following forms: Career Choice Questionnaire, Environmental Support and Post High School Experiences. The information you provide will not only help me to better understand your career choices and experiences, but will also help me to properly code each job.

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You may use the enclosed stamped, addressed envelope to return all of your completed forms. I will then send you a copy of each form for your records.

I look forward to hearing about your experiences and your views of CHROME. If you have questions, please call me at 757-286-1359 or E-mail: lmoor013@odu.edu

Sincerely,

Lisa S. Moore

Enclosures
- **Letter of support from CHROME**
- **Informed Consent Agreement**
- **Career Choice Questionnaire**
- **Post High School Experiences form**
- **Environmental Support form**
- **End of Year CHROME Senior Report**

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Appendix C

Letter of Support from CHROME Organization (Typed on letterhead)

Date

Dear CHROME Alumna:

As a former participant in the Cooperating Hampton Roads Organization for Minorities in Engineering (CHROME) program, you have been selected to participate in a research study. Your participation will help us to improve CHROME programs and services.

As a non-profit organization, CHROME continues to provide opportunities to assist underrepresented minority and female students K-12 to enter science, technically related, engineering, and math (STEM) career fields. As a CHROME alumna your input is invaluable.

Please answer questions as openly and freely as possible. There are no right or wrong answers.

Thank you for your participation in this study. Please feel free to contact me at (757) 822-1802 or e-mail at swaters@TCC.edu

Sincerely,

Sharon Waters, Chair of the CHROME Board

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Appendix D

Informed Consent Agreement

Please read this consent agreement carefully before you decide to participate in the study.

Purpose of the research study:
The purpose of the study is to examine the characteristics, experiences and perceptions of young women who participated in the CHROME program during their K-12 years.

What you will do in the study:
You will be asked to answer questions. The questions and answers will be audiotaped, and the interviewer will be taking notes.

Time required:
The total time is approximately 30 minutes.

Risks:
There are no anticipated risks.

Benefits:
This study will add to the literature on young women's career choice and decision-making as well as their participation in science, math, engineering and technically related career fields.

Confidentiality:
The information that you give in the study will be handled confidentially. You will be assigned a pseudonym. The list connecting your name to this pseudonym will be kept in a locked file. All high schools will also be assigned pseudonyms. After the study is completed and the data has been analyzed, this list will be destroyed. Your name will not be used in any report. The audiotape of your answers will be reviewed by the researcher and then erased.

Voluntary participation:
Your participation in the study is completely voluntary.

Right to withdraw from the study:
You have the right to withdraw from the study up until April 30, 2005.

How to withdraw from the study:
If you want to withdraw from the study, please call the researcher at 757-286-1359. There is no penalty for withdrawing.

Payment:
You will receive no payment for participating in the study.

Who to contact if you have questions about the study:
Lisa Moore, XXX ST, City, State Zip code Home Telephone: 757-286-1359.

Agreement:
I agree to participate in the research study described above.

Signature: ---------- Date: ----------

Please send this completed form to Lisa Moore using the enclosed addressed, stamped envelope no later than April 10, 2005. You will receive a copy of this form for your records.

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Appendix E

Career Choice Questionnaire

SECTION A. Please write your current information in the space provided.

NAME: _____
Last, First, Middle Initial

Maiden name in high school _____

Home Phone: (___)_____ **Cell phone**_____

e-mail address: _____

Current job title: _____

Years employed in this position: _____

SECTION B. Please briefly list your math/science related work history since high school:

1. Job title: _____ **Years employed:** _____

Job description: _____

2. Job title: _____ **Years employed:** _____

Job description: _____

SECTION C. Post-secondary education

Where did you attend college? _____

Did you receive your degree? Yes No

List your major and type of degree: _____

Are you attending graduate school? Yes No

If yes, list your major and type of graduate degree you plan to receive:

_____

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Appendix F

Post High School Experiences Questionnaire

1. **Marital status:**

Married ___ Divorced____ Single_____ Separated___

2. **Family/ Job Involvement:**

Children: Yes ___ No___ If yes, how many children? ____

3. **Critical Incidents:**

For the purposes of this study, critical incidents are any unforeseen occurrences which prevented young women from attaining their career aspirations Examples of critical incidents may include personal injury or sickness, death in the family, divorce/separation, extremely sick child or family member, job loss, natural or man-made disaster, victim of a crime, military deployment or spouse of military member.

