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Exploring the Experiences of African American Women in an Undergraduate Research Program Designed to Address the Underrepresentation of Women and Minorities in Neuroscience: A Qualitative Analysis

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ACCEPTANCE

This dissertation, EXPLORING THE EXPERIENCES OF AFRICAN AMERICAN WOMEN IN AN UNDERGRADUATE SUMMER RESEARCH PROGRAM DESIGNED TO ADDRESS THE UNDERREPRESENTATION OF WOMEN AND MINORITIES IN NEUROSCIENCE: A QUALITATIVE ANALYSIS, by ERICKA L. REID, was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree Doctor of Philosophy in the College of Education, Georgia State University.

The Dissertation Advisory Committee and the student's Department Chair, as representatives of the faculty, certify that this dissertation has met all standards of excellence and scholarship as determined by the faculty. The Dean of the College of Education concurs.

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ABSTRACT

EXPLORING THE EXPERIENCES OF AFRICAN AMERICAN WOMEN IN AN UNDERGRADUATE SUMMER RESEARCH PROGRAM DESIGNED TO ADDRESS THE UNDERREPRESENTATION OF WOMEN AND MINORITIES IN NEUROSCIENCE: A QUALITATIVE ANALYSIS

by

Ericka L. Reid

African American women compose a critical proportion of the potential science, technology, engineering, and mathematics (STEM) workforce of the future, yet are disproportionately represented and largely underutilized. While various programs and initiatives have been designed and implemented to target women and underrepresented minorities, the voices and experiences of African American women have been insufficiently heard or studied. This study investigates the experiences of four African American female students who participated in a 10-week undergraduate research experience (URE) program designed for the recruitment and retention of women and underrepresented minorities in STEM disciplines. Through autobiographical narratives and interviews participants shared *how* and in *what* ways the URE program influenced their career development (namely academic/career interests and choices), what they learned about their interests and choices, and what it means to them to be African American women pursuing science-related careers.

Using a qualitative case study analysis, this study focuses on the unique stories of young African-American women participating in their own career development. Seven major themes emerged from the analysis of the data. Each of the participants initially

entered the URE with an established interest in science, with an expressed desire for research experience, and with an interest in exploring career options in science. Through their involvement in the URE program, participants experienced a significant increase in self-knowledge and confidence, recognized the existence of social and/or science communities, and either discovered or clarified career interests and possibilities. All participants recognized value in their participation and expressed gratitude for having had the opportunity.

Overall, the URE program provided a vital opportunity for participants to play an active role in their own career development. The results of this study emphasize the importance of and need to expand the URE as an avenue for career development and exploration in order to address the lack of such programming for African American women in STEM disciplines.

EXPLORING THE EXPERIENCES OF AFRICAN AMERICAN WOMEN IN AN UNDERGRADUATE SUMMER RESEARCH PROGRAM DESIGNED TO ADDRESS THE UNDERREPRESENTATION OF WOMEN AND MINORITIES IN NEUROSCIENCE: A QUALITATIVE ANALYSIS

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CHAPTER 1

Introduction

When asked what they want to be when they grow up, children across the nation and from every walk of life may respond with a host of answers that include well known professions such as actor, doctor, dancer, firefighter, lawyer, musician, police officer, nurse, or teacher – each easily recognized in the home, school, neighborhood, or in the media. Teenagers, young adults and even older adults also find themselves examining this question, searching for answers, and striving to discover career possibilities, pursue academic and professional aspirations, and fulfill their personal potential.

For generations, many have regarded America as a land of access and opportunity – a land where the best in education is attainable, and satisfying jobs are sure to follow. Currently, much of America struggles financially and socially, but we are in a time where a Black man is recognized for his intellect, experience, and character; and is exalted to the highest rank of political power. There is a palpable sense that all levels of professional success are possible – possible for *anyone*.

A key factor in considering America fulfilling on its promise of access and opportunity, is that the U.S. demographic majority is shifting. The United States has a significant growing population of persons of color—with young women and minority youth taking the lead (Jackson, 2006). Unfortunately, science, technology, engineering, and mathematics (STEM) undergraduate enrollment and graduation rates are not reflecting the increasingly diverse U.S. population (Chubin & Malcolm, 2006). Strong

performance by America's citizens in STEM disciplines is not only essential to the realization of individual academic and career aspirations; but also to the future economic growth of this country (Consortium for Policy Research in Education, 1995; Council on Competitiveness, 1995).

Statement of the Problem

In 2003 the National Science Board (NSB), the governing body of the National Science Foundation (NSF), analyzed U.S. science and engineering (S&E) trends and identified serious problems that could pose later threats to the nation's long-term prosperity and security (NSB, 2003). The report, *The Science and Engineering Workforce: Realizing America's Potential*, stated the problems as: stagnant or reduced student interest in science, technology, engineering, and mathematics (STEM) disciplines; projected increased retirement from the science and engineering (S&E) workforce over the next twenty years; projected rapid growth in S&E occupations; anticipated growth in the need for American citizens with S&E skills for jobs related to national security; and severe pressure on state and local budgets for S&E education.

While the NSB (2003) study has brought these problems and concerns to the forefront, the under-representation of women and minorities in STEM disciplines has long been a problem affecting America's workforce – as evidenced in the National Research Council's (NRC) 1991 report, *Women in Science and Engineering: Increasing Their Numbers in the 1990s*. The U.S. Department of Education has examined the gaps related to gender and race/ethnicity in entrance, persistence, and attainment of postsecondary science and engineering education and concludes that, relative to men and

whites, women and minorities (excluding Asian Americans) are still significantly underrepresented (2000).

Women and minorities are increasing their overall numbers in STEM majors, but women still make up only 17.6 percent of all STEM doctoral degrees (Jackson, 2006). The NSB (2003) reports that the minority groups who are currently underrepresented in the science and engineering workforce—Hispanics, African-Americans, and American Indian/Alaskan Natives—are projected to increase as a share of the college-age population from 32 percent to 38 percent by 2025. As the retention of women and underrepresented minorities through degree completion is critical to America's technological success, we must first effectively tap into this underutilized talent pool and gain a dramatic increase in the participation of women and underrepresented minority groups. The goal is not only to ensure the sustained growth of a skilled STEM workforce aligned with national need, but also to encourage and sustain personal career goals and aspirations.

The shortage of professionals in STEM fields continues to grow, despite the efforts being made to recruit and retain the under-represented groups of women and minorities in the various disciplines. Many studies have examined the significantly low numbers of women and minorities in the STEM disciplines (see Arch, 1995; Civian & Schley, 1996; NRC, 1991; NSF, 2000; Rayman & Brett, 1995; Seymour, 1992, 1995; Wood and Schaer, 1991). Findings as to why the numbers are so dismal include lack of role models, lack of a supportive environment, stereotypic images and expectations, poor self-confidence, peer- pressure, a null learning environment, instructor behavior, and

failure on the part of the student to see the relevance of such knowledge (Fear-Fenn & Kapostasy, 1992).

The steadfast disparity of women and minorities in science related fields seems to point directly to the need to recruit and retain these groups. While some studies have reflected what is needed for success in STEM disciplines, what seems to be missing is a lack of focus on the specificity of sub-groups within these often mentioned and well-researched "umbrella" groups. African American women, as a group, are continuously included in the categories of "women" and/or "minority," when it comes to discussion regarding equity and opportunity. According to Glenn (1999), women of color are not considered as racial and/or gendered subjects. Men of color are regarded as the universal racial subject, and White women are regarded as the universal female subject. While African American women experience race and gender as "linked and simultaneous" (Glenn, 1999), Dugger (1988) points out that when conceptualizing race and gender as one being a part of the other, "racism and sexism combine to produce race-specific gender effects that generate important experiential cleavages among women" (p. 426). Thus said, not all experiences of all women are the same or mean the same to each as a group or as an individual. It is important to note that other racial and/or ethnic groups have different histories and socialization patterns, which shape different class/gender experiences (Acker, 1999). Unfortunately, African American women have not been sufficiently regarded as a group that needs to be heard on its own, for its own sake. In addition, African American women compose a critical proportion of the potential STEM workforce of the future, yet are disproportionately represented and remain an untapped source of talent.

Leaders in science and industry, university presidents, administrators, and researchers assert that a *quiet crisis* is upon us. This crisis is seen as "the steady erosion of America's scientific and engineering base, which has always been the source of American innovation and our rising standard of living" (Friedman, 2005, p. 253). The crisis also refers to the fact that the U.S. STEM workforce is quickly reaching retirement age (NSB, 2003), fewer students are seeking STEM degrees, international student enrollment is also declining, and the question becomes "who will do the science?" (Jackson, 2004). In order to stop the crisis and cease the erosion, the exclusion of a significant portion of America's available intellectual talent must also be stopped. While the aforementioned is only a part of the problem, I believe the question as important as "who will do the science?" is "who *wants* to do the science?" The challenge is not so much in the provision of access and opportunity, as it now is in developing interest in the pathways that lead to established access and opportunity.

In order to fulfill on America's promise of equal opportunity *and* sustain the STEM workforce of the future, a national commitment to develop the talent of *all* children and young men and women is direly needed. Data indicates that there is a continued and significant under-representation of women and minorities in STEM disciplines. Furthermore, Johnson (2001) states "the experiences of women of color who choose to study science as undergraduates [are] almost totally unexamined" (p. 448). There are many *voices* missing from the effort to address what is truly needed not only to ameliorate the problem and provide needed workforce resources for the nation, but also to understand the *how* and the *why* of it all. For those who may

develop or already have a genuine passion for science, a desire to fulfill their potential, and/or a need to contribute their talent and energy, access and opportunity should not be about a country's economic need, but about one's right to pursue that passion, desire, and/or need for professional fulfillment.

The presence of women of color in STEM areas is critical. The perspectives, experiences, and inquiries of a diverse workforce allows for a broad and deep understanding of STEM disciplines. However, continued under-representation persists despite what has been done to address the problem on legislative, federal, and institutional levels.

Purpose of the Study

The present study was designed to examine *how* and in *what* ways an undergraduate research experience affected the STEM-related career choices and interests of the African American women who participated. The URE was the summer initiative of a National Science Foundation science and technology center based in Atlanta, GA. Specifically, this study answered the following questions as they relate to undergraduate African American female students: 1) What factors are perceived to have contributed to the student seeking to participate in a science-based URE? 2) What factors are perceived to have affected the student's educational/career persistence (academic choices, career interests, career direction), and/or overall self-knowledge during the course of the 10-week program? 3) What factors are perceived to have contributed to the student's decision to continue her academic/career path after completing the program? 4) What factors are perceived to have contributed to what the student comes to know about herself, her ability to *do*

science, and her choices/career interests after completing a science-based URE? The exploratory nature of the current investigation provided an opportunity to better understand each participant's perception of the URE and their individual career development experience.

Theoretical Framework

The researcher has employed a combination of theoretical frameworks as a means to view and understand the significance of the academic and career development experiences of African American women who have been traditionally underrepresented in certain majors and careers. These theories include Black feminist thought (Collins, 2000) and womanism (Beauboeuf-Lafontant, 2002; Brown, 1989; Phillips & McCaskill, 1995; Walker, 1983) – taken together as womanist thought (Banks-Wallace, 2000). A second theoretical framework is Lent & Brown's (1996) social cognitive career theory.

Womanist Thought

Black Feminist Thought. It is important to note that Black feminist thought, as described by Collins (2000), "does not to begin with feminist tenets developed from the experiences of White, middle-class, Western women and then insert the ideas and experiences of African American women" (p. vii). Black feminist thought stems from the need to make the lives of Black women (and other women of color) visible, to tell their stories from their points of view and in their own words, and to work o their behalf for justice and empowerment. The primary focus of Black feminist thought is to foster *both* Black women's empowerment *and* conditions of social justice (Collins, 2000). Black feminist thought places the ideas and experiences of Black women at the center of analysis (Collins, 2000) and forwards the understanding of how their identities have been

shaped by the interlocking components of race, gender, and class (Howard-Hamilton, 2003).

There are six distinguishing features that characterize Black feminist thought: (1) it acknowledges that Black feminism remains important because African American women constitute an oppressed group; (2) it acknowledges that all African American women face similar challenges that result from living in a society that allows for people of African descent to be historically and routinely oppressed; (3) it acknowledges the connections between African American women's experiences and the development of a group standpoint; (4) it acknowledges the need for the continued, ongoing, and dynamic investigation of African American women's viewpoints; (5) it acknowledges the importance of social change and the need to engage in new and current Black feminist analyses as conditions change; and (6) it acknowledges its relationship to other projects for social justice and has forwarded the view that African American women's struggles are part of a larger struggle (Collins, 2000).

Womanism. The term *womanism*, derived from Alice Walker's (1983) "womanist," is generally used to reflect the political, cultural, and historical experiences of African American women (Beuboeuf-Lafontant, 2002). "Walker's definition of womanist provides a space to (1) recognize the uniqueness of African American women's experiences, (2) articulate the similarities and differences, between these experiences and those of other women of color, and (3) address explicitly the important bond between African American women and men" (Banks-Wallace, 2000 as cited in Phillips, 2006, p. 316). Further, womanism is:

> a social change perspective rooted in Black women's and other women of color's everyday experience and everyday methods of problem solving in everyday spaces, extended to the problem of ending all forms of oppression for all people, restoring the balance between people and the environment/nature, and reconciling human life with the spiritual dimension (Phillips, 2006, p. xix).

There are five overarching characteristics associated with womanism, they are: (1) antioppressionist – where all people should be free of any oppression; (2) vernacular – where the focus is on everyday people and everyday life; (3) non-ideological – where the focus is on inclusiveness; (4) communitarian – where the focus is on the state of collective well-being; and (5) spiritualized – where a spiritual realm is recognized (Phillips, 2006).

While the experiences of African American women have been historically omitted or ignored, the womanist perspective acknowledges the interwoven realities (race, gender, and class) and experiences of African American women (Brown, 1989 as cited in Phillips, 2006). From an educational standpoint, a womanist perspective seeks to "expose the differences and similarities that human beings experience in the classroom as a result of skin color, language, economic status, and personal experiences" (Brown, 1989 as cited in Phillips, 2006, p. 270). Additionally, it is understood that "each student brings a set of experiences to the learning environment that reflects his or her status at work and at home and within his or her family, his or her relative positions in time (history), and his or her understanding of these factors" (Brown, 1989 as cited in Phillips, 2006, p. 272). Acknowledging, understanding, and considering these everyday experiences is key in supporting the educational success of African American women.

Black feminist thought and womanism place the experiences and ideas of African American women at the center of analysis and, along with other similar theoretical constructs, is intent on providing a voice for their political, economic, life stories, experiences, cultures, and histories that have been historically excluded from the educational mainstream (Sheared, 1994). According to Collins (2000), because African American women as a group "live in a different world from that of people who are not Black and female" (p. 23), it is thereby important to not equate the experiences of women and/or minorities alone to African American women, as their experience encompasses much more than a singular experience of gender, race, or class.

The term *womanist thought* – as coined by Banks-Wallace (2000), was used to group the various theoretical frameworks (i.e., Black feminist thought, womanism, Africana womanism, and womanist theory) developed by, for, and about women of African descent, and have the experience of women of color at their core – is the term of reference for this aspect of the study's theoretical framework. Employing *womanist thought* enabled the experiences, and *voices*, of the participants – African American women pursuing their career goals in a discipline where, historically, they have been overlooked – to be encouraged, heard, acknowledged, understood, and supported.

Social Cognitive Career Theory

Lent and Brown (1996) assert that it is necessary to understand the variables through which people participate and help guide their own career development. This development includes processes toward career interest, choice, and performance. Social cognitive career theory (SCCT; Lent, Brown, & Hackett, 1994, 2000), a direct application of Bandura's general social cognitive theory (1986) applied to the domain of

educational and career development, focuses on the processes of how (a) academic and career interests develop, (b) interests promote career-relevant choices, and (c) people attain varying levels of performance and persistence in their educational and career pursuits (Lent & Brown, 1996). These cognitive-person variables interact with other aspects of the person, such as gender and ethnicity. The variables also interact with aspects of the person's environment – including particular learning experiences, barriers, and social supports (Lent, Brown, & Hackett, 2000).

This aspect of the overall theoretical framework for the current study employs a social cognitive disposition that incorporates a substructure of variables through which individuals participate in and guide their own career behavior. These variables include self-efficacy, outcome expectations, and personal goals. SCCT asserts that each of these variables mutually influence career behavior, and along with other social cognitive variables, have been found to be good predictors of students' interests, choices, performance and persistence towards success in STEM disciplines (Hackett, Betz, Casas, & Rocha-Singh, 1992; Lent, Brown, & Larkin, 1986; Lent, Brown, Schmidt et al., 2003; Lent, Larkin, Brown, 1989; Nauta, Epperson, & Kahn, 1998; Schaefers, Epperson, & Nauta, 1997).

The self-efficacy construct was brought into the career development literature by Hackett and Betz (1981) to address women's issues in career development. Additionally, the self-efficacy construct is used to address the paucity of women in male-dominated disciplines and professions (Lent et al., 2003). According to Bandura (1986) self-efficacy refers to one's judgment regarding their ability to perform in a certain way. When applied to career decision-making, self-efficacy influences a person's plans to pursue a particular

career path or choice (Chung, 2002). Further, self-efficacy beliefs assist people in determining their perceived range of career options, as well as their tenacity and attainment of desired results in pursuing such options (Lent, Brown, & Larkin, 1987). Self-efficacy influences the likelihood that a person will attempt and persevere in a particular academic or career-related behavior despite adversity (Bandura, 1986).

When focusing on career self-efficacy, many studies have failed to adequately address-race and ethnicity, the intersection of gender and ethnicity and their influence on self-efficacy, or the possibility of the special circumstances of minority women (Hackett & Byars, 1996). However, Bandura's (1986) social cognitive theory is noted as being one of the more favorable career theories that account for ethnicity in career development (Hackett & Byars, 1996; Lent & Brown, 1996; Lent, Brown, & Hackett, 1994). Further, SCCT works to highlight and illuminate the unique ways in which certain cultural, racial, or gender-related factors impact African American women – as well as other ethnic minorities – (Hackett & Byars, 1996), their learning experiences, and their professional pursuits.

Outcome expectations pertain to beliefs about the consequences of certain actions and behaviors (Bandura, 1986). Lent and Brown (1996) further assert that outcome expectations are gleaned from "a variety of direct and vicarious learning experiences, such as perceptions of the outcomes one has personally received in relevant past endeavors and the second-hand information on acquires in different fields" (p. 312).

From a social cognitive perspective, personal goals are defined as one's intent to engage in certain activities for certain outcomes (Bandura, 1986). This variable, along with the others, affords a level of personal agency or control whereby individuals

marshal, steer, and support their own educational and career development efforts (Lent & Brown, 1996). While self-efficacy and outcome expectations intermix to influence the development of interests, interests affect the distinguishing of and planning for career choice, and goals (Lent et al., 1994).

According to Lent and Brown (1996) "the effects of gender and ethnicity on career interest, choice, and performance are seen as operating largely through self-efficacy and outcome expectations, or, more precisely, through the differential learning experiences that give rise to these beliefs" (p. 315). Hackett and Byars (1996) have also noted how learning opportunities influence the formation of career-related self-efficacy in African American Women and how self-efficacy plays a role in how women of color manage barriers such as sexism and racism.

