Our Counter-Life Herstories: The Experiences of African American Women Faculty in U.S. Computing Education

by

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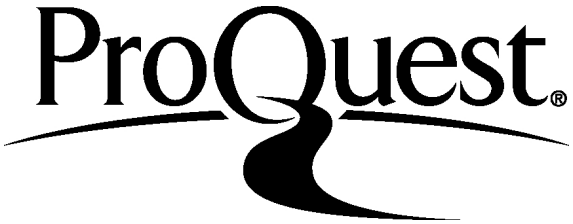

DEDICATION

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ABSTRACT

The purpose of this life history qualitative study was to explore the Counter-Life Herstories of African American women faculty in U.S. Computing Education. Counter-Life Herstories are derived from Counterstories, life histories, and herstories as powerful social justice tools to uncover hidden truths about marginalized groups' experiences. Through the collection of timelines, counter-life story interviews, and reflective journal writings, I co-constructed and interpreted the Counter-Life Herstories of five participants using an integrative conceptual framework that included critical race theory and Black feminist thought as interpretive frameworks, and Afrocentric feminist epistemology to govern my knowledge validation process. As an emerging African American woman scholar, with a Bachelor's degree in Computer Science, I have a "unique angle of vision" to situate African American women's distinctive educational experiences in the social-political context of U.S. Computing Education. In this study, I build upon limited knowledge about African American women's experiences throughout U.S. Computing Education. My discoveries indicated unequivocally that my participants' persistence in U.S. Computing Education was not solely based on their early positive reinforcements or strong academic preparation, but their resilience and ability to bounce back from insurmountable barriers, such as negative stereotypes and biases. This inquiry directly supports the U.S.' national interest to diversify the Computing workforce, while revealing hidden truths about African American women's experiences in U.S. Computing Education.

CHAPTER ONE: INTRODUCTION

My Counter-Life Herstory

From the age of twelve, my life experiences gradually quieted my voice until it became silenced. As an African American girl growing up in the South, I learned to embrace passivity as honorable (e.g., ladies are seen and not heard and never question authority). I believe other African American women may share similar experiences. As I reflect on the journeys of African American women scholars, such as Patricia Hill Collins and Cynthia B. Dillard, who embrace an Afrocentric or endarkened feminist epistemology, my dissertation journey is the first step in regaining my voice. I have often been the "first" or "one of the few" African Americans or African American women in various educational and workplace settings (Collins, 2009, p. xii). Over time, I accepted this positioning as normal, although I sensed my presence dissettled others. As I encountered daily microaggressions and assaults on my personhood, I became increasingly aware of my status as an African American woman in the United States (U.S.). Rather than confronting these challenges directly, I chose to internalize my feelings of disillusionment and remain silent. In light of recent events in the U.S. which have awakened my past racialized experiences, I believe now is the appointed time to regain my voice (Collins, 2009).

My childhood memories. Due to my limited memory, my childhood memories related to U.S. Computing Education primarily consisted of my high school experiences in a large urban school district located in central Florida (Appendix E).

High school experiences. In 1994, I graduated from a U.S. comprehensive high school (Freedom High) as a recipient of the African American Achiever and Florida Gold Seal

Vocational Scholar (Florida Postsecondary, Education Planning Commission [FPEPC], 1996) awards. I also received college acceptance letters from three historically Black colleges and universities (HBCUs) and one predominately white institution (PWI) to pursue a Bachelor's degree in Computer Engineering. I wanted to follow my love of working with computers, although my high school guidance counselor told me, "*You are not college material."*

Participation in Career and Technical Education. In 1965, Freedom High existed as the first comprehensive school in the County to offer both four-year vocational education and college preparatory academic programs. For four years, I participated in Freedom High's business technology vocational education (i.e., Career and Technical Education) program. Based on my academic performance in business technology (i.e., greater than a 3.5-grade point average [GPA]), I became eligible for the Florida Gold Seal Vocational Scholar award. As a designated program, the Florida Gold Seal award enhanced the participation of minority and disadvantaged students in postsecondary education (FPEPC, 1996). As part of the business technology program, I participated in school-to-work activities, which integrated academic (mathematics, science) and vocational (keyboarding, desktop publishing) coursework (School-To-Work Opportunities Act, 1994).

As a participant in this program, I gained hands-on work experience with a local employer. In my assignment, I became a Proof Encoder at Nations Bank. I was excited to work in a professional setting and apply my newfound keyboarding skills. In this job, I left school early, worked up to 20 hours per week, made more money than my fast food job, and had a personal bank account. Upon graduation, I received a high school diploma along with a business technology skills certification. My experiences in the business technology program sparked my interest in computers and changed the trajectory of my academic performance. After a short time

in the business technology program, I discovered my technology savviness, although I had slightly less than a 3.0 GPA at the end of my sophomore year.

Parental and spiritual support. Since my parents supported my academic success, my dad forced me to study every day after school in the public library until I achieved, at least, a 3.0 GPA during my junior year. He also reminded me that since I was African American, my only option was to excel academically because no one was going to give me anything, especially white people. As a first-generation college student, my parents instilled in me the importance of a college degree because I served as an example for my two younger sisters. My mom's enduring hope has been to live long enough to see her daughters get from under the foot of a man [obtain a college degree and a good job]. Her paternal grandmother [my paternal great grandmother] hoped the same for my mom. From an early age, my mom and paternal great-grandmother instilled in me a strong Christian faith, which empowered my personal, educational and professional pursuits. Whenever I faced barriers (e..g lack of support from my guidance counselor), I prayed and meditated on Bible verses such as "I can do all things through Christ who strengthens me" (*Philippians* 4:13, The King James Version). My faith was the source of my empowerment as I pursued a postsecondary Computing degree, despite the odds against me.