Did you experience any critical incidents which prevented or slowed your ability to complete your career choice? Yes____ No____ If yes, please explain below:

_____

_____

_____

5. Please list number of math and science courses completed in college.

Math ____ Science _____

6. What was your college GPA? _____

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Appendix G

Environmental Support Questionnaire

DIRECTIONS: Answer each question to the best of your recollection. Write additional information on back or a separate sheet of paper.

Counselor Support

1. Please describe any interactions with counselors that you experienced during your K-12 school years that you believe helped to shape your career choices and decisions.

Teacher support

2. Please describe any interactions with teachers that you experienced during your K-12 school years that you believe helped to shape your career choices and decisions.

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Environmental Support continued

Parent support

3. Please describe any interactions with parent/ legal guardian(s) that you experienced during your K-12 school years that you believe helped to shape your career choices and decisions. You may include other family member's input as well.

4. Please describe any interactions with CHROME sponsors/ other CHROME representatives that you experienced during your K-12 school years that you believe helped to shape your career choices and decisions.

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Appendix H

Standardized Oral Interview Questions

Interviewer script: Hello, and thank you for your participation. Today, I'm going to ask you a few questions about your experiences in the CHROME program as well as your career decision-making processes and choices. Please respond to each question as completely as you can. Ask for clarification for any question(s) you don't understand.

I will be recording this interview solely for the purposes of transcribing your responses for this research study. Neither your name nor any information which could specifically identify you will be used in this study. All results will be reported in a group format. I will assign pseudonyms to each participant to protect your privacy.

Are you ready to begin? [WAIT FOR RESPONSE.] Great! Let's begin.

Interview Questions

WARMUP/ INTRODUCTION

1. Describe your career choices since high school?
2. Describe the factors that you feel have influenced your career choices? What do you think has influenced your career choices?

DEMOGRAPHICS Variables

Gender

1. How do you believe your perceptions of your status as a woman has influenced the career choices you made?
2. How do you perceive that your status as a woman has impacted other's perceptions of your career choice options?

Ethnicity

1. How do you perceive that your status as a member of a racial minority has shaped your career choices?
2. Do you believe that you have experienced racial discrimination in your educational pursuits and/or workplace? If so, how?

Family Socioeconomic Status

1. How would you describe your family's socioeconomic status prior to your graduating from high school? (Prompt for annual family salary.)
2. Were you eligible for free lunch, reduced lunch or did you pay full price?

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ENVIRONMENTAL Variables

[DIRECTION: Prior to asking these interview questions, review the subject's written responses on the Environmental Support form with each subject.]

Parent

1. What impact, if any, did overall support or lack of support from your parents have on you choosing or not choosing to participate in a STEM career?

Teacher

1. What impact, if any, did overall support or lack of support from your teachers have on you choosing or not choosing to participate in a STEM career?

Counselor

1. What impact, if any, did overall support or lack of support from counselors have on you choosing or not choosing to participate in a STEM career?

CHROME

1. To what extent, if any, did services of the CHROME program affect your decision making process to choose or not to choose a STEM career?

Financial Support

1. To what extent, if any, did financial support, or lack thereof, impact your pursuit of your aspirations for your career choice?

COGNITIVE Variables

[DIRECTION: Review the Senior Report with each subject prior to asking these questions.]

Math Self-efficacy

1. How do you believe that your math and science ability enabled you to meet the requirements for successful degree completion and your subsequent career?

Math/Science Utility

1. Did knowledge of prerequisites required for your career choice impact your decisions in high school to take elective science and/or math course?

POST HIGH SCHOOL EXPERIENCES Variables

[DIRECTION: Review the definition of critical incidents prior to asking these questions.]

Critical Incidents

1. To what extent, if any, did critical incidents, such as an extremely sick child or family member, death in family, impact your pursuit of your career choice?