Social Cognitive Career Theory & STEM

Criticism of earlier career development theories (Fitzgerald and Betz, 1994; Leong, 1995; Naidoo, 1998) contends that such theories overlook ethnic populations, cultural differences, and make certain assumptions about affluence, access, and values (Kerka, 1998). The lens of social cognitive career theory lends itself to this study as it recognizes that career choice and development are influenced by multiple factors. These factors include vocational interests, self-perception and world-view, resources, socialization, and life experiences (Kerka, 1998). For the purposes of this study, SCCT was utilized as a means to focus on a particular educational experience of an identified group of African American women. According to SCCT, career development is affected by environmental factors, such as the quality of such an experience and the support provided to pursue various career development options (Lent, Brown, & Hackett, 2000).

In summary, Black feminist thought and womanism, taken together as Womanist Thought; and Social Cognitive Career Theory formed the basis of the theoretical lenses through which the experiences of the African American women who participated in an Undergraduate Research Experience (URE) were viewed. The URE was viewed as a means to foster career development for African American women who are exploring STEM career paths on which they have been historically under-represented. This framework also served as a means to further understand the social cognitive experience of African American women in STEM/pipeline intervention programs, and in this case, a research-based internship.

Armed with a better understanding of these experiences, the voices of African American women can be heard and recognized as integral to the ongoing development of the Nation's workforce, not only as a means of capital gain or global competitiveness, but more so for the fulfillment of individual and personal potential. Educators and policy makers can develop and implement more effective policies and programs that better reflect inclusion and, in turn, increase female and minority representation, retention, and success in the STEM disciplines.

As a part of the review of related literature and research, the next chapter will provide an overview of the laws, legislation, policies, and programs implemented to improve all women's educational equity, access, and opportunity. The chapter also provides a review the status of women in STEM, including recruitment, retention, and attrition. Lastly, the research questions guiding the study are formerly presented.

CHAPTER 2

Review of Related Literature and Research

Overview

A number of factors contribute to the perceptions and experiences of women and underrepresented minorities in science-based undergraduate research programs. Presumably, these programs are designed to support and encourage the participation and performance of these groups in STEM education and careers. The review of the literature will provide an overview of the research and professional practices related to this issue. Three main areas of literature informed the present study. The first area – legislation and policy – focused on efforts to disassemble educational inequity for girls, women, and minorities. The second area – the status of women, including attrition and retention in STEM disciplines – focused on the junctures at which student participation in STEM areas shifts and the factors that contribute to the reasons women and girls leave these disciplines. This area also focused on the program measures taken to minimize these factors and address the challenges of recruitment, retention, and attrition. Emphasis is on the need for programs that effectively provide what has been determined necessary for student success. The third area includes what is known about student interest and proficiency, the STEM environment, and the culture of science. Specifically, these areas of literature were integral to establishing the significance of the present study and the construction of the interview protocol.

As the reader will likely observe, the literature is sporadic in approach when compared to more strictly theoretical or empirically based literature reviews. There is no consistent theoretical thread running through the studies reported. The unifying aspect of this review is the focus on women and underrepresented minorities – the populations targeted as the salvation of the United States' STEM workforces. Another noteworthy aspect of this body of literature is the relative dearth of information on the educational and career development experiences of African American women in neuroscience or science-based undergraduate research programs.

Legislation and Policy

In a society that identifies what is traditionally male and female through gendered roles, stereotypes, expectations, and attitudes, the question of *gender equity,* is not new. The Affirmative Action definition of *gender equity* is "the elimination of sex-role stereotyping and sex bias from the educational process, thus providing the opportunity and environment to validate and empower individuals as they make appropriate career and life choices" (Hilke & Conway-Gerhardt, 1994, p.8). Historically, there have been three major reasons why women and girls have been denied equal opportunities like those of men and boys: (1) the simple physiological differences between the sexes, (2) social norms and attitudes, and (3) organizational rules and support (Pemberton, 1995). Since 1964, federal, legislative, and institutional forces have endeavored to dismantle these reasons for educational inequity.

Federal and legislative programs, including many efforts in policymaking, have been developed to help women and minorities attain STEM education at the post-secondary level (US Department of Education/NCES, 2000). These developments

include *Title VI of the Civil Rights Act of 1964,* which forbids discrimination on the basis of race, color, and national origin, *Title IX of the Education Amendments Act of 1972*, which forbids discrimination on the basis of sex, and the *Women's Educational Equity Act of 1974*, which funded projects to improve the quality and scope of education for girls and women. Similarly, the National Science Foundation (NSF) human resource programs were designed to assure equality in science and engineering education. In addition, higher education institutions, both public and private, have been recruiting and providing programming and support for women and minorities to study in technical fields traditionally dominated by white men. Also, various K-12 strategies have been developed and implemented to improve math and science education for girls and under-represented minorities. The following provides more detail regarding the legislation written and passed in order to ensure equity, access, and opportunity to women and under-represented minorities.

Title VI of the Civil Rights Act of 1964

Made up of eleven titles, the *Civil Rights Act of 1964* generally protects the constitutional right to vote, to have access to public accommodations, facilities, education, federally assisted programs, and equal employment opportunity. As a part of the *Civil Rights Act, Title VI* specifically prohibits discrimination on the basis of race, color, and national origin by any program or activity receiving federal funding (http://usinfo.state.gov/usa/infousa/laws/majorlaw/civilr19.htm).

Title IX of the Education Amendments of 1972

Title IX is the principle federal law that prohibits sex discrimination in education. It provides: "[n]o person in the United States, shall, on the basis of sex, be excluded from

participation in, be denied the benefits of, or be subjected to discrimination under any educational program or activity receiving federal financial assistance" (National Coalition for Women and Girls in Education [NCWGE], 1988, p.1). *Title IX's* broad coverage is guaranteed by the *Civil Rights Restoration Act*, passed by Congress in March of 1988. *Title IX* was put into place to ensure that girls and women would have every opportunity for participation offered and made available to them as it is already offered to their male counterparts.

The Women's Educational Equity Act of 1974

In 1974, Congress passed the *Women's Educational Equity Act* (WEEA) because it found that education in the United States was "frequently inequitable" for women and girls and limited their "full participation" in American society (U. S. General Accounting Office, 1994). The *Act* was established to award grants and contracts to eligible recipients for interventions to: (1) provide educational equity for girls and women, (2) help educational institutions meet the requirements of *Title IX of the Educational Amendments of 1972* prohibiting sex discrimination in all educational institutions receiving federal funds, and (3) provide educational equity for women and girls who suffer multiple discrimination based on sex and race, ethnic origin, disability, or age (U. S. General Accounting Office, 1994). Additionally, the National Advisory Council on Women's Educational Programs (NACWEP) was established to advise federal officials and the public about the educational needs of girls and women. In 1982 the NACWEP Council, as well as the WEEA program, came under attack by the Reagan Administration, whereas those with little experience and background in women's issues

and educational equity replaced the more experienced bipartisan members. However, the *Act* was signed into law despite President Reagan's initial veto.

Despite attacks by the Reagan Administration, diminishing funds, and moderate to no enforcement of the *Title IX* regulations, the *Women's Educational Equity Act* Program has been responsible for many landmark projects in women's educational equity. Particularly relevant, the WEEA program has been responsible for:

- Funding programs to open math, science, and technology courses and career to women and girls, and has supported important programs to overcome past stereotyping.
- Funding major programs to improve educational opportunities and career choices for low-income women – to help break the cycle of poverty, unemployment, and underemployment of women.
- Leading the way in supporting programs on double discrimination based on both sex and race/ethnicity.
- Funding programs that meet the needs of women and girls from preschool through postgraduate education

(U. S. General Accounting Office, 1994)

During the late 1980s the American Association of University Women (AAUW), whose self-proclaimed mission is to promote equity for all women and girls, lifelong education, and positive societal change, conducted a study that polled 3,000 school-aged children. The AAUW commissioned the seminal study *Shortchanging Girls, Shortchanging America: A Nationwide Poll* because of the perceived failure of education reform to address the unequal practices in classrooms that inhibit girls from reaching

their potential for success. The 1990 report declared that girls contend with a pervasive bias evident in teachers, textbooks, and tests from the beginning of schooling to the end (Hilke & Conway-Gerhardt, 1994). Other studies, such as the AAUW follow-up, *How Schools Shortchange Girls* (1992), also found that girls and boys are treated differently in the classroom and that the quality and quantity of education is disparate. However, even with earnest attempts to provide equitable opportunities for males and females, women and minorities are still significantly underrepresented in science-related disciplines (U.S. Department of Education, 2000).

The question now becomes: are such enforcements effective? Have women and girls gained significant (difference-making) equity, access and opportunity? More specifically, are the disproportionate numbers of women in STEM majors and careers changing for the better? Scholars and administrators will argue that federal legislation has made a difference, and to some extent it has. It is true that more females are pursuing college degree programs and careers in STEM areas. However, it is evident that female representation still lags behind in numbers. For example, in 1996 women received 18% of engineering degrees, 34% of mathematical and computer science degrees, and 37% of physical science degrees (U. S. Department of Education/NCES, 2000).

The Status of Women

According to the National Center for Education Statistics (2000), women represented 51% of the U. S. population and 46% of the nation's labor force, but were only 22% of the science and engineering workforces. These disproportionate numbers continue to exist as women continue to leave the science disciplines. The reasons women and underrepresented minorities leave the sciences all along the STEM pipeline,

including career entry, is well documented. Industry, educators, and policymakers continue to search for ways to address and alleviate the problem of under-representation and the perceived chilly climate of the science culture as experienced by women and underrepresented minorities.

While it is true that there have been notable advances by women in the 37 years since the inception of the Educational Amendments of 1972, those opposed to continued funding and efforts on behalf of gender equity argue that it is no longer an urgent issue. However, when the concern turns to science, technology, engineering, and mathematics and their relation to the United States' status as a technologically powerful and economically astute entity, equitable access and opportunity once again become significant. While the nation's global leadership is a very real economic concern, we must also acknowledge the very real social and ethical concerns for equitable access, opportunity; and more importantly, encouragement and support of discovery and pursuit of personal aspirations.

Although the data regarding women may reflect higher enrollments, better test scores, better grades, and comparative numbers in the workforce we should also note that women still hold the majority of low-paying jobs, women still earn a fraction of what men earn, there are still too many female-headed households living in poverty, and women are still under-represented in STEM disciplines. For example, women earned only 36.5% of doctorates in science and engineering as recently as 2001 (NSF, 2004). With the declining interest of men in STEM disciplines (NSF, 2000), as well as the support of the aforementioned legislation and reform in place, why has the situation for women improved so minimally?

Jones (1997) asserts that there is a "fantasy of fairness" that is evident when members of society, or faculty members in various departments would rather believe that they are just and impartial, than to see or admit to discrimination. Many traditional scientists in academia see the mere presence of women in their departments as an indication that gender issues have been resolved (Jones, 1997). The adverse contention is that the *mere presence* of women does not necessarily mean their presence is embraced or supported. The increased presence of women in STEM departments does not mean there is an acceptable understanding of differences and needs regarding women who choose to pursue science majors and careers, it simply means that access has been gained, with access being only a part of the larger problem equity and inclusion. Hilke and Conway-Gerhardt (1994) contend that educators need a greater awareness of gender issues and an understanding of strategy for change, instead of "assuming" that the issues have been resolved when they "see" more women.

Special programs for recruitment and retention, such as *Title IX* and the *WEEA* program have been legislated, designed, and launched. Concerns and strategies regarding America's science and technology workforce and the necessity of educational reform abound (Arch, 1995; Cusick, 1987; Hilke & Conway-Gerhardt, 1994; NRC, 1991; NSF, 2000). However, women's STEM enrollment and attrition data indicates persistent and continuous underrepresentation. If access has been granted and opportunities are present for women and girls interested in science and science-related fields, why is their presence still not at critical mass?

Students in general – including men, women, and various racial and ethnic groups – enter the science pipeline and more women and under-represented minorities

(excluding Asians) leave at various junctures. This "pipeline" is an often-used metaphor that refers to the journey from secondary school through college to career entry in STEM disciplines (Blickenstaff, 2005). Unfortunately the pipeline is also known to be "leaky," allowing for the loss of students at any point along the way. The extant research indicates *why* some students leave and what factors contribute to their departure. What we do not know is *what* happened and *how* various experiences of African American women influence the decision to leave or continue in the chosen discipline.

Hanson's (1995) study revealed that girls are taking more math and science classes in high school, are earning more degrees in the STEM disciplines; but that women still do not choose STEM careers. It appears that regardless of ability, interest, or confidence women are leaving science at some point and not persisting to career entry. If we continue to look at science education as a talent pipeline, the challenge is not only to identify, understand and stop the persistent leak(s), but also to understand and alter a system that was not originally designed with women in mind. Miller and Silver (1992) assert that while women begin their academic pursuits with various needs, abilities, and fears, they do not need fixing. Perhaps the focus does not need to be on *fixing* women and girls, but on *fixing* the so-called pipeline before the leakage occurs. Betz (1997) identified three crucial junctures where girls and women leave the pipeline: (1) initial career choice, (2) transition from the undergraduate degree to the graduate degree, and (3) entrance to academia. The present study focused on the undergraduate to graduate degree juncture, where women are preparing to take the next and more definitive step toward a career in science.

The Attrition of Women and Girls in Science

Numerous studies have examined the significantly low numbers of women and minorities in the STEM disciplines. Focus on this issue has uncovered reasons for the changing of college majors and leaving the field at various levels of academic study. Many of the reasons noted for students leaving STEM disciplines speak to issues specific to women and minorities. These issues include lack of role models, lack of a supportive environment, stereotypic images and expectations, poor self-confidence, peer- pressure, learning environment, instructor behavior, and failure to see relevance (Fear-Fenn & Kapostasy, 1992). Although the research speaks to social-cognitive and environmental factors that contribute to the departure of women and girls from STEM disciplines, we also know that girls begin school with the same capacity for science and math as their male counterparts.

Girls' Interest and Proficiency

According to Oakes (1990), young women show a similar proficiency in math to young men through secondary school, but express less interest than young men in pursuing a math or math-related major or career. During the elementary school years girls often achieve at a greater rate. However, once adolescence sets in, interest in math and science dissipates and achievement and participation in these areas declines (Franklin, 1990). Arch (1995) asserts that the primary differences between males and females in regard to technology and science are their levels of interest and self-efficacy, as these levels affect willingness to participate. Due to the differential experiences of girls and boys in school (e.g., interaction with parents, counselors and teachers regarding rewards, encouragement, and reinforcement), Hearne (1986) suggests that attitudinal factors may

limit girls' pursuit of higher mathematics skills, although advanced classes in math and science are critical to arriving prepared for the undergraduate pursuit of STEM majors (Fear-Fenn & Kapostasy, 1992).

According to the National Research Council (1991), 84% of school-aged boys and 81% of school-aged girls show an interest in math prior to high school. By the time they enter high school, 72% of boys and only 61% of girls maintain that interest (NRC, 1991). According to Fear-Fenn and Kapostasy (1992), this change can be attributed to the following factors: stereotypic images and expectations, lack of self-confidence, peer pressure, learning environments, teacher behavior, lack of female role-models, failure to see relevance, attribution style or personal responsibility, and lack of incentives. Identified strategies to negate these barriers include: dispelling stereotypes, increasing self-confidence, enhancing the learning environment, equalizing teacher behaviors, providing female role models, implanting relevance, creating incentive, adjusting attribution style, and instilling personal responsibility (Fear-Fenn & Kapostasy, 1992).

Undergraduate Women

As undergraduate students, women are faced with as many of the same obstacles and barriers as their male counterparts. In a 1992 study, Seymour found that all students who switched to non-science-based majors reported faculty issues as reasons for the switch. Some of the faculty issues reported included poor teaching and lack of approachability, feeling overwhelmed by the pace and work load, inadequate help and advice from faculty through periods of difficulty, and difficulties due to length of time to degree completion. The study supports the notion that while the experience of being female in a discipline that has historically been dominated by White males still

constitutes a very different and challenging experience, many students who leave the disciplines experience a multitude of the same difficulties.

Seymour's (1995) completion of the 3-year ethnographic inquiry sought to discover factors related to students at 4-year colleges and universities switching from science-based to non-science-based disciplines, as well as to distinguish the experiences of students of color and females of all ethnicities from that of their white male peers. A total of 460 students were interviewed in two phases. The data were gathered from the main (N=335) sample in semi-structured open-ended interviews and in small focus groups at seven different sites. Text data from the verbatim transcripts of the interviews and focus groups were coded and analyzed for patterns and themes.

Findings from Seymour's (1995) research explaining the experience of women in STEM majors include: (a) the sharing of the "weed-out system" with their male counterparts, though interpreting it very differently; (b) the entering of a social system which has traditionally been all male; (c) the need to adjust to an unknown system that was designed to support white males; (d) the need to prove one's self through competitive activity; (e) the desire for praise; and (f) a pattern of socialization that is very different from their own and that conflicts with their own socialization experiences. African American women, however, exhibited patterns of socialization that indicated independence, self-reliance, and assertiveness towards career choices and educational needs. Seymour concluded that while some women entering the STEM disciplines continue to experience uncertainty regarding their ability, their preparation, and their level of belonging, "moving pedagogy from a focus on teaching to a focus on learning,

and from selecting for talent to nurturing it, will disproportionately increase the persistence of able women in [STEM] majors" (Seymour, 1995, p. 470).

Seymour's study was well constructed and met the axioms for credible and trustworthy ethnographic inquiry. The basic criticism of this research study is the same criticism that ethnographic focused research receives. In this regard Fetterman (1998) stated "there is a possibility that an ethnographic focus will overestimate the role of cultural perceptions and underestimate the causal role of objective forces." However, Seymour's study (1995) through the use of exploratory interviews, focus groups, and surveys added depth to the breadth of the inquiry. The reader gains an integral understanding of women's experience as well as the reasons for their leaving STEM degree programs.

Civian and Schley (1996) studied 445 Wellesley College women students, as a part of the Pathways Project, which followed students from orientation to graduation to isolate factors associated with persistence in math and science. The assumption was that because Wellesley is a selective college, is culturally responsive, and has a strong female faculty presence, women would be supported in pursuing STEM careers. Data were collected utilizing surveys, focus groups, and administrative data. The findings pertaining to why some women left math and science majors reflect on factors such as: the amount of time involved, that courses were perceived as being too demanding, and that participants developed interest in other disciplines. What the study does not tell us relates to the demographics of the participants. We know that they attend Wellesley, that "leavers" (22%) have slightly lower grades and SAT math scores, and are less likely to have a parent with an advanced degree. While background information and

characteristics were collected, there was no mention in this study of where the participants come from, level of preparation, race or ethnicity, which also may be factors in persistence.

Cronin and Roger (1999) maintain that women also leave the sciences for reasons such as stress and isolation, negative attitudes from males, poor teaching approaches, lack of opportunity, individual competition, inadequate advising, and family issues. Other factors identified with leaving STEM disciplines include low self-confidence (Seymour & Hewitt, 1997; Ware & Lee, 1988); social relationships, the environment (AAUW, 1995); the clash between traditional and changing gender roles, disinterest (U. S. Department of Education/NCES, 2000); and faculty and teaching issues (Matyas, 1992). It seems that there is a plethora of reasons as to why women leave, and few resolutions that make more than a small difference.

According to the National Academy of Sciences (1994), many women tend to defeat themselves by low estimates of their abilities, low self-confidence, and low aspirations. However, research (see Cano, Kimmel, Koppel, & Muldrow, 2001; Lee, 1998) shows that many women come to the STEM disciplines just as prepared as their male counterparts, with high self-confidence, and determination to succeed. Unfortunately, women are diverted from completing science, engineering, mathematics, or technology degrees due to institutionalized obstacles, educational and work-related barriers, and gender segregation (Bird & Didion, 1992), as well as gender discrimination.

Research continues to uncover and confirm reasons for the low numbers of STEM degrees awarded to women, with results indicating factors such as young women being less likely to take the necessary courses that facilitate entry in STEM majors, female

students not exhibiting a particular level of interest in STEM studies, and a tendency for women to be alienated from the mainstream STEM communities (Matyas, 1992). Some faculty have even explained attrition as *appropriate* for students who are not as well prepared, have expressed disinterest, do not work hard enough, or have discovered other, better-suited interests (Seymour, 1995). But what about women who are well prepared, are interested in STEM, and work exceptionally hard? Not only is attrition still a problem as women continue to leave STEM disciplines at disproportionate rates, but women still are not choosing to pursue these areas in college degree programs. Despite the legislative acts that have prohibited discrimination in education and employment, the millions of dollars (and labor hours) allocated for program and intervention funding; the problem of the disproportionate number of women and under-represented minorities in science, engineering, and mathematics academic programs remains unresolved (Jones, 1997).

Generally speaking, lack of preparation, disinterest, low efficacy, and alienation seems to be only partially responsible for women's attrition in STEM disciplines, with the possibility of many of these issues and others being addressed programmatically. While studies and reports show that qualified women depart from STEM disciplines more often than qualified men (NRC, 1991), there is evidence that the disproportionate number of women in STEM fields is not because of insufficient preparation (Atwater, 1994; Seymour & Hewitt, 1997; Tobias, 1990), disadvantaged backgrounds, lack of interest or self-efficacy, or deficiencies (Atwater, 1994). Perhaps the problem has more to do with the culture of science, a culture that has been historically devoid of women. Although women now have the opportunity to enter STEM fields and to participate in a scientific community, this traditionally male-dominated community seems to not have made the

necessary changes or instituted the necessary provisions pertinent to the success of women and underrepresented minorities.

According to Bonous-Hammarth (2000), who examined the flow in and out of science, engineering, and mathematics majors among under-represented minority students, findings suggest that students flourish in the STEM disciplines when there is consistent motivation and a strengthening of student interest, academic preparation for increased competency in mathematics and analytical thinking, connections to motivated peers also pursuing STEM majors, and positive interaction with STEM faculty. Bonous-Hammarth (2000) also contends that nurturing female interest in the sciences and support from role models affects the long-term academic persistence of women in these disciplines. Effective motivation- and interest-generating programming, mentoring, and addressing the psychosocial needs of under-represented students seems to be issues for the "to do" list if the continued out flow of women in science, engineering and math disciplines is to be effectively addressed. Mau (2003) states that "young women cannot simply be recruited into the S[T]E[M] pipeline without continued support and encouragement" (p. 241).

The scientific community, from the classroom to the laboratory, and the "culture of science" itself, plays a crucial role in the attrition of women and minorities from STEM majors and careers (Jones, 1997). If women *are* treated differently (e.g., faced with formal and informal barriers and obstacles) in science because they act differently (i.e., culturally and socially determined differences) in science (Sonnert, 1995), then movement toward understanding, or at least embracing, differences is necessary to encourage the science pursuit versus complicating or discouraging it. If given access and

opportunity people are expected to adjust to their environments, to accept what is, make the most of their situations, and to learn how to play the game; but according to Bem (1993) as referenced in Jones (1997, p. 32), science is an example of the type of situation where women are disadvantaged by policies that appear on the surface to be gender neutral, but still lack the support and encouragement necessary for their success.

Recruitment and Retention

There are many factors that contribute to the paucity of women in the STEM disciplines, many of which have already been discussed. However, the focus now turns to the recruitment and retention of women and addressing the challenges of these efforts, thereby attempting to minimize the so-called "leaky pipeline." One of the primary problems for women and girls in STEM disciplines is that they are not usually *encouraged* to pursue a degree or career in science (Bird & Didion, 1992; Jones, 1997; Seymour 1992). Researchers assert that women with interests in STEM degree programs often find themselves in the *null academic environment*, an environment that neither encourages nor discourages students and where faculty members do little to support them (Betz, 1989; Markert, 1996). Betz (2002) goes further to claim that this environment is discriminatory towards women because it does not take into account the differing environments from which students, male and female, come.

In taking a closer look at student behavior factors that affect motivation, such as confidence and interest, women suffer from socially learned low self-confidence, lack of interest in science and related fields, and the impact of a male-dominated environment more than other under-represented minorities (U. S. Department of Education/NCES, 2000). Additionally, girls are discouraged from developing a strong motivation for

achievement (Sonnert, 1995). Researchers contend that part of the problem is that women are actually diverted from completing degrees in the sciences by institutionalized obstacles inhibiting participation, the perception that work-related and educational barriers do exist, the loss of self-confidence, and the subsequent questioning of one's goals (Atwater, 1994; Bird and Didion,1992). Presumably, equity, access, and opportunity are not enough to foster a significant change in balancing the numbers of women in STEM majors and careers. The test seems to be in developing learning environments, educational and intervention-based programs, and institutional attitudes and a culture that encourages rather than discourages female students while developing interest, building confidence, changing attitudes, and supporting aspirations.

STEM-based Enrichment Programs

This section of the literature reviews the programmatic efforts undertaken to provide research-focused career development opportunities for women and underrepresented minorities at the undergraduate level. According to Seymour, Hunter, Laursen, and Deantoni (2004), there are 4 common models for undergraduate summer research experiences, though most actual programs employ a combination of the following: (1) retention programs – designed to move underrepresented undergraduates in the sciences towards graduation; (2) career promotion programs – designed to recruit high school students into college and undergraduates into graduate school and STEM careers; (3) research apprenticeships – summer and year-long mentored opportunities for advanced undergraduates; and (4) research-based learning programs – integrates research-like experiences into the classroom environment. The following sections

describe the related program development initiatives of both national and collegiate supporters.

Research Experiences for Undergraduates (REU). Entities such as the National Science Foundation (NSF) have been particularly concerned with the research interests of STEM students and have supported programs designed to attract, train, and encourage the career development of students in these disciplines (Wiedenbeck & Scholtz, 1995). These types of programs include the National Science Foundation's *Research Experiences for Undergraduates (REU)*, a Foundation-wide answer to the need to provide research opportunities in science and engineering, and many other disciplines, to undergraduate students who might not otherwise have such opportunities. The REU is "a major contributor to the NSF goal of developing a diverse, internationally competitive, and globally-engaged science and engineering workforce" (NSF, 2006, http://www.nsf.gov/pubs/2005/nsf05592.htm). The over-all program is focused on recruiting and retaining talented undergraduate students to the STEM disciplines and providing effective educational and hands-on research experiences for women and underrepresented minorities. The NSF defines underrepresented minorities as, "Blacks, Hispanics, American Indians, Alaska Natives, and Native Hawaiians or Other Pacific Islanders" (NSF, 2005). REU sites are determined by independent proposals, applications, and well-defined goals to engage undergraduates in research. Many REUs include an orientation to the program, mentoring, individual research projects and presentations, weekly academic and ethics seminars, and follow-up activities in order to maintain contact with the undergraduates after completion of the program.

Undergraduate Research Experiences (URE). Colleges and universities across the nation have also recognized the need to provide research experiences for undergraduate students as a means of career exploration and development. Similar to the REU Program created and funded by the NSF, the *concept* of the undergraduate research experience (URE) is the result of the efforts of academic and graduate departments and programs to provide opportunities for students to gain hands-on knowledge and experience in a mentored research environment. This avenue has also proven to be a part of the inroads to STEM careers for students of all backgrounds, including women and underrepresented minorities. However, very little has been done to explicitly examine the educational or career development experiences of African American women in STEM disciplines, including neuroscience – the discipline of focus for the unit of analysis for this study.

Frantz, DeHaan, Demetrikopoulus, and Carruth (2006) reported the outcomes of a comparison study focused on two different models of a summer-intensive URE emphasizing neuroscience and inquired as to whether or not either model affected student attitudes and confidence in science skills and neuroscience concepts for women and underrepresented minorities. The study compared the outcomes of an Apprenticeship Model, where individual students were assigned mentors and joined the mentor's laboratory; and a Collaborative Learning Model, where students were organized into teams, worked through a guided curriculum, and engaged in independent research projects. For both models, the results indicated increased positive attitudes towards neuroscience, confidence with neuroscience concepts, and confidence with science skill. Neither model altered attitudes towards science due to a pre-existing affinity for science as indicated by scores on the pre-program survey given the participants. While the

sample involved students selected from a number of historically Black colleges and universities (HBCU), based on the design premise of a REU/URE for the recruitment of women and underrepresented minorities, the experiences of these targeted populations were not identified or discussed from a qualitative standpoint. That is, the results indicated that the attitudes and confidence of the participants were affected, but we do not know *how* they were affected or *what* the experience encompassed for the participants.

According to Mickley, Kenmuir, and Remmers-Roeber (2003), the growing worldwide interest in neuroscience finds undergraduate students seeking opportunities to work with faculty on the design, conduct, documentation of experiments, and publication of results in peer-reviewed literature. These researchers described a *model system* at Baldwin-Wallace College where students had the opportunity to experience "all aspects of the research enterprise" (p. A28) including conducting research, assisting in the management of the laboratory and its traditions, and on-going skill building. Students entered this system of faculty and peer mentoring through selection as freshmen and sophomores, were engaged in a thorough orientation to the laboratory and team building, and usually stayed involved for the next 2-3 years.

Program evaluation results of the Neuroscience Laboratory at Baldwin-Wallace College included information from exit interviews, transcript reviews, and responses to an annual survey. The survey allowed for the assessment of acquired student skills, career plans, and the perception of experiences. Overall, the results indicated that 90% of the students who worked in the Neuroscience Laboratory have gone on to graduate training and/or have begun careers in science. As 35% of all science majors at Baldwin-Wallace go on to professional or graduate study, it is unclear as to whether the selection criteria

for the Laboratory worked in concert with the experience itself. It is also unclear as to the representation of the students involved in the Neuroscience Laboratory at Baldwin-Wallace College since demographic information was not provided. We do not know the gender or ethnicity of the students involved. Despite the use of program evaluation, without such information it would be difficult to fully utilize the description of this program even for purpose of identifying best practices.

The long-term success of any URE program is usually reflected in the number of past participants who go on to pursue graduate degrees in STEM disciplines, the number of conference presentations and publications, and positive anecdotal accounts from past participants (Kremer & Bringle, 1990). However, it is unclear as to the extent of what is learned during the research experience or the interns' perception of what they have learned (Kardash, 2000). Due to the lack of gender and ethnic demographic information, a clear understanding of retention beyond the program is still problematic. However, most program directors and mentors anticipate interns will come away from the experience with the ability to *do science*, including the ability to communicate ideas, understand theory and procedures, know pertinent literature, and develop satisfactory skills in the field or lab (Kardash, 2000). Such an experience can also provide interns with a more practical view of the occupation in which they have expressed interest (Bradburn, 2001). The current study will contribute to the understanding of what participants, particularly African American women, gain from their involvement in such an intervention.

Seymour, Hunter, Laursen, and Deantoni (2004) described the student-identified benefits of participating in research experiences for undergraduates. Their particular

study reported on a 3-year, qualitative inquiry designed to explore student perceived benefits of participation over time. The total student sample was 139 with a comparison group of 63. The researchers began with conducting 76 first-round interviews with students who completed a summer URE at 4 participating liberal arts colleges. Students were also asked to comment on a "checklist" of possible benefits. This list was developed from a review of benefits reported from previous research. Students were then interviewed a second time prior to graduation and were asked to comment on their overall view of their undergraduate research experiences. A third set of interviews, conducted 20 months after graduation, was an opportunity for respondents to comment on the development of their career paths, the influence of research and other factors, any longer term effects, and current educational or career status. All interviews were tape-recorded and transcribed verbatim. Transcripts were analyzed with emphasis on the research questions. The findings showed that 91% of the statements regarding benefit of participation in a URE were positive. Such benefits included personal and professional gains, "thinking and working like a scientist"; gains in various skills; clarification/confirmation of career plans, including graduate school; enhanced career/graduate school preparation; and shifts in attitudes to learning and working as a researcher (Seymour, Hunter, Laursen, & Deantoni, 2004).

While the results of the study (Seymour, Hunter, Laursen, & Deantoni, 2004) confirm the student-identified benefits of participating in an undergraduate research experience, identify "growth" in young researchers and professionals, and address many of the questions asked of, and by, faculty as to what students need to be successful and to progress towards careers in selected disciplines, we do not know much about the

individual students who participated in the URE. The researchers only tell us that the students in this study attended Grinnell, Harvey Mudd, Hope, and Wellesley. Understanding who (i.e., demographically) the students are who participate in programs "designed" to recruit and retain students for various disciplines, what their experiences mean, and how the programs influence their particular choices is imperative. What works for some students may not work for all. The experiences of some students may not be the same experiences of other students.

At the same sites used by Seymour, Hunter, Laursen, and Deantoni's 2004 qualitative study, Lopatto (2004) surveyed 384 undergraduate students participating in a science research program and examined gains on potential benefit. Lopatto's findings, as before, indicated that the URE enhanced student experience in science and reinforced plans to continue. However, the findings do not tell us about the individual experiences of the participants or the meanings assigned to those experiences. In order to better understand the influences of a URE on student outcomes, investigations of personal experiences – which are not possible to examine with structured instruments (Myers, 2000) or by using experimental design – are also necessary.

Effective Programming for Women in STEM

Efforts to increase female participation in the STEM disciplines have focused on problem areas revealed in the literature, such as generating interest and developing prerequisite skill, converting pre-college interest to STEM matriculation, and the prevention of attrition (Matyas, 1992). Innovative programs designed specifically to increase the number of women in STEM disciplines have been developed, implemented, and facilitated at all levels of education; both short-term and long-term. These pipeline

programs also have been developed and supported by organizations for women and girls, such as the Girl Scouts of America, Girls, Inc., the American Association of University Women, as well as professional groups such as the Association of Women in Science (AWIS) who support mentoring as an avenue to counteract the many negative messages these young women receive (Bird & Didion, 1992).

Matyas (1992) asserts that the more effective STEM intervention programs, meaning those that have been evaluated and have reached programmatic goals, have common characteristics, including but not necessarily all of the following:

- Goals are well-defined.
- A plan has been developed for evaluating the program's effectiveness.
- Strategies are based on current educational research findings and the program does not depend upon a single strategy for success.
- Participants are recruited from diverse racial/ethnic groups and have input into the design and implementation of the program activities.
- The program has strong support from and involvement of the sponsoring university's faculty and administration through group mentoring programs, advisory boards, laboratory visits, and/or research experiences for students.
- The program includes multi-year involvement with participants, strong academic components, daily or weekly contact with students, strong peer support networks, low or no fees for participation (or readily available financial aid), hands-on (laboratory) activities, inquiry approaches, cooperative learning situations, residential experiences for participants

such as overnights, bridge programs, and summer programs where appropriate, and involvement of role models from both academe and industry.

- Outreach activities include activities with parents and teachers as well as students and have follow-up components for all three groups.

(p. 48)

Cano, Kimmel, Koppel, and Muldrow (2001) studied the establishment and expansion of the Women in Engineering & Technology Initiative-FEMME programs at the New Jersey Institute of Technology. The programs provided elementary and secondary school-aged girls with opportunities to enhance skills in math and science, complete prerequisites and advanced placement courses, learn about STEM fields, build self-esteem and self-efficacy, and alter attitudes and beliefs about female children. The structure of the program included classroom discussion and activities, lectures, laboratory experiences, projects, and field trips. Additionally, all of the activities utilized "non-biased, gender friendly" instructional methods, problem solving cooperative techniques, and a teamwork approach (Cano, Kimmel, Koppel, & Muldrow, 2001). In the initial follow-up study conducted in 1987, which garnered a 96% response rate, 92% had enrolled in college and 73% had declared STEM majors. The 1994 follow-up study with 340 alumni "study participants" resulted in a 50% response rate of which 39% were pursuing post-secondary STEM degrees. Additionally, of the thirty-five participants still in high school in 1994, 77% were enrolled in advanced mathematics and science courses. Keeping students in the pipeline tends to be a challenging endeavor for educators and

policy makers. However, effective programming may provide avenues for addressing the "leaks" in the STEM pipeline.

To gain an understanding of the effectiveness of programs designed to assist women in combating key barriers and obstacles to their success in STEM disciplines higher education, Schmidt, Smith, Vogt, and Schmidt (2003) studied the Research Internships in Science and Engineering (RISE) program after its first year of implementation. RISE, an intervention developed at the University of Maryland (funded by NSF, the University's Office of the Provost, and the Clark School of Engineering) was designed to support and encourage women in the post-secondary STEM pipeline (including first-year students, graduate students, and female faculty members) based on the following premise:

> There appear to be two key points in the career of undergraduate women where participation in deliberately designed intervention can significantly impact success. The first is during the transition from high school to college (which tends to be the initial encounter with the predominantly male STEM environment). The second is during the latter half of their undergraduate education, when career options, are being considered.
>
> (Schmidt, Smith, Vogt, and Schmidt, 2003, p. 18)

With these points of opportunity in mind, the program utilizes a two-track approach. The first track is *The First Year Summer Experience* (FYSE), designed for freshman women who intend to major in a STEM discipline. The second track is *Summer Research Teams* (SRT), designed for junior and senior women majoring in STEM fields and involves a directed team-based research experience. Prospective

participants are actively recruited through listservs and direct mailings to academic departments and are asked to submit an application, transcripts, an essay identifying career goals, and reasons for wanting to participate. Potential SRT participants are also asked to submit letters of recommendation, and rank their degree of interest in working on mentor-listed research projects.

Schmidt, Smith, Vogt, and Schmidt (2003) assessed the program utilizing qualitative and quantitative methodologies including written surveys, focus groups, and individual semi-structured interviews. The goal of the assessment was iterative as it was designed to provide feedback from the first year that would influence following years. Preliminary impact results reflected student success when comparing the grades of RISE participants to non-RISE participants. Student success is also indicated in the significant percentage (58%) of those continuing with RISE activities, the articulated desire to attend graduate school, and the replicable features (i.e., role model hierarchies, mentor training, and predominantly female-research teams) of the program that can be used by other institutions interested in accepting the challenge of increasing the numbers of women in STEM disciplines.