Marital Status

1. To what extent, if any, did your marital status impact your career choice?

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Math/science courses

1. Describe the types of math and science courses you have taken since high school graduation?

ACADEMIC ACHIEVEMENT Variables

[DIRECTION: Review Senior Report with subject prior to asking these questions.]

Elective Math

1. To the best of your recollection, are the credit bearing math courses you completed in middle and high school accurately reflected on your Senior Report?

Elective Science

1. To the best of your recollection, are the credit bearing science courses you completed in middle and high school accurately reflected on your Senior Report?

OTHER Variables

Do you have anything else you would like to share?

Do have any questions for me?

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Appendix I

Example of 1999-2000 End of Year CHROME Senior Report

Please return by Wednesday, May 31, 2000 to
CHROME, P.O. Box 1394, Norfolk, VA 23501
Or FAX to (757) 683-6031

High School: _____

Name: _____, _____ _____ _____
[Last] [First] [Middle] [Suffix]

Career Interest (s) : _____ {COGNITIVE, Aspiration}
College or University
Planning to Attend: _____
Intended Major: _____

Scholarships? Name of scholarship	Amount	Renewable (yes / no)
_____	_____	_____
_____	_____	_____
_____	_____	_____

If college is not in your immediate plans, what are your plans?
{COGNITIVE, Aspiration}

Are you interested in joining a CHROME Alumni Association? ___ Yes ___ No
{DEMOGRAPHICS, Ethnicity}

Ethnicity:		
[Please circle	[B] Black/African American	H Hispanic – American
one or more]	W White/Euro-American	F Filipino –American
	A Asian-American	N Native American

{DEMOGRAPHICS, Gender}
Sex:___ Date of Birth:_____ Age: ____ Soc. Sec. No: _____
Home Address: _____

CHROME Participation in Elementary/ Middle/ High School – Please Check and Bring Up To Date

Year	School		
1___-___	_____	HS Graduation Year: 2000	
2___-___	_____	HS Graduation Rank: ____ of__ (or ____%) Date {ACADEMIC ACHIEVEMENT,	
3___-___	_____	GPA; Math:____ Science____ Overall:____ High School: Science GPA,	
4___-___	_____	SAT: Math: ___ Verbal: ____ Elective math, Elective Science courses}	
5___-___	_____	**Math Courses**	**Science Courses**
6___-___	_____	**& Letter Grades**	**& Letter Grades**
7___-___	_____	_____	_____
8___-___	_____	_____	_____
9___-___	_____	_____	_____
10___-___	_____	_____	_____
11___-___	_____	_____	_____
12___-___	_____	_____	_____

CHROME Related Programs: {ENVIRONMENT, CHROME}

_____
_____

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Appendix J

Definition of terms

Adaptation

Conformity that makes survival possible, including internalizing values and beliefs that reflect external conditions (Hall, 1990).

Ascribed roles

Behavior and expectations related to a status defined at birth. Individuals cannot control ascribed statuses such as race, sex, or age and assigned expectations tend to be arbitrary (Hall, 1990).

Aspiration

Used to assess aspired occupational prestige and educational level. In Farmer's work, young women's high career aspirations in high school were not predictive of later participation in a STEM career, whereas they were predictive for young high school men (Farmer, Wardrop & Rotella, 1999, p. 778).

Blatant Sex Discrimination

The unequal and harmful treatment of women that is visible, intentional, and can be easily documented. " Examples of blatant sex discrimination include sexual harassment, sexist language and jokes, physical violence (rape, incest, wife abuse), and other forms of obviously unequal treatment in the family, employment, education, politics, religion, law and other areas" (Benokraitis, 1997, p 7).

Choice

Having the ability to select from available options; a necessary condition for fulfillment (Hall, 1990).

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Covert Sex Discrimination

This type of discrimination refers to the unequal and harmful treatment of women that is hidden, purposeful, and often, maliciously motivated. Men demonstrate behavior that consciously attempts to ensure women's failure – especially in educational and employment situations. Two common examples of this behavior are sabotage and manipulation (Benokraitis, 1997, p. 12).

Critical Incidents

Examples of critical incidents, for the purposes of this study, may include personal injury or sickness, death in the family, divorce/separation, extremely sick child or family member, job loss, natural or man-made disaster, victim of a crime, military deployment or spouse of military member.