Favorably, these types of programs make a difference by further opening the door of equity, access and opportunity for women and girls with STEM interests. Cronin and Roger (1999) assert, however, that a larger part of the problem has to do with the "inaccurate and/or incomplete perceptions of the reasons for women's under-representation" (p. 643). So what are we missing? What questions have we not asked? What we have is a well documented, yet little understood phenomenon (Schmidt, Smith, Vogt, & Schmidt, 2003) that is yet to be resolved.

Success for Women in Science

Certainly it is necessary to hold fast to the investigation of why women leave STEM disciplines, as well as continue the revision and implementation of intervention processes that bolster persistence. There is also the continued need to persevere with instituting appropriate environmental supports such as proper advising, encouragement, and mentoring (Rayman & Brett, 1995); changing the climate in classrooms and laboratories (Sadker & Sadker, 1994); and challenging the culture of science itself (Seymour, 1995). I contend that there is an additional need to further the understanding of the experiences of all women who choose to participate in STEM programs, particularly if there is an explicitly expressed desire or intention to follow this, yet still, non-traditional career path.

Johnson's (2001) ethnographic study on why women drop out of science and ways to support them in staying revealed steps that women who stayed adhered to in order to have their majors be more satisfying. These women took care to manage their isolation, learned to follow the "rules of the game," maintained their fascination with and intrinsic interest in science, and defined their own standard of success and reasons for persisting in the major. Seymour (1995), maintains that women who persist enter STEM degree programs with adequate independence to manage the impersonal teaching styles, exhibit strong intrinsic interest and career direction, and develop coping mechanisms in order to "neutralize" any hostile effects of their peers. Additionally, the National Academy of Sciences (1994) report on why there are so few women in science and engineering uncovered five attributes or qualities that seem to be common among women who earned such degrees and gained industrial employment. These attributes are: (1)

expertise and competence; (2) the ability to establish and meet goals and to take risks; (3) strong communication skills; (4) self-confidence; and (5) openness to change. Understanding how women gain such attributes is a necessary step in understanding their experiences, as well as what experiences enable such growth.

While it is evident that equity, access, and opportunity are not the only provisions necessary for women to enter and persist in their chosen fields, they do find ways to persist in STEM majors and careers. Many come to the STEM table with everything they need to succeed, however the table has not necessarily been set for them. If attrition, retention, and persistence in STEM disciplines are still issues for America's workforce, then it is time to take women's needs and concerns into consideration when the invitation to participate is extended. Educators and policymakers should be particularly attentive to discovering, understanding, and facilitating experiences that develop and reinforce attributes of persistence among women – women of all races, ethnicities, and backgrounds.

Summary

Selected areas of literature have been reviewed to gain an understanding of the factors that contribute to the continued exodus of girls and women from the STEM disciplines, as well as the efforts implemented for the recruitment and retention of talented women and underrepresented minorities in STEM degrees and careers.

As mentioned at the beginning of this chapter, efforts in educational policy and practice include *Title VI of the Civil Rights Act of 1964*, which prohibits discrimination on the basis of race, color, or national origin*; Title IX of the Education Amendments of 1972*, which prohibit discrimination on the basis of sex by any federally funded

institution; and the *Women's Educational Equity Act of 1974*, congressional legislation designed to improve the quality and scope of education for women and girls; all of which were implemented to assure quality and equity in education and professional endeavors (U. S. Department of Education/NCES, 2000). Additionally, STEM enrichment programs have been specifically designed with under-represented populations in mind. While it appears steps have been taken to attract and retain women in the STEM disciplines, the numbers are still disproportionate. Seymour (1995) asserts that the design of many STEM majors did not have women in mind, that the design was based on the needs of educating young men, which is in direct conflict with how young women are socialized. Perhaps it is the historical culture of science that continues to hinder women and underrepresented minorities in their pursuit and attainment of STEM degrees and careers.

Focus on factors contributing to why women leave STEM areas and what women need to be successful in their STEM pursuits supports the well-documented dilemma of female attrition and the disproportionate numbers of women in STEM disciplines. However, one of the major limitations of this literature is that so much of it focuses on pre-college issues such as lack of preparation and sex differences regarding interest in science-based courses (Arch, 1995; Lee, 1998). Additionally, the post-secondary literature reflects deficiencies, barriers and obstacles, and predictors for leaving STEM disciplines (Bonous-Hammarth, 2000; Seymour & Hewitt, 1997; Tobias, 1990); as well as factors that influence persistence, including self-efficacy (Coyle, 2001; Luzzo, Hasper, Albert, Bibby & Martinelli, 1999; Mau, 2003). While there is research on African American women in STEM that focuses on pre-college experiences (Hanson & Johnson,

2000) and the role of family and academic performance (Hanson, 2007; Louque & Garcia, 2000), less is known regarding the undergraduate research experiences or career development experiences of these women and other women of color who are targeted for recruitment and who choose to participate.

Rationale for the Present Study

While there are insights into the attributes of women who persist as well as predictors for persistence, these findings come from studies that primarily investigated reasons for leaving. Hines, Chinn, and Rodriguez (1994) assert, "it is increasingly necessary to critically examine the culture of these women [in science] to assist them in making a larger place for themselves within the scientific enterprise" (p. 4), although attracting more women to the disciplines does not guarantee they will stay. Therefore, understanding the culture, experiences, and needs of any group, as well as the culture of the disciplines to which they aspire provides opportunity for change, growth, and success.

As a next step to address this gap in the research, the current study explicitly investigates the social cognitive experiences and perceptions of African American women who have participated in a undergraduate research experience. Walker (2001) identifies the practical problem of needing to know how to understand gendered experiences in order to develop educational practices more inclusive of female students. Therefore, the purpose of the study is not only to understand the experience of the participants, but to also understand their perception of the scientific culture in which they study. The ultimate goal is to understand the factors related to *how* African American women choose to participate in their career development via a URE, continue or discontinue their STEM education, and gradually progress toward a science-based career.

Research Questions

The central research question asks: Did the Undergraduate Research Experience (URE) influence the educational/career persistence (i.e., academic choices, career interests, career direction) of the participating African American female students and what did they come to know about themselves as African American women engaged in science?

The study is specifically designed to answer the following guiding research questions:

- What factors are perceived to have contributed to the respondent seeking to participate in a science-based URE?
- What factors (critical incidents), related to the URE, are perceived to have affected the respondent's educational/career persistence (academic choices, career interests, career direction), and/or overall self-knowledge during the course of the 10-week program?
- What factors, related to the URE or not, are perceived to have contributed to the respondent's decision to continue her academic/career path after completing the program?
- What factors are perceived to have contributed to what the respondent comes to know about herself, her ability to "do" science, and her academic choices/career interests after completing a science-based URE?

The overarching goal was to understand the experience of African American female program participants – from their point of view and in their own words (Merriam, 2001) – in order to better inform effective program development and policy that more

effectively leads to the fulfillment of individual potential. This understanding may also allow for more solid career development avenues that better support personal goals and aspirations of undergraduate students who choose vocational paths on which they have been historically excluded.

An additional goal includes better understanding the influence of undergraduate research programs as a means of career development for students interested in STEM disciplines. An abundance of research has focused on women and minorities, but has not adequately singled out the experiences of African American women. Richie, Fassinger, Linn, Johnson, and Prosser (1997) state that there has been inadequate attention given to the career development and experiences of women of color. The presence, perspective, and contribution of African American women in science not only diversifies the science community and culture, but it also speaks to the fact that African American women, second to Latina women, are the fastest growing female population. Their voices must be heard, acknowledged, and considered as we strive to understand and affect their persistent underrepresentation in STEM areas, address the nation's global leadership concerns, and provide equitable access to anyone seeking educational and career opportunities.

CHAPTER 3

Methodology

The first section of this chapter provides an overview of qualitative research design and methodology. Other sections focus on research design, case study, in depth interviewing, validity and trustworthiness of the study, purposeful sampling, data collection and treatment of data and assumptions.

Research Design

The purpose of this study was to explore the experiences of African American women who participated in an undergraduate research experience (URE) program (also referred to as *the URE* or *the program*) during the summer of 2006. This 10-week program was developed for the recruitment and retention of women and underrepresented minorities in STEM disciplines. Research questions focused on each participant's perception of her reality and experience in relation to the social-cognitive aspects of the undergraduate research experience. These perceptions included (but are not limited to) their interaction with advising, encouragement, mentoring, classrooms and laboratories, faculty, peers, curriculum, strategies for academic and/or career success and persistence, and support mechanisms.

Employing a qualitative case study approach, this study was designed to specifically answer the following questions as they pertain to African American women pursuing STEM-related degrees and careers: (1) What factors are perceived to have contributed to the respondents seeking to participate in an URE? (2) What factors are

perceived to have affected the respondents' educational/career persistence, and/or overall self-knowledge during the course of the 10-week program? (3) What factors are perceived to have contributed to the respondents' decision to continue her academic/career path after completing the program? (4) What factors are perceived to have contributed to what the respondents' come to know about themselves, their ability to "do" science, and their academic choices/career interests after completing a science-based URE?

Overview of Qualitative Research

According to Merriam (2001), qualitative research is used as an "umbrella" term to refer to several forms of inquiry such as naturalistic inquiry, participant observation, inductive reasoning, interpretive research, ethnography, and case study. The focus of qualitative research is on meaning and understanding in context or how the participants develop meaning and understanding regarding the phenomenon being studied. The goal is to understand the phenomena being studied from the perspective of the participant (Merriam, 2001). The term also refers to a variety of fundamental data gathering techniques including observations, in-depth interviewing, and the collection and analysis of documents (i.e., print materials).

Yin (1994) suggests that case study provides a distinct advantage for investigating *how* and *why* questions, while Merriam (2001) asserts that using case study may reveal knowledge about a phenomenon to which researchers may not otherwise have access. Case study methodology was utilized as a means to explore and seek answers to *how* the URE influences academic/career "thinking," interests, choices and self-knowledge of African American female participants; and to understand the complex social phenomena,

such as individual experiences, while retaining the holistic and meaningful characteristics of real-life events (Yin, 1994).

Case study, one mode of inquiry inside of qualitative research, reflects a comprehensive research strategy (Yin, 1994). It is "an intensive, holistic, description and analysis of a single instance, phenomenon, or social unit whose aim is to discover the interaction of significant factors characteristic of that single instance, phenomenon, or social unit" (Merriam, 1988, p.21). Characteristic of this type of inquiry is viewing the case, or unit of study, as a "unit around which there are boundaries" (Merriam, 2001, p. 27). As two levels of sampling are usually necessary in qualitative case study design, the first level focused on the selection of the case to be studied, or that about which the researcher had a general question (Merriam, 2001). The second level of sampling focused on the selection of subcases, or the numerous participants who could have been interviewed (Merriam, 2001). For the purposes of the present study, the unit of analysis (or case) is the URE program, and the subunits (or subcases embedded within the case) are each of the participants selected for the study.

Setting

The case, an Undergraduate Research Experience (URE) program, was selected through purposeful sampling, convenience sampling specifically. This case was selected due to the availability of the site, the respondents, and the location. While a sample of convenience brings questions of credibility (Merriam, 2001), the selection of this case also meets the rigor of a typical sample as it reflects the average URE program. Additionally, this case meets selection criteria (i.e., designed to recruit and retain undergraduate students in STEM disciplines, designed with women and underrepresented

minorities in mind, and designed with a particular focus on neuroscience) for a unique sample. There were a total of seventeen other related URE programs housed on a summer internship website. The URE program in this study was the only one which would have met all of the selection criteria. Furthermore, this case was selected because it was one from which "one can learn a great deal about issues of central importance to the purpose of the research" (Patton, 1990, p. 169).

The URE program is based on the Research Experiences for Undergraduates (REU) program created by the National Science Foundation (NSF) in response to the need to provide practical experience to undergraduates. The URE used for this study was a 10-week, paid internship, housed at a prestigious university situated in the southeast United States. This particular URE was designed to provide undergraduate students with a summer research experience in a variety of subfields within neuroscience. Each participant was assigned a faculty mentor and placed in the mentor's established laboratory where he or she would learn how the laboratory worked, assist with on-going research and develop his or her own research project to be presented at the end of the summer. Participants were also engaged in classroom instruction to develop and enhance knowledge of neuroscience, communication, research, and quantitative skills. Additionally, participants were provided with weekly innovative workshops to promote the necessary "survival skills" for success in graduate and postdoctoral studies, as well as careers in science-related disciplines. Twenty-two participants/interns were selected from a competitive pool of approximately 200 applications – applications which reflected classification, grade point average, major, academic and career interest, letters of recommendation, and personal statements. The 22 interns of the 2006 URE program

consisted of 11 African American women, 2 African American men, 2 Hispanic women, 3 Asian American men, 3 Caucasian women, and 1 Caucasian man; ranging in age from 19-26.

Participants

Because this study was designed to investigate the experiences of African American women specifically, purposeful sampling was utilized in order to select a sample from which the most can be learned (Merriam, 2001). Participants were selected based on the following characteristics: African American female students who were accepted into and participated in a neuroscience Undergraduate Research Experience program based at a prestigious research university in the southeast United States during the summer of 2006. The participants had also expressed a genuine interest in pursuing a degree and career in science. There were 11 African American women who participated in the selected URE and who met these characteristics. A sample size of three (minimum) to five (maximum) was specified "based on expected reasonable coverage of the phenomenon given the purpose of the study" (Patton, 1990, p. 186). Utilizing typical sampling, each participant selected represented the average program participant, program situation, and phenomenon being studied (Merriam, 2001). Five respondents agreed to participate in the study. As one respondent was unable to keep scheduled interview times and became unresponsive, four of the five participants completed the study. Basic participant information can be found in Appendix A.

Data Sources

Data sources were multiple and were collected at various junctures of the URE. Personal statements were received as a part of the URE program application package and

provided the applicant with an opportunity to tell the selection committee about their career goals, research interests, and reasons for applying to the program. Autobiographies were written to be shared as an introduction to the final selection of participants, and were collected prior to the beginning of the URE program. Critical incident reports were turned in weekly and described relevant incidents that caused the participant to think about her academic/career path. In addition, experience papers, or end-of-program reflective narratives addressing focused questions regarding perception of the summer experience, were collected during the last week of the 10-week program. Instructions for participants regarding the writing of critical incident reports and the experience paper can be found in Appendices B and C, respectively. Lastly, interviews utilizing in-depth, structured and semi-structured, open-ended questions were conducted well after the end of the URE. The interviews focused on the participants' personal reflections of the summer program, along with their current academic/career goals.

According to Seidman (2006), "individuals' consciousness gives access to the most complicated social and educational issues, because social and educational issues are abstractions based on the concrete experience of people" (p. 7). A combination of structured and semi-structured interview questions allows for this access. The interview format also allows for researchers to be more flexible in managing the interview session and respond to issues that may arise, such as new ideas on the topic or the "emerging worldview of the respondent" (Merriam, 2001, p. 74).

The interview questions were created around the aforementioned guiding research questions and the lenses of the theoretical framework, which include the combination of womanist thought and social cognitive career theory (SCCT). The factors and

experiences in question reflect the salient issues reviewed in the literature related to attrition of women in science; effective program funding, development, and design of programs for women and girls; and the benefits of undergraduate research experiences as an avenue for career exploration and development. At the base of in-depth interviewing is "an interest in understanding the lived experience of other people and the meaning they make of that experience" (Seidman, 2006, p. 9). By utilizing in-depth interviews as a mode of inquiry, this researcher intended to build upon and explore the participants' responses to the open-ended questions and have the participant reconstruct her experience (Seidman, 2006) from her perspective and in her own words. Interview questions were designed around the research questions, field tested with URE participants from the summer program of 2005, and were revised to more accurately investigate the factors under study. The interview guide, or list of questions asked during the interview (Merriam, 2006), can be found in Appendix D.

For the current study, there were four sets of interview questions. The interview began with questions designed to further establish rapport between the researcher and the participants, as well as to gain an understanding of how participants first became interested in science and science-related subjects. Additionally, these questions probed the thoughts and feelings of participants regarding their role as African American women pursuing education and careers in the sciences.

The second group of questions focused on the research question designed to uncover factors related to the participant seeking an undergraduate research experience and, more specifically, a summer program that targeted women and underrepresented minorities in neuroscience. The next questions were directly related to the research

question that investigated the span of the 10-week URE program and sought to reveal any incidents (i.e., discussions, interactions, thoughts) that may have encouraged or discouraged the participant's academic/career interests and choices.

The next cluster of questions focused on the third research question, which was designed to elicit responses regarding the influence of the overall URE on whether or not the participant chose to maintain or alter her academic/career path. This specific URE was designed to address the underrepresentation of women and minorities in neuroscience by providing access and exposure to science culture. As a form of career exploration and development, this experience also lends itself as an avenue to additional exploration of career options and clarification of career goals.

The final cadre of questions addressed the development of *self-knowledge* as it pertains to concepts such as self-efficacy, ability, choices, and interests. These questions sought to identify factors related to the participants' perception as African American women involved in their own career development and the exploration of science careers in which they have been historically overlooked and underrepresented.

Data Collection

Five African American female respondents (out of 11 African American female URE program participants) who successfully completed the 2006 URE program were selected to participate in the study. Selected URE program participants were contacted via email and by phone to inquire as to their willingness and availability to participate in the study. After selection, each respondent was contacted by phone during which the researcher began to develop rapport with the respondent (Creswell, 1998); explain the purpose of the study; and set a time, date, and location for the interview. All interviews

were conducted by the researcher by phone, and were audio-taped with participant permission, labeled, securely stored as an audio-file on both flash drive and compact disk, and transcribed. The researcher also maintained field notes during the interview in order to capture points to be explored further later in the interview and to be referred to during data analysis.

Prior to the interview, respondents received a copy of the interview questions to allow time to personally reflect on the 2006 URE program. Respondents also received the consent to participate form (Appendix E). The consent form was signed and returned to the researcher before the interview began. Four of the five respondents completed the interview and fully participated in the study. A summary of participant information can be found in Appendix A.

At the beginning of each interview, the researcher restated the purpose of the interview and how it would be used as a part of the current study. Participants were invited to ask questions and express any concerns that may be present. At the close of each interview, the researcher again invited each participant to ask questions or express any concerns regarding the interview and/or study. The researcher also discussed with the participants the possibility of a follow-up interview to clarify any instances in the initial interview that were unclear. Each interview was approximately 45 minutes in duration and included a brief period of member checking at the close of the interview. Lincoln and Guba (1985) recommend that the interviewer provide a brief summary at the end of the interview as a form of member checking. Additionally, each participant received an electronic copy of her interview to review and check for accuracy.

Most data, including personal statements (received as a part of the application package), autobiographies (written for the group as an introduction), critical incident reports (turned in weekly to describe a relevant incident that caused the participant to think about her academic/career path), and an experience paper (an end-of-program reflective narrative addressing focused questions regarding perception of the summer experience), were initially collected prior to and during the 2006 URE for a larger program evaluation project. Each of these data points were reviewed and summarized prior to the interview period. The semi-structured, open-ended interviews were conducted in the Fall of 2008, two years after the end of the URE. This timeframe was used to allow for any short-term and/or long-term changes to the participants' educational or career paths (i.e., change of major, graduation, application/admission to graduate programs) following the end of the URE program. Any such changes were explored during the interviews.