Equal Opportunity

Having similar access to resources and the satisfactions of full living (Hall, 1990).

Equality

Being in a state in which women and men are treated fairly and similarly without regard to sex, race or ethnic background (Hall, 1990).

Evaluability Assessment

"Evaluability assessments (Wholey, 1979; Smith, 1989) are conducted through interviews, document analysis, and observations to determine whether a program is sufficiently well conceptualized and consistently implemented to undertake a formal and rigorous evaluation, especially a summative evaluation aimed at determining overall effectiveness" (Patton, 2002, p. 164).

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Information Technology Job

Involves the creation, storage, exchange, and/or use of information through technological means. More specifically, it encompasses occupations that require designing and developing software and hardware systems; providing technical support for computer and peripheral systems; and creating and managing network systems and databases (Burger & Sandy, 1999, p. 5).

Math-Ability Attributions

Farmer et al found that, "Attributions for successes and failures in math to ability and to rejection of ability, respectively, were found to influence both women's and men's participation in science careers, although the effect was stronger for men (Farmer, Wardrop and Rotella, 1999, p. 778).

Math Self-efficacy

"Betz (1990) found that higher math self-efficacy is related to women choosing higher – level careers in science" (Farmer et al, 1997). Studies have found that self-efficacy is "persistence at a task until it is mastered as well as engaging in a task" (Bandura, 1989).

Math/Science Utility

Farmer et al describe math/ science utility as "one of the strongest predictors for young adult women, who were participating in a science career, was current motivational feelings and commitments- namely, valuing mathematics and science for their career relevance" (Farmer, Wardrop and Rotella, 1999, p. 776). Also, adolescent girls valuing math and science for career utility were more likely to take more math classes in the future (Farmer et al, 1999, p. 777). The number of elective science courses young women took in high school was the strongest predictor of persistence in a STEM career.

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Occupational Prestige

The prestige of a career is associated with its educational requirements and earnings. Occupational prestige levels have been assessed and assigned by expert's opinions about status and power of jobs; census index scores which ranks jobs according to median income level and education; and socioeconomic indexes such as the Duncan's Socioeconomic Index, which is a measure relating occupational prestige, education and income (Stevens & Cho, 1098; Farmer et al, 1998; Miller, 1991).

Sex role socialization

Describes how "experiences affect many young girls in their early years when they learn what roles are appropriate for girls and what roles are not (Gottfredson, 1981). Gottfredson noted how these experiences led girls to constrict their career choices and to compromise their career potential" (Farmer. 1997, p. 4).

Science, Math, Engineering and Technology:

The fields and/or positions in natural science; social and behavioral science; and engineering; including physical scientists, earth systems scientists, mathematical scientists, computer scientists, biological scientists, agricultural scientists, psychologists, social scientists, aeronautical/ astronautical engineers; chemical engineers; civil engineers; electrical/ electronics engineers; mechanical engineers; and other engineers (NSF, 1992, p 179; NSF, 1990, p. 2; OTA, 1988a, p. 7).

Subtle Sex Discrimination

This type of discrimination refers to the unequal and harmful treatment of women that is typically less visible and obvious than blatant sex discrimination. This type of

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discrimination is difficult to document and often overlooked because the sexist behavior is considered normal or acceptable (Benokraitis, 1997, p 11).

Underrepresented Minorities (URMs):

Includes groups of ethnic/racial minorities (African-American, Native American, and Hispanic) and women whose representation in science and engineering is less than their representation in the population (NSF, 1992, p. xxxii; OTA, 1988a, p. 7).

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Appendix K

Population divided school division type

Table 1.

Number of Senior Reports per School (N = 81)

# CHROME Senior Reports	School	Location	Rural, Urban or Suburban (R/U/S)
1	School 1	Hampton	S
20	School 2	Courtland	R
6	School 3	Portsmouth	U
11	School 4	Chesapeake	S
7	School 5	Chesapeake	S
2	School 6	Newport News	U
4	School 7	Newport News	U
1	School 8	Newport News	U
2	School 9	Smithfield	R
3	School 10	Virginia Beach	S
5	School 11	Portsmouth	U
2	School 12	Newport News	U
1	School 13	Virginia Beach	S
10	School 14	Gloucster	R
7	Suffolk 15	Suffolk	R

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APPENDIX L

Post high school findings from questionnaire (Research Question #1)

Table 2

Marital Status, Children, Critical Incidents affect on degree completion

Pseudonym	Marital Status	Children Yes or No	Critical Incident	Degree from 4-yr university
ANN	Single	No	No	Yes
BETTY	Single	No	No	Yes
CAREN	Single	No	No	Yes
DEE	Single	Yes	Yes (in Mil)	No
ELLA	Married	Yes	Yes (Mil Spouse)	No
FAY	Single	No	No	Yes
GAIL	Single	No	No	Yes
HOPE	Single	No	No	Yes
INDIA	Divorced	Yes	Yes (Divorce)	No

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APPENDIX M

College Math and Science Courses (Research Question #1)

Table 3

Number of college level math and science course completed and college GPA

Pseudonym	College GPA	No. of Math Completed	No. of Science Completed
ANN	2.60	4	20
BETTY	3.40	5	0*
CAREN	3.40	6	25
DEE	not disclosed	3	2
ELLA	3.20	4	2
FAY	3.34	3	4
GAIL	3.60	2	27
HOPE	3.40	2	11
INDIA	3.25	4	8

*Note: BETTY completed college science requirements through dual enrollment courses in high school. Science includes computer science courses. Math includes statistics and business statistics.

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APPENDIX N

Environmental Support variables (Research Question # 2)

Table 4

Environmental Support received (Y = Yes or N = No)*

Pseudonym	Parent	Counselor	Teacher	CHROME	Financial
ANN	Y	N	Y	Y	N
BETTY	Y	N	N	Y	Y
CAREN	Y	Y	N	Y	Y
DEE	N	N	N	Y	N
ELLA	Y	Y	Y	Y	Y
FAY	Y	Y	Y	Y	Y
GAIL	Y	Y	Y	Y	Y
HOPE	Y	N	N	Y	Y
INDIA	Y	Y	N	Y	Y

***Findings from Environmental Support questionnaire**

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APPENDIX O

Academic Achievement variables (Research Question # 3)

Table 5

Number and type of Math and Science Electives completed during high school*

Pseudonym	Math	Science	Type of Math	Type of Science
ANN	2	2	Algebra II	Physics, Biochemistry
			Elementary Functions	
BETTY	3	2	Algebra II, Calculus	Biology II, Physics
			Honors Math Analysis/Trig	
CAREN	4	4	Algebra II, Math Analysis	Physics
			Trig/Precalculus	Honors Chemistry
			AP Statistics	AP Computer Science I & II
DEE	1	1	Math Analysis	Chemistry
ELLA	0	1	No elective math	Chemistry
FAY	1	1	Trigonometry	Chemistry
GAIL	3	2	Algebra II, Calculus	AP Biology
			Functions/Trig	Chemistry
HOPE	3	2	Algebra II/Trig	Physiology
			Precalculus, Calculus	Chemistry
INDIA	1	1	Algebra II	Chemistry

*Findings from Senior Report and Standardized interview

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APPENDIX P

Demographic Variables (Research Questions # 3 and # 4)*

Table 6

Number of years in CHROME and Family Socioeconomic Status

Pseudonym	No. Years In CHROME	Class Status UM/M	National School Lunch Program
ANN	5	UM	Full price
BETTY	5	M	Full price & reduced
CAREN	4	UM	Full price
DEE	3	UM to M	Full price & reduced
ELLA	5	UM to M	Reduced
FAY	5	M	Full price
GAIL	1	M	Full price
HOPE	5	UM to M	Full price
INDIA	4	M	Full price & reduced

*** Findings from Environmental Support questionnaire and interview**

Note: Class status UM = Upper middle class, M = Middle class. Participants self reported their class status. Coordinated through the United States Department of Agriculture (USDA), the National School Lunch Program is a meal program that provides low-cost or free lunch and snacks in public schools, non-profit private schools and residential child care facilities. Using the USDA Income Eligibility Guidelines (IEG) for program participation, household income can be further validated. In the 1999-2000 school year, the federal poverty guideline was annual household income of $16,700 for a family of four; thus, for a child to receive reduced lunch, the household family income could not exceed $30, 895 (income between 130 to 185 percent of the poverty level).