The identified themes are presented according to the collection of the data: *before* the program, *during* the program, and *after* the program with common themes explained progressively. This approach is based on Dolbeare and Schuman's (Schuman, 1982) three-interview series, which is designed to focus on the context of the participant's experience, details of the experience within that context, and reflection on the meaning their experience holds for them (Seidman, 2006). While this study employed one interview as the last phase of data collection, this researcher sees the entire 3-phase data collection process as reflective of the Dolbeare and Schuman model.

In the Dolbeare and Schuman model, the first interview places the participant's experience in context by having the participant share as much about his or her life history

as possible regarding the topic under investigation (Seidman, 2006). In the present study, as a part of the application package and prior to the start of the summer URE program, participants were asked to prepare a personal statement discussing their interest in and expectations of the program. Participants were encouraged to share as much about themselves as possible as it relates to their desire to participate in the URE, the development of their interests in science, and their current career goals and aspirations. Participants were also asked to prepare an autobiography to share with their fellow interns as a means of preliminary introduction. These data points represent the *before phase* of the 3-phases of data collection and are referenced as such in the following chapter.

Dolbeare and Schuman's second interview was developed to provide details regarding the participant's lived experience as it pertains to the topic being examined (Seidman, 2006). In the current study, participants were asked to write and turn in weekly critical incident reports as a means of reflecting on their lived experience. The reports focused on any incident that occurred during the URE (i.e., interaction, discussion) that may have caused the participant to think critically about her presence in the program as well as her academic/career goals and aspirations. The Critical Incident Report instructions and questions can be found in Appendix B. At the end of the 10-week summer program participants were also asked to write an experience paper reflecting on various aspects of their time in the program. This paper was turned in by the last day of the program. An outline and instructions for the paper can be found in Appendix C. These data points represent the *during* phase as referenced in the following chapter.

The third and final interview of Dolbeare and Schuman's model is designed to allow the participant to reflect on the meaning of his or her experience and to express what "sense" it made to them as an individual (Seidman, 2006). In the present study, the in-depth interview was conducted two years after the end of the summer URE to further explore each participant's experience of the entire program and the sense it made to her. Primarily, the interview was an opportunity for the participant to later reflect on the experience and to discuss whether or not and in what ways the URE may have influenced her immediate and/or ensuing academic/career path, goals, and/or aspirations.

Data Analysis

Data analysis relied on the theoretical prepositions (Yin, 1994) of qualitative case study. Data analysis strategies borrowed from other qualitative forms of inquiry such as ethnographic analysis, which focuses on culture and society and voids simple interpretation by offering thick, rich description; narrative analysis, which focuses on experience through stories and first-person accounts; and phenomenological analysis, which focuses on the essence of, or basic structure of, a phenomenon and strives to account for what is being experienced (Merriam, 2001).

All data sources were coded using the coding methods as described by Merriam (2001) where "coding occurs at two levels – identifying information about the data and interpretive constructs related to analysis" (p. 164). The first level of coding involves the assigning of phrases, single words, numbers, and/or letters to various facets of the data and leads to the second level where common themes or patterns found across the data are identified and categorized (Merriam, 2001). This categorization – and organization – is

also used for easy recovery of specific pieces of data during the analysis and the writing of the case study report, or results.

Data sources (personal statements, autobiographies, critical incident reports, experience papers, and interviews) were grouped by the phase in which the data were collected. This measure was taken to reveal how each data source informed each of the others across the phases of data collection. The personal statements and autobiographies (Phase 1) reflect what each participant wanted to share with the selection committee and the final selection of URE program participants prior to the start of the program. This source provides data that speaks to each participant's reasons for applying to the program and what they perceived qualified them for participation. The critical incident reports and experience papers (Phase 2) provided participant reflection soon after the occurrence of each reported incident and prior to the close of the program. Lastly, the in-depth interviews (Phase 3) provided an opportunity to explore whether participants' previous perceptions and observations were still the same and if there were any changes in short-term and/or long-term goals and aspirations.

Interviews were transcribed verbatim, and all data sources were coded and analyzed separately. For each phase, first level codes and descriptions were placed in excel spreadsheets to facilitate the comparison of data and generate categories or themes. Numerous first level codes were identified for each phase, which led to a second review where similar first level codes where combined to produce unique second level codes. The remaining codes were eventually reduced to major themes for each phase. These themes represent the repetitive patterns that were indicated by the data and were identified across the data (Merriam, 2001).

This researcher incorporated peer debriefing (Lincoln & Guba, 1985) as a part of the analysis phase in order to explore alternate codes and descriptions and to increase the reliability of the process. In the current study, peer-debriefing activities included informal conversations between the researcher and professional colleagues, periodic discussions regarding potential strategies for analysis with a highly skilled qualitative researcher, and informal discussions with members of a science education-based writing group comprised of fellow doctoral students. This researcher also maintained a reflexive journal, which documented ideas and changes.

The goal of the analysis was to build an explanation about each sub-case, leading to an understanding of *how* the respondents came to participate in their own career development by participating in the URE, *how* the experience – through their participation in a neuroscience-based summer undergraduate research program – influenced their academic/career choices, interests, and overall persistence; and *what* the respondents came to know about themselves as African American women pursuing careers in STEM disciplines, and ultimately "doing science."

Overview of Reliability and Validity

Two recurring issues in qualitative research are that of reliability and validity. Merriam (2001) points out that these concerns can be approached through careful attention to the way the study is designed and "the way in which the data were collected, analyzed, and interpreted, and the way in which the findings are presented" (pp. 199-200).

Reliability

Reliability refers to dependability and consistency. Generally speaking, it refers to the extent to which the research findings can be replicated, and if repeated, if it will yield the same results (Merriam, 2001). In the case of qualitative research, "the question…is not whether findings will be found again but whether the results are consistent with the data collected" (Merriam, 2001, p. 206). The following strategies were used to address issues related to reliability: (1) clarifying the investigator's position, such as assumptions, basis for selecting informants, and the social context from which the data were collected; (2) triangulation, by using multiple methods of data collection and analysis; and (3) the audit trail, which enables the authentification of the findings by following the trail of the researcher (Merriam, 2001).

Researcher Bias

According to Creswell (2002), researchers must recognize and acknowledge that their own views and perceptions affect the interpretations made when analyzing qualitative data. The researcher identified several biases that were taken into account regarding this study.

First, the study came out of the researcher's desire to make a difference in the lives of the young women who expressed an interest in the undergraduate research experience program for which she was professionally responsible. The researcher, an African American female, identified greatly with the young women who participated as they explored career possibilities, recognized new options, and developed self-awareness. The researcher also identified greatly with each young African American woman who sought her advice on coping with academic challenges and career ambiguity. The

researcher could also relate to the student participant's struggles due to her own struggles as a first-generation college student with great ambition, but little knowledge of what was required to excel. Lastly, as the Associate Director of Education for the National Science Foundation-funded Science and Technology Center that housed the URE program under investigation, the researcher's work undoubtedly influenced the implementation and facilitation of said URE program.

Triangulation

In order to strengthen reliability, the researcher used multiple sources of data, collection, and analysis. Various aspects of data were collected at different junctures. Personal statements and autobiographies were collected prior to the start of the 10-week URE. Critical incident reports and experience papers were collected during the URE. These data points were initially collected for NSF reporting purposes and as a part of a Center-wide evaluation project. The interviews were scheduled and conducted well after the end of the URE. The utilization of multiple sources, as well as multiple methods of data collection and data analysis, helped to confirm the emerging findings (Merriam, 2001).

Audit Trail

The audit trail refers to a detailed account of "how the data were collected, how categories were derived, and how decisions were made throughout the inquiry" (Merriam, 2001, p. 207). If another researcher followed the trail, this researcher's findings would be authenticated. Noting the establishment of data sources, how and when the data were collected, the development and revision of first and second level codes, the

extraction of categories/themes, and the establishment of guidelines for the implementation of the study generated the audit trail.

Validity

Issues of validity speak to how well the research findings match reality – *internal* validity; and how generalizable the results are of the research study – *external* validity (Merriam, 2001). This study employed the following strategies to address issues related to validity: (1) triangulation, by using multiple sources of data and collection; (2) member checks, by giving each participant a copy of her transcribed interview to review for accuracy, (3) identifying researcher biases and accounting for any assumptions prior to the onset of the study; and (4) peer review, by asking colleagues to comment on the findings as they emerge (Merriam, 2001; Stake, 1995).

Internal Validity

Triangulation. See the subsection entitled Triangulation in the Reliability section of this study. This strategy was also utilized to enhance the internal validity of the study.

Member Checks. Immediately after each interview, the audio-file was played back for participant review. Additionally, an electronic copy of the transcript was later forwarded to the participant for her review. Participants were encouraged to make any clarifications they thought necessary. None of the participants identified necessary changes.

Researcher Bias. See the subsection entitled Researcher Bias in the Reliability section of this study. As the researcher is "the primary instrument of data collection and analysis" (Merriam, 2001, p. 42), he or she must address any biases he or she may harbor

that can affect the final output. Measures taken to account for researcher bias include member checks and peer review/debriefing.

Peer Review. This researcher worked with senior researchers experienced in qualitative methodology to ensure a valid qualitative research design. Interview questions were reviewed and recommendations were made for the rewording of some questions and the addition or deletion of others. Additionally, this researcher engaged the assistance of fellow graduate students and professional colleagues familiar with the plight of women and underrepresented minorities in STEM education and careers. These individuals were invited to comment on the emergent findings as the study progressed.

Merriam states that external validity speaks to the "extent to which the findings of one study can be applied to other situations" (p.207) or how generalizable the results are of the research study (2001). Qualitative research, though, is not about generalizations, but about understanding the context and perspective regarding the phenomenon being studied. However, Stake (1995) suggests providing the reader the opportunity to make naturalistic generalizations, which are arrived at through sensing, intuition, and personal or vicarious experience and lead the researcher to the similar themes and patterns. External validity is addressed with: 1) rich, thick, description – to provide enough description and detail so that readers will see how nearly their own experiences match the experiences studied and whether the results can be conveyed; 2) typicality or modal category, which describes how typical the phenomenon is compared with others of the same experience, so that readers can make comparisons of their own situations; and 3) a multisite design, where this study used multiple sub-cases to allow for the results to be

applied by readers to a wider variety of like situations and can be based on purposeful sampling (Merriam, 2001).

External Validity

Rich, Thick Description. In an effort to provide opportunities for the reader to compare his or her own experiences to experiences studied detailed descriptions were provided. Each of the data sources were mined extensively to draw out rich, thick description of the experiences had by each participant. Results of the study were written to encompass each data point so that the reader could actuate the similarity of their own experiences to that of the women in this study, and ultimately if the results could be similarly applicable.

Typicality and multisite design. The participants in this study comprised a multiple-subcase group of young African American women who had taken part in an undergraduate research experience designed specifically for their recruitment and retention in STEM education and careers. The case report depicts the uniqueness of each participant by providing contextual elements of their lives and lived experiences. Such provision allows for readers to compare the results of this study to their own experiences and/or situations (Merriam, 2001).

CHAPTER 4

RESULTS

This chapter begins with the stories of each of the four young women who participated in this study. These stories were written to give the reader insight into each woman's experience. To assist in best representing the "voice" of each participant, quotations that most clearly capture the themes are used throughout the chapter. Some participants are quoted more often than others, which may be due to the length of information provided and/or their ability to better articulate themes than others. In order to preserve and protect confidentiality, each participant was given a pseudonym (Corrine, Fiona, Pam, and Penny). The stories are followed by an analysis of the themes that emerged from the data sources and across the three phases of data collection, and are evident in each participant's story.

Participant Stories

Corrine

Corrine applied to the URE as a 23-year-old junior majoring in biology. She expressed her ultimate goal as becoming a pediatric neurosurgeon and following in the footsteps of world-renowned pediatric neurosurgeon, Dr. Ben Carson. Corrine knew she wanted to be a physician by the age of nine, but was unsure as to what specific field she would pursue. She had the opportunity to hear Dr. Carson speak about his role in the separation of Siamese twins who were joined at the brain, an opportunity on which she often reflects. Corrine states, "Just hearing about something this monumental keeps the

fire burning in my mind and heart to continually strive to reach this goal." Corrine remains inspired by Dr. Carson's work and came to the URE with the goal of better understanding behavioral neuroscience and gaining hands-on research experience.

Corrine anticipated participation in the URE as a means to view neuroscience from three angles: research, teaching, and clinical application. She regarded this particular URE as a way to "grasp a better overall understanding of the brain, how it works, and contributes to the behavior of individuals." She also stated an appreciation for the versatility that science offers where she has options to become a physician, researcher, and/or educator. In exploring these options, Corrine professed, "science is the only field that I know and love, and that will continuously grow as I grow."

Corrine was assigned to a psychology laboratory although she had anticipated being assigned to a biology laboratory. She was not particularly happy with her lab assignment as the focus was mainly on psychology, observable human infant behavior, and required the coding of many video recordings. Her hope was to be in what she considered a "real laboratory" where she would have the opportunity to "cut up" things, instead of a classroom with video and transcription equipment. The arduous task of transcribing videotapes was a large part of Corrine's introduction to data analysis. She proclaimed, "I have learned that research is FOREVER ongoing. It just seems like I have been doing the same thing for the past two weeks. Oh wait…it's because I have!" Corrine admits, however, that she learned a great deal in her assigned laboratory, including coding strategies and techniques for analysis.

As the summer progressed, the more time she spent in her mentor's lab and assisted with the daily protocol, the more Corrine felt that she was "blessed to have even

had this experience." She further states, "This is just one of those times in life that will allow me to mature and grow as each day goes by." Because the lab assignment and the tasks involved were not exactly what Corrine wanted in her URE, she was able to clearly identify what she *did not like* about the type of research in which she was involved. However, what she said she discovered in the tediousness of coding and data analysis for her lab's project was a purpose for her own study. She attributes the viewing of each video, observing the infant participants and with what they played, and the reading of the relevant literature to the discovery of her interest in whether or not the production of cortisol affects cognitive abilities in babies.

Corrine shared that her experience in the laboratory, with her mentor, and during the URE overall, had also given her an opportunity to reflect on her life and the people in it. She feels that the work that she does and is a part of is a reflection of from where she comes and to where she is going. She states, "I have begun to have a small glimpse of who I am as a person…I am just hoping that each experience that I have left in this program helps guide me down the path that God wants me to go." As far as her lab experience and how it relates to her career path, she proclaims, "I learned that I have to do something I love…I want to be happy in whatever it is that I do."

Corrine expressed an early concern regarding a late start to a more diligent pursuit of her career goals than that of her peers due to a lack of information disseminated at her home institution. However, upon exiting the URE, Corrine believed that she had gained some ground through her participation and with what she described as "a better understanding of what exactly I needed to do to get the job done." This understanding included a better grasp of the research process including developing, designing, and

presenting one's own research project. Corrine believed that this understanding would better enable her to make informed decisions regarding her science-related career path, goals, and aspirations.

Corrine initially sought admission to the URE being examined in this study, as it seemed to be a "once in a life time opportunity to work with some of the biggest, brightest, and up and coming scientists in the neuroscience field." She also viewed its reference as a "definite asset" to her resume. Two years after the close of the program, Corrine disclosed an appreciation for programs that "enrich Black people as a whole." She stated that she felt that opportunities for people of color are not the same as their white counterparts and that "we still have to work ten times harder to get the job done – which is sad."

Corrine's continued reflection on the URE revealed a dedication to success and a desire to do well simply because she can – despite her age, race, or gender. Corrine is currently anticipating receipt of her MCAT scores and a Fall 2009 admission to medical school.

Fiona

Fiona applied to the URE as a 19-year-old freshman majoring in Biology/Pre-Med. She disclosed that she had been interested in science since elementary school primarily because it was that in which she excelled. She also spent her junior and senior years of high school at an academy for mathematics, engineering, and science.

Fiona realized she wanted to become a physician by participating in a program designed to provide an opportunity for minority students to meet and talk with medical professionals at major hospitals throughout the city in which she lived. Through

conversations with a particular physician at one of the hospitals, Fiona gained an understanding of how rewarding being a physician could be and how much a difference it could make for her community. With a desire to expand on her penchant for science, Fiona states, "by pursuing a career in science I will be able to help people with their health and that would be the most rewarding part of having a profession in science." Fiona emphasized the importance of *helping* people and having her career path lead in that direction.

While Fiona expressed an interest in neuroscience, she also voiced a desire to gain research experience through her participation in this particular URE, preferably in neurological disorders in children. By gaining research experience, Fiona hoped to be able to determine if research was an appropriate career path for her, as well as explore other options such as a medical degree/doctorate (i.e., MD/PhD) program.

Fiona was assigned to a mentor and laboratory that she had already worked with during the preceding school year. In discussing her desire to pursue an independent project, her academic-year mentor recommended that Fiona apply to the summer URE, as there would be funding available for students to work in a well-established laboratory and have their own research projects. Fiona attests to her time in her mentor's laboratory as providing more of a learning opportunity than any of the science classes she has had so far. She says she has developed skills and techniques that she otherwise would not have by this point in her academic career. Being apart of an established laboratory with on-going research projects has allowed Fiona to look forward to implementing an independent project with the support of her URE lab assignment.

As a part of the 10-week URE, Fiona found herself challenged in several ways, including dealing with lab-related circumstances over which she had no control. There was one situation where the data she was collecting did not agree with the previous results obtained by her mentor. Because of this she had to re-test the animals the very same day. Fiona confessed, “This upset me a little bit because it made me look like I was doing something wrong or I was not following directions. I understood that it needed to be redone and that didn’t bother me too much; just the fact that I looked incompetent bothered me.” Needing to understand what had happened to skew the results caused Fiona to question her ability and performance in the laboratory. As it turned out the machine with which she was working had a faulty bulb and caused the errors in the results. Fiona states she learned that she should not be so hard on herself when mistakes occur, especially when the mistakes are not due to any fault of her own. While the discrepancy in the results were not directly caused by Fiona, she felt as though the entire situation made her “look bad” and that she was still responsible. However, she disclosed that because her mentor did not make her feel incompetent and did not blame her for the mishap, she now feels comfortable in attempting lab tasks on her own without the fear of something going extremely wrong. When asked what such an experience meant to her she replied, “This basically means that for my ‘bigger picture’ I should not be too hard on myself when I know that something is out of my control.” Fiona also found that when things do go wrong that she had it within herself to “stay focused” and to “tough it out.” In keeping with these strategies, she gained confidence while believing that these were key to the success of any scientist.

Fiona entered the program certain she wanted to be a physician, work with children, and make a difference in her family's native country of Nigeria. She shared that she viewed the URE as an opportunity to grow and to learn as it pertains to science and who she is as a scientist. She has spoken of passion and purpose and applying it to her career.

> The main thing I learned about myself this summer was that passion drives success. If I am not truly passionate about my work as a scientist, failure will continue to endure. Science is not the kind of profession people can go into just to make money. It has to "turn you on" like Dr. Neal says. I've learned that science does that for me and I could not see myself pursuing any other career. The most impactful aspect of being a part of the program this year was finding myself as a scientist. I have learned what my place is in the science world, what is out there for me to learn, what I could possibly accomplish. I have also learned that the road to success in a scientific related career will not be an easy one, but the scientific research community is vast and support will be there at all times. Scientists are passionate about the work they do, and that is why I know this is the field for me.

When speaking of the "communities" she recognized over the course of the summer, Fiona acknowledges the existence of a *science* community. The science community is one in which all aspects of doing science and being a scientist resides. During the URE, Fiona found that this community supported her learning and her growth as a scientist. She spoke of the support this community provided her where she felt

empowered to make mistakes and ask the necessary questions. She stated, “In my lab, I was made to feel like an actual scientist who was passionate about her work. I was not made to feel like hired help or just a student volunteering in the lab for some extra credit. I was involved in every aspect of the lab politics and had positive interactions with fellow lab members.” Fiona found this level of acceptance very encouraging and expressed that it fueled her desire for a career and a professional environment in which she could flourish. While Fiona felt certain the current and immediate science community was supportive of her professional development and could appreciate the quality of her work and determination to succeed, she also wondered if the level of support would change as she progressed on her career path.

One of Fiona’s larger challenges had to do with whether or not neuroscience research and working with live animals was really for her. Being a vegetarian, Fiona expressed that she preferred alternate routes of testing that did not “hurt” animals. While prior to this “hands-on” experience she had justified animal testing as a necessary means to save human lives, watching animal surgeries bothered her more than she had anticipated.

> This basically means for my ‘bigger picture’ I really have to decide on whether or not research is the best avenue for me or whether I just need to find other ways to research without putting animals through so much suffering. I guess it didn’t bother me as much when I didn’t see it being done in front of me. I guess that goes for pretty much anything in life though.

Fiona's summer research experience offered an opportunity to explore the field of neuroscience and to play an active role in a well-established research laboratory. While the URE was designed for this reason, participants also had the opportunity to determine if behavioral neuroscience or research were truly avenues for further exploration. Fiona believed that being a participant in the URE, being introduced to professionals in the field and learning about their career paths allowed for other career interests to surface. While she is not completely sure what path she will take, she knows that making a difference for the people of Africa is a must. She professes, "Before I was so sure I wanted to do pediatrics, then it was neuroscience, but at the moment I am strongly attracted to public health. If it will allow me to go to Nigeria or any other African country and directly help my people over there, I know that is the path I need to take." Fiona is open to exploring her interests and researching other career development opportunities so as not to "settle" or "limit" herself to a career that others encourage her to pursue or a career that she feels obligated to pursue. She states that being passionate about her work is too important to settle for less.

Fiona expressed considerable appreciation for being able to have her own research project after having spent the previous year working on those of others. While this experience met her research expectations, Fiona found that the experience had also opened her eyes to other science-related career opportunities. She commented, "being exposed to neuroscience in the program helped me to realize why I wanted to study medicine and science in the first place…I want to be able to give back to the people who gave something to me and made me who I am today." Fiona believed that she had "found" herself as a scientist. "Just being in the lab confirmed that for what I want to do

for my career… because I learned that I could play a more active role in science through research."

For Fiona, the trek to finding herself as scientist during the summer of 2006 also included an appreciation for other aspects of the URE. Each Thursday all of the interns would meet with the program staff and scheduled speakers for career-oriented presentations. Prior to the speaker's session, interns would have the opportunity to share their individual experiences.

> I did appreciate how we had to meet every Thursday, because that gave us the opportunity to meet with other students who were like me…you know like Black women…students my age who were going through the same experience, as opposed to me just being in the lab…people who knew a lot more science than I did…I felt that it made me more comfortable.

Fiona found this opportunity to share valuable as she regarded her presence in the science community as a "double whammy" – being both female and African American in a field that has traditionally been bereft of women and under-represented minorities. Having the opportunity to be apart of an URE specifically designed to support these populations, Fiona revealed her thoughts about it.

> What it means to me is that people understand…that there is a place for minorities and women in science, but that we are not being represented…and they realize we are not really being encouraged to participate… having a program that is designed to recruit us and gives us an opportunity to participate in science hands-on, in good programs, it lets us know we are wanted in the community…in the science community.

Fiona stated that *doing* research, being a part of the URE, and knowing why it and for whom it exists often feels like "positive reinforcement." She shared that it gives her "more drive" and not just for the love of science, but also for proving that she belongs, is capable, and that she deserves the same recognition as any of her counterparts.

At the time of the interview, Fiona was preparing for a December 2008 graduation. Her current career goal is to participate in *Teach for America* and later pursue a master's degree in Public Health.

Pam

Pam applied to the summer program as a 20-year-old junior, chemistry major. When contemplating her interest in science she stated, "For as long as I can remember, I have always loved science. It may be because my mother is a chemist, or because it is one of the courses I have always had to take throughout my school years. Either way, I am a true science geek." She began participating in science fairs as early as the 3rd grade and continued to be involved in science-based activities, both academic and competitive, through high school.

Pam's interest in a science-based career was sparked at the age of 16 when a close family member was diagnosed with Multiple Sclerosis. By seeing the effects of the disease first hand, she developed a desire to find a cure for such a devastating illness and others like it. Pam sought out the URE as a preliminary step to a career in Neuropathology, and a means to explore other biomedical science professions. Pam proclaimed, "A journey of a thousand miles begins with a single step – I am ready and able to begin my journey."

Her application to the URE was part of a 2-year plan she had devised in order to excel in a pre-medical curriculum. One of the first tenants of her two-year plan was to participate in a summer program that would fit her interests, enable her to gain research experience, and provide exposure to possible fields of study. For Pam, participation in the URE was the next step in a science-based academic path that began in the third grade with her first science fair.

Pam received her mentor and laboratory assignment and after meeting the lab team, she quickly acknowledged, "I was convinced that I was placed with the right mentor and that my summer research experience would be very relevant to my future career goals in research." With a positive outlook and a true desire to make the most of her summer research experience, Pam embraced the mission of the program (to increase the number of women and under-represented minorities in behavioral neuroscience) and the opportunity to make her family proud. She stated, "I now know that as the second generation of college graduates in my family, it is pertinent for me to succeed. I have to stay focused and be confident in myself and in the purpose of my life." Not only did Pam believe her participation was significant for her family and for herself, she also expressed a sense of obligation as both an African American and a female, "I feel that as an African American female student, it is my obligation to take advantage of opportunities given to me that will benefit not only me but the generation to follow." According to Pam, participating in the URE was not just about her career development, but also about proving herself.

Although Pam was admitted to the summer URE, she had experienced some apprehension about her competitiveness for such programs, as well as for medical school.

Prior to the program Pam wondered if her less than stellar grade point average (GPA) would be a hindrance and affect her ultimate goal of becoming a physician and researcher. However, her laboratory experiences led her to a new awareness about her ability to succeed. She asserted, "After this week of not only starting my project but helping to analyze data from the previous project in this laboratory, I feel like I can really survive in this field of research and that I will contribute significantly." Additionally, by the end of the program Pam believed that her performance could and would outweigh her grade point average that had been adversely affected early in her undergraduate career.

> Through completing this program I feel as if I can no longer use my GPA as a crutch to say why I was not chosen for this or why someone may think I am not qualified for that. Now I know for sure that I am qualified to be Neuroscientist. This program gave me confidence in myself that I can truly succeed and that my potential is endless no matter what.

As Pam's confidence increased so did her belief that she would always engage in learning activities, explore new questions, and that it was solely her choice as to what lengths she would carry these endeavors.

Pam regarded the URE environment as an opportunity to think about what would be her contribution to science. In exploring the possibilities over the summer and with the support of her mentor, Pam came to understand that the research process is one of trial and error, starts and stops, and that mistakes and criticisms will be made. She reflected,

> I learned through working in the perfectly matched laboratory of Dr. H, that is ok to change, start over, and most of all make mistakes, because without mistakes you cannot progress. Although I am aware that I am very

> lucky to have had such an excellent mentor that gave me ample opportunity to do hands-on experiments and ask as many questions as I like, I still feel that it is important to know that mistakes will be made and changes will occur, you just have to take note of them and continue on with your research/life.

Not only did Pam have the opportunity to explore possibilities regarding her scientific contribution, she also had the opportunity to visit the lab environments of her peers and her mentor's colleagues. While visiting another prestigious university in the city, Pam experienced a sense of feeling "out of place." She attributed that sense to being one of very few African American females present during the visit. She expressed, "it was kind of different to still see in this day and age people staring at you for whatever reason." Overall, Pam viewed the visit as yet another learning opportunity – an opportunity to learn more about herself as a scientist, how she fits into the science community, and how she would react to and manage "uncomfortable situations" with her professional colleagues.

> Although at times this week I felt a little 'out of place,' that did not discourage me from still asking questions, speaking up, and working efficiently in the laboratory. I think this week meant for me that even when you feel alone or out of place, never lose sight of your focus. This week caused me to think about how I will fit in the research world. Will I feel out of place and inferior to my fellow scientist? Or will I rise to the occasion and show the bright intelligent woman that I am and always will be? The choice is mine.

To support her mission to have the URE be as personally effective as possible, Pam made it her goal to "always make connections and network." It was important for her to learn as much as possible from those around her and to leave a positive impression through hard work and diligence. She expressed, "You never know the impression you leave with someone or what you might gain from a fellow scientist by just listening." Pam viewed the science community as an open door to her career future and wanted to be sure she was as prepared as possible to walk through it.

The URE was designed to expose participants to the discipline of behavioral neuroscience and careers in scientific research. Pam stated, "I entered the program open minded and eager to see and know what other options were out there for my future." Entering the program with the aspirations of becoming both a physician and a researcher, the URE has allowed Pam to explore the reality of doing such, to ask questions of those who have achieved such, and to contemplate the direction of her own career path.

During the final weeks of the URE Pam had begun to focus on her career options. She realized that her love for research was beginning to outweigh her desire to become a physician. "In participating in this program I now feel that my initial goal of getting a medical degree so that I can do research and still practice medicine has been altered by my new found love of only wanting to do research." In her Critical Incident Report of week 7, Pam shared that 10 weeks was not enough time to make a "life changing decision" as it pertained to her career goals, but that she was clear she was beginning to favor one option (research) over the other (medicine).

In Pam's experience paper written at the end of the program, she reiterated her goal to pursue a career in research and divulged a continued contemplation of the medical

degree. While her final plans remained undetermined, Pam concluded, “This summer has been a major milestone in the development of my career and of personal growth as an individual.

Pam views the URE as having constituted a major milestone in both her career development and personal growth. Opportunities for networking, investigating career options, talking with her faculty mentor about research, and learning the necessary skills to conduct research on her own provided Pam with a deep sense of “excitement” towards starting a career in science. She stated, “I enjoyed the program so much that this will be a challenge to vocalize my deepest gratitude for even having this opportunity…I will take away from this program a lot more than I cold have ever thought…it was a great opportunity and I’m happy I took it.”

While Pam felt an initial apprehension about her ability to compete academically, and possibly professionally, her lab experience afforded her the occasion to see how mistakes were made, managed, and rectified. Pam disclosed that seeing others, namely professionals in the field, make mistakes and still continue towards success was invaluable. She states, “Other people make mistakes…it shows me that you can make mistakes and you can still bounce back from those mistakes. I mean that is what research is.” This experience empowered Pam to move towards her goals and to not let her academic mistakes stop her from future accomplishments.

Whereas the URE proved valuable for Pam, the symposium and poster session was the culminating event that represented the hard work endured over the course of the 10-week program. Pam regarded this event as “an opportunity to show what we learned

and articulate our ideas about science and the topics we had explored" and welcomed the opportunity to "shine."

Pam exhibited a true desire to want to do well in the URE. She stated that a program designed with African American women in mind is a "blessing."

> So, the fact that there is a program that knows that there are intelligent African American women out there, and African Americans in general out there…then I think that that's a blessing because sometimes we get overlooked. And if we are overlooked we sometimes need someone to say we are here just for you because we know that you are out there…and we are here to show you that we know you are capable…more than capable.

Pam's reflection on the URE of 2006 also revealed a continued dedication to a career in science. Currently Pam is applying to both medical degree programs and MD/PhD programs. She hopes to be admitted for Fall 2009.

Penny

Penny came to the URE as a 19-year-old freshman majoring in biology. Her interest in science first became evident during high school after her very first biology class and the enjoyment she experienced by doing well in that class. She entered the URE with a desire to become a physician and assist in finding cures for AIDS and cancer. While her application implied an interest in pursuing both a medical degree and a doctoral degree, Penny stated that she has "always" wanted to practice medicine and really was not interested in any other career options. During a conversation with her academic advisor after arriving at college, she learned that strong medical applications

usually included research experience. Her advisor also encouraged her to keep her career options open while pursuing her plan to attend medical school.

In applying to the URE, Penny expressed, "it is important for me to utilize research opportunities to my best ability so that I can know if research is really for me." Even without previous research experience, Penny was open to exploring the challenge of research, working in a laboratory, and other career options.

Penny entered the URE having just completed her freshman year at a prestigious Historically Black College/University (HBCU) in the same city as the location of the URE. Not sure as to what she should do this first summer, but knowing that her career goal of becoming a physician may call for research experience, Penny was open to exploring an undergraduate research opportunity. She admits, "I was not really interested in research because I had already had my mind set on going to medical school and becoming a physician, but I knew that I needed research experience to make my medical school applications stand out." Penny hoped that the URE would prove to be fun, exciting, and worth the hard work it would surely entail.

Penny's mentor and laboratory assignment did not begin as she would have liked. As a new researcher, Penny was given – what she felt were – more administrative tasks. Penny immediately questioned whether the program, the discipline, and research were really for her.

> I was typing in collected data into a database. Eight hours at a computer, with a lunch break sitting at my desk, was not how I planned to spend my entire summer. This made me wonder why I was doing this program because I expected to be in a lab working with animals like everyone else.

> All I did all day long was sit at a computer, which made me rethink the idea of wanting a PhD. I was beginning to think that research was not for me, but I didn't want to give up.

To be sure her experience was as it should be and that the tasks put to her were not just "busy work," Penny began to ask questions of her faculty mentor, the lab team, and the URE's administrative staff in hopes of validating her presence in the program. She disclosed, "I just needed reassurance that I could handle the challenge of trying something new. I plan to work hard each and every day and absorb all the information about my research as I can." With a conscious commitment to keeping an open mind about what the program would provide by the end of the summer, Penny chose to view the URE as an opportunity to learn something new, about science and about her self.

Penny acknowledged that this URE was her first research experience and her first experience in a psychology lab. She stated a determination to work extra hard and to prove herself capable of performing the progressive tasks assigned to her. She admits, "There were many days when I wanted to quit and give up, but I am glad that I didn't." While her expectations to be in a laboratory with live animals and to be involved with hands-on experiments were not met when she first started the program; by the time she was able to focus on her own research project Penny felt more confident in taking what she had learned in the psychology lab and applying this knowledge to her own project. Penny attests, "This experience has taught me a lot about myself as a student, as an intern, and as a researcher…my experience in the lab has helped me to grow as a person. I've become more independent as I spent majority of my time working by myself, which made me have a sense of freedom." Penny's self-knowledge and confidence continued to

grow over the course of summer and she acknowledged, “I learned more than I thought I would this summer, and I am so happy that I chose to be apart of this program.”

Penny’s laboratory assignment allowed her to become better acquainted with both her mentor and the graduate students with whom she worked daily. The URE, as a whole, also provided Penny with opportunities to better know the other participants and to develop a sense of community.

> Being surrounded by other interns, graduate students, Ph.D.s, and so on, I felt like I was a part of a science community. I had never realized that we were part of a community until now, but I always knew that I shared a common interest of science with the other interns. My relationship with the other interns is more on a family level, and my relationship with everyone that I have met this summer is more on a science/colleague relationship.

Penny expressed a sense of support that came from her interactions in both the lab and a more social environment. These communities also helped Penny to realize that “strong support” is a driving force for her. She stated that such support “drives me to do my best.”

Although Penny found the URE to be quite challenging and periodically considered quitting, she voiced, “This program has not changed my mind about pursuing a career in the science field. In fact, this program has made me want to continue searching for the right research that I am interested in. As Penny continued with the program, she engaged both her mentor and lab team for their counsel regarding the research process, their personal career paths, and her possible career options. The URE

also provided information sessions where a variety of speakers (i.e., graduate students, post-doctoral participants, and admissions officers) discussed their career journeys and the process involved.

Notwithstanding the fact that the program was designed to increase interest in neuroscience and the numbers of women and under-represented minorities participating, Penny divulged, "I do not want to pursue a career in neuroscience, but I am glad that I found that out early on. I am not going to give up on research just in case I want to do research over becoming a physician or working in the health care field." What became more important to Penny over the course of the summer was the opportunity help and to be of service to those in need. She recognized that "in the end, I just want a science related career whether it is actually seeing patients or figuring out how to cure some disease. All I want to do is to help people, and as long as I do that, then I will be satisfied."

By the end of the program Penny's career plans included a continued exploration of career options, including graduate school *and* medical school. She had found that she did not have to limit herself to becoming a physician in order to help others – she had discovered a variety of science-related career options. She expressed that a guiding force in her continued exploration of these options would be the memory of her very first research experience during the summer of 2006.

Penny entered the URE without any research experience, but with a desire to learn something new and to make the most of the summer after her first year in college. She was also adamant about her long-term career goal of becoming a physician. By the close of the 10-week program, Penny had gained new skills in laboratory protocol, conducting

and presenting research, being a part of a research team, writing for publication, and public speaking. She also voiced a continued willingness to explore a variety of career options and possibilities.

Penny stated that the program activities on Thursdays were a source of encouragement and needed information. She commented, "The different science talks on Thursdays where different graduate students, post-docs, and admission officers spoke have encouraged me to continue in the science field and to continue exploring all of my options." Other aspects of the program, including time with her mentor, working in a mostly female lab environment, and preparing for and presenting her poster during the end-of-program symposium provided a level of support that has influenced Penny's now less-than certain career path.

> I thoroughly enjoyed my summer and am leaving with more than I expected. I am very thankful for all the opportunities that have opened up for me as a result of this program. Words cannot express how grateful I am to the program for helping me to realize that there are so many more opportunities besides going to medical school and that I do not have to limit myself to thinking that this is what I am going to do without trying other options.

Penny left the URE being more open to a career other than one in the practice of medicine only. What she had gained through the provision of information and exploration was the possibility of combining medicine with research. Regarding the overall URE she commented, "As a science major I thought I would probably go to medical school, but

after doing the summer program, I realized that if I wanted to go to medical school – I could do medical school, I could go to grad school, or I could do both."

Penny is one of two participants who came to the URE from a Historically Black College/University for women. She speaks of her constant exposure to progressive and successful women in science and education as empowering and encouraging. Even still, she expresses appreciation and gratitude for programs, such as this particular URE, that focus on the needs of women and sees her participation as simply doing her part in receiving and sharing the knowledge.

> It means a lot to me, because I am glad that there are programs out there that cater specifically to African American women and minorities because it will help…it does help increase numbers. It does make me actually want to apply to the research programs that actually foster my commitment to doing research or wanting to do research. So I think that the programs are important and actually help African American females and minorities become involved in research and actually increase the numbers of participation in science.