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APPENDIX Q

Ethnicity (Research Question # 4)*

Table 7

Influence of race on discrimination and career choice

Pseudonym	Racial Discrimination At School	Racial Discrimination At Work	Shaped their Career Choice	Age in 2005
ANN	N	N	N	24
BETTY	N	N	N	22
CAREN	N	Y	Y	22
DEE	Y	Y	Y	23
ELLA	N	Y	Y	23
FAY	N	N	Y	22
GAIL	N	N	N	23
HOPE	Y	N	Y	22
INDIA	N	N	Y	23

*** Findings from Environmental Support questionnaire and interview**

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APPENDIX R

Career Aspirations (Research Question # 5)

Table 8

Career Aspirations from 2000 to 2005

Pseudonym	Aspirations in Year 2000	Career Aspirations & Jobs since high school with O* NET job code
ANN	Radiologist	Dental Hygienist (29-2021.00)
		NASA -Summer Mentorship (17-3023.03)
		Office Mngr Asst in Dental office (43-9061.00)
BETTY	Business/Technology	Manager Trainee (11-1021.00)
CAREN	Network Engineer	Electrical Engineer (17-2071.00)
		Intern at numerous companies (17-3023.03)
DEE	U.S. Navy	Cryptology Technician -U.S. Navy (55-3019.99)
ELLA	U.S. Armed Forces	Paralegal (23-2011.00)
		Medical Assistant (31-9092.00)
FAY	Forensic Pathologist	Lawyer (23-1011.00) Special Education Teacher (25-2042.00)
GAIL	Disease Research	Environmental Health/ Safety Specialist (29-9011.00) Soil Lab Technician (19-4041.02) Math Tutor (25-3099.99)
HOPE	Biomedical Research	Public Health Specialist (29-9011.00) Laboratory Research Intern (29-3012.00) Museum Intern-Mollusk Curator (25-4013.00)
INDIA	General Practitioner-MD	Psychologist (19-3039.99)
		Sales Associate (41-2031.00)

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APPENDIX S

Math/science Utility (Research Question # 5)

Table 9

Math / Science Utility (Low= L, Medium = M or High= H)

Pseudonym	Utility	Excerpted quotes
ANN	Math- H	In high school I took chemistry and physics and that helped
	Sci- H	with college level chemistry and physics
BETTY	Math –H	…I took extra sciences so I wouldn't have to take as many
	Sci-H	in college.
CAREN	Math –H	I opted to take Physics in summer school just so I could
	Sci-H	have it on my transcript.
DEE	Math-M	No. The Navy or any military don't require that. All you do
	Sci-M	is take a test called the ASVAB.
ELLA	Math –H	I was willing to put up with the math more so than science.
	Sci-L	I never really enjoyed science and history…
FAY	Math-H	I did take some courses such as AP Calculus and higher
	Sci- H	level math and sciences so I could prepare for college.
GAIL	Math-H	I did take AP Biology because I knew that I could get
	Sci –H	college credit from that. I also took some advanced math…
HOPE	Math –H	I know a lot of schools wanted you to take Calculus, …
	Sci-H	I made sure that I got at least one experience in Calculus.
INDIA	Math –M	She did not elaborate on this question. Assessment made
	Sci-M	based on other comments in interview and questionnaire.

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APPENDIX T

Math/Science Self-efficacy (Research Question # 5)

Table 10

Math/Science Self-efficacy (Low= L, Medium = M or High= H)