Penny's reflection on the URE uncovered short-term and long-term goals. At the time of the interview she was preparing for a May 2009 graduation and studying abroad in Spain. While Penny has changed her focus from neuroscience to human ecology, she hopes to pursue a master's degree in medical science or public health and attend medical school the year after completing the master's degree.

Themes

The results continue with a focus on the themes that emerged across the three phases of data collection, reflect the experiences of the four women who participated in this study and reveal the factors that influenced the participants' on-going career development. The stories of each of the four women who participated in this study were written to coincide with each phase of data collection and the themes that emerged from that phase.

Seven major themes gradually emerged from the analysis of the data. First, all participants came to the URE with a developed interest in science and a planned academic/career path. Second, each participant expressed a desire for research experience. Third, participants stated an interest in exploring career options in science. Fourth, each participant experienced a gradual increase in self-knowledge and confidence. Fifth, participants recognized their presence in a social and/or a science community. Sixth, the participants experienced a discovery or clarification of career interests and/or possibilities. Lastly, each participant recognized value in participating in the URE and expressed gratitude for having had the opportunity.

The presentation of the results is based on Dolbeare and Schuman's (Schuman, 1982) series of three interviews that "allows the interviewer and participant to plumb the experience and to place it in context" (Seidman, 2006, p. 17), as explained in the Data Collection section of the previous chapter. An overview of the data collected and the themes that emerged can be reviewed by referring to Table 1. More specifically, the data collected in phase one yielded the first three themes, and the remaining four themes emerged from the data collected in phase two. While various themes emerged from the

data collected at different junctures, themes that emerged from the first phase were also present and expanded in the second phase. All themes were present and expanded by the third, and primary, phase.

Table 1

Phases of Data Collection & Emergent Themes

Abbreviation	Theme	Phase 1: BEFORE *Source: Personal Statement & Autobiography*	Phase 2: DURING *Source: CIRS & Experience Paper*	Phase 3: AFTER *Source: In-Depth Interviews 2 yrs Later*
1 – ACDCAR	Academic/ Career Path	Entered program with an established interest in science and on a related academic/career path	Expanded interests and academic/career path possibilities	Gained an understanding of how to better direct interest and continue path
2 – RESEXP	Research Experience	Entered URE with an expressed desire for research experience	Participated in hands-on research experience	Gained hands-on experience that allowed for better career decision-making
3 – CAREXPL	Career Exploration	Entered URE with an interest in exploring career options in science	Explored other options for a career in science	Gained a willingness to consider combining research with the chosen career goal (i.e., medicine, public health, teaching)
4 – SLFKNWL	Self-Knowledge & Confidence	-----	Experienced a gradual increase in self-knowledge & confidence	Gained a significant increase in self-knowledge & confidence
5 – COMENV	Community/ Environment	-----	Recognized social and science communities	Gained a better understanding of both social and science communities
6 – CARCLR	Career Clarity	-----	Discovered/clarified career interests & possibilities	Gained more clarity as to career interests, possibilities and goals
7 – VALGRTD	Value & Gratitude	-----	Recognized value in participating in the URE and expressed gratitude for the opportunity	Gained an appreciation for programs designed with them in mind

Phase One: *Before* the Undergraduate Research Experience

An established interest in science was the first theme to emerge. Upon application to the Summer 2006 Undergraduate Research Experience (URE), each participant

expressed a sincere interest in science and science-related subjects that developed early in life. This theme was supported by comments from all of the participants. Each participant knew early on that she wanted to either practice medicine or be involved with science in some manner. They all either excelled in or "liked" their math or science courses in elementary and secondary school. Additionally, they each realized how becoming a physician could make a difference in their communities and for the people in their lives.

As a child, Corrine identified with neurosurgeon, Dr. Ben Carson and soon began her journey to understanding the human brain. Fiona also had opportunities as a youngster to identify with those in the medical field, via a community program designed to give minority students access to career information. Pam's mother was an influence on her interest in science. As a chemist, Pam recalled that her mother made so many things "interesting" by seeming fearless in the face of the unknown. Additionally, a family member was diagnosed with a neurological disease, which Pam recalls desperately wanting to understand. In high school, Penny experienced a simultaneous sense of achievement and enjoyment after doing well in her very first biology class. Each of these young women came to the URE having had positive opportunities and/or experiences with science.

The second and third themes to emerge had to do with a desire for research experience, either to strengthen medical school applications or to explore career options that may include a background in scientific research. All of the participants viewed the URE as an opportunity to gain valuable research experience in neuroscience. Participants also found the design of the URE (i.e., provision of career information, mentoring, and one-on-one conversations with others in various fields) valuable in exploring their career

options and other professional possibilities (i.e., the MD/PhD, careers in public health, teaching, research). Participants recognized that the URE provided an opportunity for them know if research was the proper career path.

The data collected during this first phase – *Before* the URE – and later analyzed, reflects the first three, of seven, major themes that emerged from the data as a whole. While these first 3 themes: 1) a previously developed interest in science and academic/career path, 2) a desire for research experience, and 3) an interest in exploring career options in science first appeared in Phase One, each continued to appear throughout the remaining phases.

Phase Two: *During* the Undergraduate Research Experience

With the onset of the 10-week summer URE, participants were assigned a faculty mentor and placed in the mentor's laboratory to work with an established lab team, assist with the current research project, develop a research project of their own, and prepare for the end-of-program research symposium and poster presentations. The first three themes (an established interest in science and an academic/career path, a desire for research experience, and an eagerness to explore related career options) were again identified, as well as reinforced and expanded, during Phase Two. Each participant included her interest in science and reasons for program participation in her initial critical incident reports and as a part of the introduction to her experience paper. Participants wrote of expanding their initial interests and career path possibilities, actual participation in the hands-on research experience, and the initial exploration of newly recognized career options.

Through the analysis of the weekly reports and the end-of-program experience paper, the remaining four themes emerged. The fourth theme to emerge was that participants reported a gradual increase in self-knowledge and confidence where each came to better trust her actions, her mistakes, her choices, and her ability to learn new techniques and ways of thinking. This theme also includes participants' recognition of a greater understanding of her likes and dislikes regarding scientific research and the daily work involved.

While Corrine's desire for a biology lab assignment was met with a psychology lab assignment and she was required to work with humans instead of animals, she progressed through the URE viewing it as an opportunity to "grow." Fiona found her laboratory responsibilities very challenging, which caused her to question her abilities. She progressed through the URE viewing it not only as an opportunity to grow and learn as it pertains to science; but also as an opportunity to discover who she is as a scientist. Pam entered the URE apprehensive about her ability to compete academically, and perhaps professionally. The URE, however, provided Pam with an experience that empowered her to move towards her goals and to not have early academic mistakes impede her future as a scientist. Initially, Penny simply viewed the URE as an opportunity to learn something new about science and about her self. What Penny gained was a sense independence and freedom while working in her assigned lab. She felt more confident in taking what she had learned in the classroom, and over the course of the summer, and applying it to her research project.

The fifth theme to emerge was that participants indicated a greater understanding of the existence of both a science and a social community. The science community

encompassed the realm in which the roles, expectations, and interactions of scientists and science exist. The social community included the supporting structure on which those who participate rely for encouragement and assistance. Participants acknowledged having experienced both types of communities during the URE. They found that both communities supported their learning and growth as scientists, and that both provided a "safe place" to make mistakes and ask questions. While each of the participants found support and encouragement in these communities, they also expressed the desire to appear just as smart as the other participants, and to keep their mistakes to a minimum. Participants also expressed a concern about whether the level of "support" and encouragement" would change as their careers progressed. They also expressed concern about how they would fit into the world of research and science culture as professionals.

With the sixth theme, participants experienced a discovery or clarification of career interests and/or possibilities. The URE provided the participants with an opportunity to explore the different facets of a career in neuroscience. Participants were able to identify likes and dislikes regarding the daily work they were involved in, ask questions, and explore other options. Corrine felt she had gained a better understanding of the research process and with that she felt more able to make informed decisions regarding her career path. Hands-on experiences afforded Fiona insight as to whether or not neuroscience and working with live animals was really for her. The URE became an opportunity for her to distinguish her goals, the populations she wanted to work with, and how best to focus her passion for health and science. Pam entered the program, like all of the participants, with the medical degree as her ultimate goal. Towards the end of URE Pam was certain she would pursue a research career, and perhaps the MD/PhD. What

became most clear to Penny over the course of the URE was her desire to be of service to others. She decided not to pursue a career in neuroscience, but would continue with research should she decide to go on to medical school or pursue a research degree. Penny realized that she did not have to limit herself and that there were a variety of science-related career options.

The seventh and final theme to emerge was that each woman expressed a sense of value and gratitude for having had the opportunity to participate in the URE. This theme also encompassed each participants experience from the point of view of an African American woman. Corrine initially viewed the URE as a valuable opportunity and a "definite asset" to her resume. By the close of the program, she voiced her gratitude for programs that supported Black people, because opportunities for people of color to achieve were not always equal. She also expressed thanks to God for allowing her the opportunity to participate and for "guiding" her along this career path towards her "purpose." Fiona was grateful for the URE and its purpose, as she viewed her presence, being both Black and female, in the science community as a "double whammy." She was also thankful that people understood that smart, talented women of color do exist and have been overlooked. She stated that a program such as the URE lets them know that they are wanted. Pam left the program with a deep sense of "excitement" about a career in science and a degree of gratitude she did not think she would be able to express. She viewed the URE, designed with African-American women in mind, as a "blessing" and recognition that African American women are being given opportunities to prepare and to succeed when they have otherwise been overlooked. Penny ended the URE with gratitude for having had the opportunity to discover her career options and to meet wonderful

people. Coming from a Historically Black College/University for Women where she is surrounded by progressive, successful women, Penny expressed appreciation for programs such as the URE that focus on the needs of women. She saw it as motivation to be involved, to do her part, and to make a difference.

The data collected during this second phase – *During* the URE – and later analyzed, reflect the emergence of the other four themes: 4) increase in self-knowledge and confidence, 5) recognition of both science and social communities, 6) a discovery or clarification of career interests and/or possibilities, and 7) recognition of value in and gratitude for the URE program. Each of these themes, as well as the first three themes which emerged in Phase One, were supported throughout Phase Two.

Phase Three: *After* the Undergraduate Research Experience

The final phase of data collection occurred two years after the close of the 2006 summer undergraduate research experience examined in this study. This span of time allowed for any short-term and/or long-term changes to the participants' educational/career goals and aspirations, as well as allowed for a comparison of perceptions regarding URE program influence over time.

An in-depth interview was conducted with each of the four participants. This interview was designed to allow for each participant to reflect on her experience in the URE and to discuss what the program meant for her individual career development. The seven major themes, uncovered in Phases One and Two, were again identified in Phase Three after analysis of each participant's in-depth interview and reflection on her 10-week research experience.

Data collected during Phase Three, *after* the program, mirrored the data collected during the first two phases – *before* and *during* the URE program. To a great extent participants reiterated statements they made during the first two phases. It seemed little had changed for the participants in regard to their career interests, goals, and aspirations. Each participant had maintained her interest in science, as well as being a science major. Participants also remained committed to their goals to pursue careers in science. Additionally, all participants maintained that the URE program had allowed for a chance to obtain valuable research experience, explore career options, and was beneficial as a professional and personal growth opportunity. However, each of the seven themes had indeed expanded to include significant gains by the participants. By the third and final phase, 2 years after the end of the program, the data reflected participants having gained: an understanding of how to better direct their academic/career interests and continue their career paths; the initially desired hands-on research experience allowing for better career decision-making, a willingness to consider combining research with the chosen career goal (i.e., medicine, public health, teaching); a significant increase in self-knowledge and confidence; a better understanding of both social and science communities; clarity regarding career interests, possibilities, and goals; and an appreciation for programs designed with them in mind.

Participants were empowered to act on the realization of other career options. As each participant came to the URE program aspiring to the medical profession, two of them reflected on having identified other career possibilities. Two years after the end of the program, Fiona and Penny were preparing to seek graduate degrees in public health. These participants also shared an interest in the possibility of teaching science abroad or

joining the *Teach for America* program before entering graduate school. At the time of the interview Corrine was waiting to hear the results of her medical school application. Pam had applied to a dual degree (MD/PhD) program and was also awaiting admission results.

Summary

After all phases of data collection were completed each data source was coded separately, analyzed, and studied to identify common categories and patterns. Seven major themes were identified:

1. Participants came to the URE with a developed interest in science and a planned academic/career path.
2. Participant expressed a desire for research experience.
3. Participants stated an interest in exploring career options in science.
4. Participant experienced a gradual increase in self-knowledge and confidence.
5. Participants recognized their presence in a social and/or a science community.
6. Participants experienced a discovery or clarification of career interests and/or possibilities.
7. Participant recognized value in participating in the URE and expressed gratitude for having had the opportunity.

The major themes were initially presented as a continuum encompassing the three phases of data collection and the subsequent emergent themes as referenced above. Now the focus is shifted from *when* the data were collected and the individual themes that subsequently emerged to full focus on all seven themes present and supported by the primary mode of data collection – the in-depth interview, which entailed participant

reflection on the entire experience. This opportunity to reflect allowed for the expression of what participants perceived they had gained from their involvement in URE program. Table 1 (p. 92) depicts the overall effects of the program on the participants and is evidenced by the course of the three data sets. The following chapter presents a final discussion of the research questions and findings. The chapter concludes with study limitations and implications for practice, research, and policy.

CHAPTER 5

> *Women and girls, at all stages of their educational and careers, are most likely to excel in the sciences when they have opportunities to participate in educational experiences that nurture, not discourage, interest in the sciences; to conduct research with real-world applications, including research connected to other disciplines and to important social, political, and health issues; and to network with other women, including mentors and role models.* (NSTA Reports, 2001, p.30)

Discussion and Conclusions

The purpose of this study was to explore the experiences of four African American women who participated in and completed a science-based undergraduate research experience (URE) program during the summer of 2006. The study examined *how* and in *what* ways the URE program influenced the participant's career development (namely academic/career interests and choices), what the participant learned about her interests and choices, and what it means to each of them to be an African American woman pursuing a career in a STEM discipline, and ultimately, *doing science*. The guiding research questions of this study included:

1. What factors are perceived to have contributed to the respondents seeking to participate in an URE?
2. What factors are perceived to have affected the respondents' educational/career persistence, and/or overall self-knowledge during the course of the 10-week program?

3. What factors are perceived to have contributed to the respondents' decision to continue her academic/career path after completing the program?
4. What factors are perceived to have contributed to what the respondents' come to know about themselves, their ability to "do" science, and their academic choices/career interests after completing a science-based URE?

The overarching goal was to understand the experience of African American female program participants – from their point of view and in their own words (Merriam, 2001) – in order to better inform effective program planning, policy, and career development avenues for undergraduate students who choose vocational paths on which they have been historically excluded. This chapter presents a final discussion of the research questions and findings, limitations of the study, and implications for practice, research and policy.

Research Question 1

Research question 1 focused on factors that contributed to why the respondents sought out participation in the URE program. The literature speaks to programs specifically designed to recruit and retain women and minorities in STEM disciplines. These programs are focused on providing educational and hands-on research experiences for women and underrepresented minorities, as well as encouraging their career development in these disciplines (Wiedenbeck & Scholtz, 1995). The data, as evidenced by the first 3 themes to emerge, indicated that the participants came to the URE with a developed interest in science and a planned academic/career path. Each respondent spoke of an interest in science recognized prior to entering college, as well as each having medical school aspirations. Participants had developed interests in science as early as the

third grade and as late as grade nine. Each participant had discovered a desire to practice medicine during this time frame as well. Reasons for pursuing the medical field ranged from family members with medical conditions and a desire to cure such maladies to meeting prominent physicians in their communities.

Participants also expressed a desire for research experience and wanted to participate in a "hands-on" opportunity where they would be able to develop and practice new skills. Respondents initially expressed goals to attend medical school and wanted to strengthen their medical school applications by participating in the URE program. However, each participant found herself open to exploring other career options in science and found the career information provided over the course of the summer very helpful as they considered other career possibilities. The URE program offered an opportunity to gain research experience, explore career options, and to discover, clarify, and/or confirm career goals and aspirations.

Research Question 2

Research question 2 assessed factors that affected the participants' educational/career persistence and/or the development of self-knowledge as it pertained to their educational/career pursuits. The data, as evidenced by the remaining themes, indicated that the respondents began to gain knowledge about themselves and their career paths, including their likes and dislikes regarding their career choices and possibilities.

Corrine's lab assignment called for her to observe infants and transcribe videos. She learned that she mainly disliked being in a lab that focused on humans instead of animals. However, she also learned the importance of the opportunity to gain unexpected research skills and interests, and the difference it would make in her career decision-

making. Fiona came to the URE program with the intent to pursue her independence as a researcher, what she also learned was the importance of passion for the work she would do and how significant it is to her to be accepted as a serious researcher and not just a "student in the lab." Pam's pursuit was part of a larger plan, a plan that would enable her to explore various fields of study. Pam realized how driven she was by her own expectations, those of her family, and the need to prove herself in regard to her past academic mistakes, her race, and her gender. Penny's academic advisor encouraged her to not only pursue research experience to strengthen her medical school applications, but also to keep her career options open. Penny made a conscious commitment to keeping her mind open about the program and what she could learn about science and about her self as researcher.

A review of the literature revealed the importance of the learning environment to women (see AAUW, 1995; Betz, 1989; Fear-Fenn & Kapostasy, 1992; Markert, 1996). One of the strategies noted by Fear-Fenn and Kapostasy (1992) to negate the barriers women face when pursuing STEM education and careers is to provide an encouraging and supportive learning environment. Additionally, Bonous-Hammarth (2000) found that nurturing female interest in the sciences and support from role models affects the long-term academic persistence of women in STEM.

In the current study, participants found the URE program to be a safe environment where they could ask questions, take risks, and make mistakes from which they, and their peers, could learn. Additionally, the URE program encouraged a connection with like-minded peers – peers who were also exploring career options in science, and learning new skills and techniques over the course of the summer. By spending time in their

assigned laboratories, with their mentors and lab partners, and via scheduled information sessions participants gained access to information about life in the laboratory, research and academic careers, graduate and professional degree programs, and other science-related career options. The URE program allowed for further clarification of science-related interests and goals, as well as an increase in self-knowledge and confidence in regard to ability and performance as a scientific researcher.

Research Question 3

The third research question focused on factors that contributed to the respondent's continuation of her academic/career path after completing the program. Schmidt, Smith, Vogt, and Schmidt (2003) assert that undergraduate women who participate in an intervention specifically designed for them when career options are being considered, experience significantly more successful outcomes. According to social cognitive career theory, career development is affected by environmental factors, such as the quality of such an experience and the support provided to pursue various career development options.

The research data of the current study, as evidenced by the themes that emerged from the data collected at the close of the program and after the program, participants found overall value in the hands-on research experience. Participants completed the URE program with increased confidence in current ability and future career possibilities, and they were better informed as to career options. Ironically, through the "tediousness" of her lab assignments, Corrine was able to discover an interest in a particular topic that resulted in her research project. She also shared that the URE program had given her the opportunity to "reflect" on her life and the people in it. Overall, she felt that the program

had enabled her to better understand what it was going to take for her to be successful in a research-based career. Fiona found herself needing to determine if research in neuroscience and working with live animals was the best career path for her to follow. For her, it became an issue of her own personal ethics – an issue she did not know existed prior to the URE program. Pam realized that despite her academic set backs she could survive in the "world of science" and contribute significantly to her chosen field. She also realized that continuous learning was important to her and that seeking answers to questions would always be a part of her professional pursuits. While Penny discerned that neuroscience was not the career path she wanted to follow, she realized that the URE program had inspired her to continue to search for the right discipline in which she could conduct research, as well as possibly practice medicine.

Participants found the provision of career information to be encouraging and very helpful as various career options became apparent. Again, participation in the URE program helped confirm and/or clarify the goals and aspirations of the respondents. Two years after the end of the URE program, participants had maintained their science-related majors and still planned to pursue advanced education and careers in a science-related field.

Research Question 4

The final research question assessed factors that contributed to what the respondents came to know about themselves as scientists, their ability to "do" science, and their academic choices and career interests after completing the URE program. Seymour, Hunter, Laursen, and Deantoni (2004) described the student identified benefits of participating in a URE program, where 91% of the statements were positive. Similar to

the benefits expressed by this study's URE program participants, benefits included the opportunity to think and work like a scientist, clarification of career goals and plans, and enhanced graduate/professional school preparation (Seymour, Hunter, Laursen, & Deantoni, 2004).

Participants were interviewed two years after program ended. This timeframe allowed for any short-term and/or long-term changes to participants' educational/career plans following the end of the URE program. Data collected *after* the close of the program paralleled the data collected *before* and *during* the URE program. While participants referenced the discovery of career options beyond medical school, as well as an increase in their confidence and ability in "doing" science, they also spoke of how their affinity for science was confirmed and how they "knew" they would continue on a science-based career path. Participants also acknowledged value in having participated in the 10-week summer URE.

Corrine found her participation as a time to grow and to mature, and with that she found that she had to do something she loved. Fiona also reflected on her time in the URE program of 2006 as a time to grow and to learn about her role in and contribution to science. She discovered that it was more important to her to have her career path lead towards helping people, and that for her, such a path probably did not mean a career in neuroscience, but public health. Pam learned that maintaining her focus would enable her to dispel feelings of being alone or out of place in the science community. She found that her time in the URE program caused her to think more seriously about how she would fit into the "research world," and being as prepared as possible. Penny completed the URE at the end of the summer with a "can do" attitude. Through her participation she realized

that there were many more career options available to her, including a combination of both research and medical degrees. Furthermore, Penny learned that practicing medicine was not the only way she could make an important difference in the world, but that making a difference in the world by simply "helping people" was just as important.

Lastly, participants gained an understanding of the integral role they play in their own career development – that they have a say in their career choices, the necessary preparation, and the option of exploring and pursuing other possibilities. What became clear was that the overall URE provided an important opportunity for the exploration and development of career interest in science, increased individual perception of ability and confidence, hands-on experience and provision of information in preparation for advanced studies, and further clarification of career goals.

Data in this study supported the premise that URE programs designed to attract train, and encourage the career development of students in STEM disciplines (Wiedenbeck & Scholtz, 1995) and those with a specific focus on providing effective educational and hands-on research experiences for women and minorities are beneficial. As noted by Bradburn (2001), such programs provide a practical view of the career path that participants *believe* they want to follow. Through their participation in the URE program, the respondents experienced the research process first-hand and worked in laboratories that offered support and encouragement. This researcher asserts that such experience allows for a more informed means of career decision-making. Benefits of participation in this URE program mirror those as identified in the literature, such as gains in various research skills, clarification of goals, preparation for graduate school,

and shifts in attitude to learning and working as a researcher (Seymour, Hunter, Laursen, & Deantoni, 2004).

According to the data collected for this study, aspects of the URE program that worked well include: the hands-on research experience, relationships with mentors and lab partners, the provision of a safe environment that encouraged rather than discouraged participation in the science community, and the symposium and poster session as an opportunity for practice and feedback. Overall, the data provided evidence that the URE program was critical in providing an avenue for career development for these young women. Each expressed an appreciation for the opportunity to actively engage in the scientific process, explore science-related careers, and acquire information regarding graduate and professional school possibilities. Additionally, the participants expressed an appreciation for a program designed with them in mind. According to these young African American women, such programming implies that their presence is expected, although not always welcome. Fiona stated that she often felt that her presence as a science major was a "double whammy" – being both female and African-American, while Pam saw her participation as an opportunity to *prove* that she belonged, was capable, and deserved the same acknowledgements as any one else. This study also revealed that the participants appreciated that someone understood the dilemma regarding the lack of access and equity, and was working on their behalf to provide a place for underrepresented minorities and women should they choose to participate.

Much of the literature focuses on the flight of girls and women from the STEM disciplines and reflects deficiencies, barriers and obstacles (Bonous-Hammarth, 2000; Seymour & Hewitt, 1997), as well as factors that influence persistence (Coyle, 2001;

Luzzo, Hasper, Albert, Bibby & Martinelli, 1999). However, there remains a paucity of literature that focuses on the career development experiences of African American women in STEM disciplines, which the current study sought to address. Unfortunately, one program cannot solve all of the issues related to the underrepresentation of African American women in STEM disciplines, nor can one program address all of the issues related to the career development needs of African American women.

Limitations of the Current Study

There are a number of limitations to the current study. The first has to do with sample size. The data was drawn from one URE program (the case) with one main focus (neuroscience) and four respondents (the subcases). While a small sample size is acceptable for a qualitative case study approach, generalizations from the results of this study should be made with prudence. Nonetheless, as focus on the career development experiences of African American women was desired, this aspect of the study was achieved.

Another limitation of the study was that participants were each interviewed by phone rather than face-to-face. Additionally, each interview was anticipated to span 60-90 minutes. However, each interview was completed in 45-60 minutes. The researcher speculates that perhaps face-to-face interviews may have provided more extensive responses, as well as additional non-verbal information. Fortunately, the impersonal nature of interviewing by phone was reduced by the already established relationships between the researcher and the participants, through the researcher's role as URE program director. The familiar rapport between researcher and participant is likely to have had an impact on participants' willingness to take part in the current study. Lastly,

as the program director of the URE in which respondents participated in 2006, the researcher's program role may have impacted the respondents' degree of candor during the interviews in 2008.

Implications for Practice, Research, and Policy

Despite its limitations, the current study makes a number of significant contributions to the women in science and career development literature. The researcher did not design the current study to build or test theory; however, the utilization of the theoretical framework, incorporating womanist thought and social cognitive career theory, allowed for the voices and career development experiences of the participants to be heard, encouraged, acknowledged, understood, and supported. The current study provides rich, thick descriptions of four African American women's experiences and perspectives regarding a program designed to recruit and retain underrepresented minorities and women in neuroscience. A voice is given to their perceptions of the factors contributing to their education/career interest, persistence, and self-knowledge as they relate to the URE program.

The results of this study emphasize the importance of and need to expand the undergraduate research experience as an official avenue for career development and exploration in order to address the lack of such programming for African American women in science. Expansion of the program design should include career counseling as a means to further assist participants in clarifying career goals and to better understand what is needed for career achievement and success. Using the URE as a means for career development would also call for employing long-range follow-up with participants.

Matyas (1992) contends that a longitudinal component is a characteristic of the more effective STEM interventions.

Additionally, findings indicate a need for the development of attributes, traits, coping mechanisms, and qualities that better enable women and minorities to survive, thrive, and succeed in the science community. According to the National Academy of Science (1994), there are five attributes or qualities that appear to be common among successful women in science: 1) expertise and competence, 2) the ability to establish and meet goals and to take risks, 3) strong communication skills, 4) self-confidence, and 5) openness to change. Incorporating a career development and counseling component to the URE program design should lead to the investigation and evaluation of the overall program as such.

The findings for this study also have implications for national policy and funding. As the *concept* of the locally supported undergraduate research experience (URE) is identical to the National Science Foundation's Research Experiences for Undergraduates (REU) Program, effective replication with significant outcomes is beneficial to the NSF and its constituents for planning and policy-making purposes. Also, those planning similar STEM interventions and those seeking to understand African American women's career decision-making processes, must also acknowledge the importance of the participant's perspective, designing programs with women in mind (Seymour, 1995), and how women gain the necessary attributes for success.

Lastly, it is important to address the role of the existing culture of science. As stated earlier, perhaps the problem has more to do with a culture that has historically been devoid of women. There still exists a traditionally male-dominated community that has

yet to fully embrace the differences and needs of the non-traditional participant. Further, there still exists a society that does not fully embrace or understand science-related career possibilities, the full-scope of the STEM disciplines, or *who* can "do" science. Developing learning environments, expanding educational and intervention-based programs, changing institutional and cultural attitudes, and even gaining the support and commitment of the media to forward a more positive and interesting message regarding science-based careers are all necessary to bridge this gap. Such effort will further open the doors of academic and career possibility and negate the interwoven existence of racism, sexism, and classism for all who wish to participate and fulfill their potential.

When children across the nation are asked what they want to be when they grow up, responses should easily include well-known, highly regarded, and popular professions such as scientist, technologist, engineer, and mathematician.

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APPENDIXES

APPENDIX A

Summary of Study Participants: Prior to Start of Summer URE Program, 2006

Name	Age	School	Major	Year	GPA	Grad School Intent?	Grad School Objective	Career Objective
Corrine	23	Predominantly White Institution SE, USA	Biology	JR/SR	3.3	Yes	MD PhD	Pediatric Neurosurgeon
Fiona	19	Predominantly White Institution SE, USA	Biology Pre-Med	FR/SO	3.47	Yes	MD PhD	Pediatrics
Pam	20	Historically Black College/University for Women SE, USA	Chemistry	JR/SR	2.81	Yes	MD Maybe PhD	Chronic neurological diseases
Penny	19	Historically Black College/University for Women SE, USA	Biology	FR/SO	3.92	Yes	MD	Health care industry; non-profit; cure for AIDS & cancer

Summary of Study Participants: At Time of Interview, 2008

Name	Age	School	Major	Date of Grad.	Current Occupation	Grad School Intent?	Grad School Objective	Career Objective
Corrine	25	Predominantly White Institution SE, USA	Biology	Dec 07	Lab Technician	Yes	MD	Neurosurgery
Fiona	21	Predominantly White Institution SE, USA	Biology Pre-Med	Dec 08	Student	Yes	Masters	Teach for America; Public Health
Pam	23	Historically Black College/University for Women SE, USA	Chemistry	May 07	Researcher	Yes	MD PhD	Research in Neuropatho-logy
Penny	21	Historically Black College/University for Women SE, USA	Biology	May 09	Student	Yes	Masters MD PhD	Medical Science or Public Health

APPENDIX B

BRAIN 2006
Critical Reflection Assignment
Due: Weekly
(6/15, 6/22, 6/29, 7/6, 7/13, 7/20, 7/27, 8/3)

The BRAIN internship opportunity is also considered a form of "experiential" learning. In an effort to better understand your experience as an intern and its impact on your learning and understanding of a career in science and/or research, we are asking that you complete a Critical Incident Report (CIR) on a weekly basis.

The CIR involves the following:

I. **What happened this week that caused you to stop and think about why you are here and/or your academic and/or professional pursuits/interests?**

II. **What did you feel or think about it?**

III. **What does this mean, if anything, for your "bigger picture"?**

CIRs are due every Thursday as a word document via email to Ms. Reid (elreid@emory.edu). At your request your CIRs will be returned to you on Monday, 8/7, to be used in the writing of your Experience Paper.

If you have any questions or concerns regarding this assignment, please do not hesitate to contact Ms. Reid.

APPENDIX C

BRAIN 2006
EXPERIENCE PAPER ASSIGNMENT

Due: Friday – August 11, 2006
on CD in the Education Office, DS 304

In order to get a comprehensive view of your time spent at the CBN as a BRAIN 2006 Intern, we are asking that you write an "experience" paper addressing specific questions that depict the impact of the BRAIN program in regards to enrichment, academic choice, and career trek.

We do ask that you be as candid as possible and incorporate your weekly critical reflections/CIRs. Your honesty will enable the further design and planning of BRAIN to be greatly enhanced. The data gleaned from your answers will also provide insight into the qualitative impact of such enrichment programs.

Please feel free to contact me should you have any questions or concerns in transferring your thoughts and experiences to paper!

elreid@emory.edu
404.727.0483

Please address the following questions as direct answers or as an essay. Please note that your responses must be in "narrative" form, not yes or no answers. We hope that you tell us your story, from your point of view, with all that is creatively you.

- Why neuroscience?

- Why the Center for Behavioral Neuroscience?
    - Did it have anything to do with Emory University or Atlanta, GA or the [phenomenal] research facilitated here or some other significant determinant? Or did you just need something to do

for the summer that would look good on your resume or graduate/professional school applications?

- Did you enter this program to find out if science or neuroscience were real areas of interest for you academically and/or career-wise?
    - If so, what did you find out?
    - If not, did anything surprise you or show up unexpectedly?

- What were your expectations of the program, your mentor, and/or research experience?
    - Where they met? Please explain.
- How has this program encouraged you to begin or continue your journey to a career in science?
    - Or…how has this program discouraged you from beginning or continuing your journey to a career in science?

- Has anyone, in particular, associated with this program encouraged/discouraged or supported/not supported you in a way that has made a difference in your academic or professional outlook?
    - If so, in what way?

- During your time with the CBN, whether on any of the various campuses, have you felt as though you were a part of a "science community"?
    - Why or why not?

- Were there times where you felt more a part of this community than others?
    - Please explain.

- Can you speak to any events during your time as a BRAIN Intern that you felt that your gender was an issue, made a difference, or was a hindrance?
    - Please explain.

- Can you speak to any events during your time as a BRAIN Intern that you felt that your race or nationality was an issue, made a difference, or was a hindrance?
    - Please explain.

- What did you learn about yourself as a student, as an Intern, as a researcher, and/or as a person this summer?

- What are your current and future academic and/or professional goals?

- Have these goals been affected in anyway by your experience with BRAIN 2006? If so, in what way?

- Please end your paper with your "take away" for your 10-week undergraduate research experience. In other words, what has been the most impactful (e.g., memorable, life-altering, mind-blowing, or simply beneficial) aspect of your time with the CBN, as a BRAIN Intern, or as one exploring and contributing to the field of neuroscience?

Thanks for your willingness to be a part of this *experience*!
elr

APPENDIX D

INTERVIEW GUIDE

1. How did you first become interested in science/science-related subjects?

2. When/how did you know that an academic/career path in science was what you wanted to follow?

3. What does it mean to you to be an African American woman pursuing an education and/or a career in science?

4. What prompted you to seek out an internship/research program for the summer?

5. What prompted you to seek out this particular program?

6. Tell me about your program experience.

7. Of the topics we just discussed, which aspect of the URE did you find most valuable?

8. In reflecting on your 10-week URE, describe any incidents (i.e., conversations, discussions, actions, interactions, readings, thoughts etc.) that **discouraged or had you question/rethink** your academic choices and/or career interests.

9. In reflecting on your 10-week URE, describe any incidents (i.e., conversations, discussions, actions, interactions, readings, thoughts etc.) that you feel **confirmed/reinforced/encouraged** your academic choices and/or career interests.

10. Overall, did you have concerns about being a part this program?

11. How well do you think you did in the program?

12. Upon completion of the URE did you continue with the same academic/career path as you'd chosen or considered prior to participating in the URE?

13. In what ways did the URE influence this direction?

14. What are your plans for after graduation?

15. As an African American woman who has completed a science-based URE, what knowledge have you gained about yourself, your ability to "do" science, and/or your choices regarding your academic and career journey?

16. What do you believe has contributed to this "knowledge"?

17. As an African American woman in science, what are your thoughts on what you "bring" that your counterparts may not?

18. As an African American woman in science, have you ever felt like you were on the "outside" looking "in"? If so, Please tell me more about this. What's this feeling like for you?

19. The program was "designed" to recruit and retain – increase the numbers of – women and underrepresented minorities in (behavioral) neuroscience. What does this statement mean to you, if anything?

APPENDIX E

Georgia State University
Department of Educational Psychology and Special Education
Informed Consent

Title: Exploring the Experiences of African American Women in an Undergraduate Summer Research Program Designed to Address the Underrepresentation of Women and Minorities in Neuroscience: A Qualitative Analysis

Principal Investigator: Dennis N. Thompson, Ph.D.
Student Principal Investigator: Ericka L. Reid, M.Ed.

I. Purpose:

You are invited to participate in a research study. The purpose of the study is to investigate the experiences of African American women who completed a neuroscience undergraduate research experience (URE) during the summer of 2006. You are being asked to volunteer to participate in this study because you are an African American female who has expressed an interest in science a career in science. Additionally, you applied to, were selected for, and successfully completed a neuroscience-based URE in 2006. A total of 5 participants will be recruited for this study. Participation will require no more than 5 hours of your time over a 4-5 week span of time during the Fall of 2008.

II. Procedures:

If you agree to participate in this study, you will be asked to participate in 1-2 interviews about your experience in the undergraduate research experience you participated in during the summer of 2006. Interviews will take place at a time or place of your convenience, will last approximately 60-90 minutes, and will be recorded on audiotape. If you live outside of the Atlanta area, arrangements will be made to conduct a phone interview. In addition to this initial interview, you may be contacted for a follow-up interview or for additional information.

III. Risks:

In this study, you will not have any more risks than you would experience in a normal day of life.

IV. Benefits:

There will be no direct benefits or compensation to you as an individual for participation in this study. However, your participation will help researchers, policy makers, and educators better understand how to effectively improve the numbers of women of color in science, technology, engineering, and mathematics.

V. Voluntary Participation and Withdrawal:

Participation in research is voluntary. You do not have to be in this study. If you decide to be in the study and change your mind, you have the right to drop out at any time. You may skip questions or stop participating at any time. Whatever you decide, you will not lose any benefits to which you are otherwise entitled.

VI. Confidentiality:

The information I gather will be used solely for the purposes of this study and will be kept completely confidential to the extent allowed by law. All data gathered will be coded in such a way that neither real names nor any revealing characteristics of individuals will be used. I will use a complex compilation of numbers and letters rather than your name on study records. Furthermore, your name and other facts that might point to you will not appear when this study is presented or results published. All audiotapes that are made during the interview(s) will be for my use only. You, as the participant, have a right to review the tapes if you like and make any clarifications you feel are necessary. All written documents produced from this data will employ pseudonyms to protect both the confidentiality of the individual participants as well as the confidentiality of any institutions and communities. All data will be kept in a secure location accessible only by the principal investigators.

VII. Contact Persons:

Please call Dr. Dennis Thompson at 404.413.8319 (dthompson@gsu.edu) or Ericka Reid at 404.394.2309 (ericka_reid@hotmail.com) if you have any questions about this study. If you have any questions about your rights as a participant in this research study, you may contact Susan Vogtner in the Office of Research Integrity at 404.413.3513 (svogtner1@gsu.edu).

VIII. Copy of Consent Form to Subject:

You will receive a copy of this consent form to keep.
If you are willing to volunteer for this research and be audio recorded, please sign below.

_____ _____
Participant Date

_____ _____
Principal Investigator or Researcher Obtaining Consent Date