Pseudonym	Self-efficacy	Excerpted quotes
ANN	Math- M	Math, I feel like I did okay...I didn't really like math.
	Sci- H	I know in science, I definitely feel strong in that.
BETTY	Math –H	I felt very strongly about my math and science skills.
	Sci-H	I feel like it did help me to achieve my goals quicker.
CAREN	Math –M	Math to me is not one of my strong points; however,
	Sci-H	with the right training I could do it.
DEE	Math-H	Because I was advanced in high school, it put me
	Sci-H	ahead of everybody else in the Navy schools I attended.
ELLA	Math –H	I definitely feel more confident now in math because the
	Sci-L	attention that I didn't get in high school, I got...in college.
FAY	Math-H	I think the analytical skills...in math and science...have
	Sci- H	been instrumental in all areas of my academic career.
GAIL	Math-H	It was very important that I majored in science. So being
	Sci –H	able to complete...science and math was very ...beneficial.
HOPE	Math –H	I felt like I had a strong ability. I took science courses, but
	Sci-M	personally ... I don't think that I'm very good in science.
INDIA	Math –H	She did not elaborate on this question. Assessment made
	Sci-H	on other comments from interview and questionnaires.

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Appendix U

Internet Resources for Researchers

Resource	Internet address
American Association Of University Women	www.aauw.org
Building Engineering And Science Talent	www.bestworkforce.org/
CHROME	http://www.chrome.org
Counseling for Gender Equity	http://genderequity.vsgc.odu.edu/links.html
Girl Scouts	www.girlscouts.org/girlsgotech
Girl Tech	www.girltech.com
IBM	www-3ibm.com/software/info/students/events/exite.html
National Institute for Science Education	http://www.wcer.wisc.edu/nise/Publications
National Science Foundation Report: Women, Minorities, And Persons with Disabilities In Science and Engineering 2000	http://www.nsf.gov/sbe/srs/nsf00327/
National Science Foundation: New Formulas for America's Workforce: Girls in science And engineering	www.nsf.gov/pubs/2003/nsf03207/start.htm
National Women's History Project Learning Place	http://www.nwhp.org/
Virginia Space Grant Consortium	www.vsgc.odu.edu
Women in Science Learning Series	http://net.unl.edu/wonderwise/main.htm

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Appendix V
Publisher approval to print Helen Farmer's Models

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Dear Publisher:

I am currently a doctoral student at Old Dominion University. I request permision to copy models on pages 7, 9 and 10 from Helen S. Farmer's book, Diversity and Women's Career Development, published in 1997. I plan to reference her Conceptual Model for Understanding Inhibited Academic/Career Motivation in Women (p. 7) and A Model of Reciprocal Transactions (p. 9) to provide background to the reader as to how she developed her current Conceptual model for Testing the Contribution of Background, Personal, Environment, and Motivation Factors to Occupational Choice (Behavior). I will be using her most recent model as a part of the methodology in my study. I am doing a qualitative program evaluation on the CHROME program, which is a nonprofit K-12

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CURRICULUM VITA

LISA SIMMONS MOORE
Department of Educational Leadership
Old Dominion University
Norfolk, VA 23529
E-mail: lmoore@odu.edu

EDUCATION

2005	**Ph.D.**	**Urban Services - Urban Education Concentration** **Old Dominion University, Norfolk, VA**
1996	**M.S. Ed.**	**Elementary Education- Science and English Concentrations** **Old Dominion University, Norfolk, VA**
1987	**B.S.**	**Health Science, Environmental Science emphasis** **James Madison University, Harrisonburg, VA**

HIGHER EDUCATION EXPERIENCE

2005	**Present**	**University Supervisor for PreK-6 Teacher Candidates** **Old Dominion University, Norfolk, VA**
1995	**1997**	**Graduate Assistant, Office of Financial Aid** **Old Dominion University, Norfolk, VA**

TEACHING CERTIFICATION

1997	**Present**	**Post Graduate Professional License**

PUBLIC SCHOOL TEACHING EXPERIENCE

1997	**2004**	**Science Department Chair; Science and math teacher** **Norfolk, VA and Virginia Beach, VA**

AWARDS

2002 & 2003	**School Bell Award, Norfolk Public Schools, Norfolk, VA**
2003	**CHROME Club Sponsor of the Year**
2002	**CHROME Club of the Year, Middle School Division**
2002	**Inspiration Award Nominee, Science Education, Norfolk Public School**

PROFESSIONAL DEVELOPMENT/ CONFERENCE PRESENTATIONS

NOV 2005	**Virginia Association of Science Teachers; Roanoke, VA**

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