Transition into postsecondary Computing Education. Although I recognized the earning potential of working with computers [or technology] as a Proof Encoder, I knew a postsecondary Computing degree would afford me a better quality of life. Since the pathway to a career in Computing was unclear, I believed I needed to obtain a Computer Engineering degree. Upon being accepted to four southeastern universities (3-HBCUs and 1-PWI), I chose to enroll in the PWI because of the support system they offered. They invited me to participate in a Summer Bridge Minority Engineering Program prior to starting classes in the fall of 1994.

I found the Minority Engineering Program attractive because it would prepare me for my first semester courses of Pre-Calculus and Chemistry (i.e., prerequisites for Calculus and Physics) since I had only completed Algebra 2 and Chemistry in high school. The Minority Engineering Program served as a support system throughout my years of study. Since I was underprepared in mathematics and science in high school, my pursuit of a Bachelor's degree in Computer Engineering was daunting. However, I firmly believed my quest for this degree was for a greater purpose than me. As I stated in my church's recognition program for high school graduates: "[My goal was] to pursue a degree in Computer Engineering starting June 21, 1994. Upon graduation, I plan to attend Georgia Tech for graduate study, which will enable me to contribute to molding future technology and enhance the advancement of Black Engineers." Since then, my educational and professional experiences in Computing have further shaped my passion for broadening the participation of African Americans in Computing.

My adult memories. My adult memories associated with U.S. Computing Education reflect my experiences in an undergraduate Computer Science and Engineering program at a predominately white institution located in central Florida. Upon completion a Bachelor of Science in Computer Science, I worked in the Computing workforce for 13 years (Appendix E).

Undergraduate Computing Education experiences. Over time, my experiences in the undergraduate Computer Engineering program became challenging because I was underprepared in mathematics and science. Although I began my studies with a strong support system, my GPA decreased after being immersed in the Computer Engineering major coursework. During my first two years of college, I took classes with the same cohort of students from the Minority Engineering Program. We lived on campus, studied together, and had peer mentors/tutors to help us succeed academically. Yet, we still encountered social and institutional barriers, such as

feelings of inadequacy, a sense of not belonging, working with faculty with unintelligible accents (i.e., hard to understand), and high student to teacher ratios in classes as we engaged in our prerequisite mathematics and science coursework. However, my faith and support system helped me overcome these obstacles.

High point. During my undergraduate studies, I was a member of the National Society of Black Engineers (NSBE), which was one of the largest student-run organizations (10,000+ members) in the nation. In 1995, I attended my first NSBE conference as a Torchbearer because I had a 3.5 GPA. As a Torchbearer, I sent my resume out to be considered by potential employers for a summer internship. After only one semester in college, I was selected to intern in an information management leadership program at a Fortune 50 company (Fortune, 2015). This opportunity provided me with practical, hands-on experience, which catapulted my future income potential and employment opportunities in Computing. I worked with this employer for two additional summers, and I had two other significant internship/cooperative experiences with local companies.

Low point and challenges. Upon entering my third year, I completed the prerequisite mathematics and science requirements and began to take Computer Engineering-related coursework. I quickly discovered Computer Engineering was more closely related to Electrical Engineering and far different from the business technology discipline I had experienced in high school. At this point, my cohort had diverged into other engineering majors, and there were a select few Minority Engineering Program students in the Computer Engineering major. I experienced isolation from my other classmates because of gender and racial barriers. For instance, most of the students in my department were either white or Asian males. There were only a few women in Computer Engineering, including one other African American woman I

knew of, but she did not live on campus. Due to cultural differences, I also perceived I was distant from my professors because they were all Asian and white men. They also did not make me feel welcome. This, I believe, was a contributing factor to my lower academic performance.

Turning point. After a year of taking courses, I discovered I performed much better in the Computer Science courses that were a part of my Computer Engineering program. Therefore, I changed my major to Computer Science in order to raise my major GPA prior to graduation. Although my graduation was prolonged, I was elated to have the opportunity to work with computers. On May 5, 2000, I was one of five Black women (I'm not sure how many were U.S. native-born) at my university, and I was one of 1,670 students in the United States to graduate with a Bachelor's of Science in Computer Science. Despite my less than perfect GPA, I passed a computer programming aptitude test and received a job offer to work as a Technical Trainer and Consultant with one of the top three accounting and management consulting firms in the world. In retrospect, this job opportunity, my internships, and college acceptances were likely the result of affirmative action policies or other programs for disadvantaged minorities. Whatever the case, I believe I was afforded these opportunities for a greater purpose.

My Motivation to Conduct this Study

Today, I am a Ph.D. Candidate in Career and Workforce Education with 13 years of Computing experience as a technical trainer, consultant, and global program manager. Although I made a career change in 2013, my passion for broadening the participation of African Americans in Computing is the impetus for this study. As an African American woman, I understand from experience the barriers to entry and persistence in Computing Education.

In light of my accomplishments, I have wondered several questions, such as "Why my high school guidance counselor told me I was not college material? Was it because I am an

African American woman? Or was it because I was enrolled in a vocational education program since historically vocational education has been a 'dumping ground' for low-income and minority students to pursue low-skilled jobs (Schwartz, 2014) while academic programs have focused on college preparation (Gordon, 2014; Levesque, Lauen, Teitelbaum, Alt, & Librera, 2000)?" Yet, the enactment of the Carl D. Perkins Act of 1990 shifted vocational education's focus to preparing students for entry-level jobs and postsecondary education and thus became more unified with academic education (Fletcher, Lasonen, & Hernandez, 2014; Silverberg, Warner, Fong, & Goodwin, 2004; Stone, 2014).

Since distinct pathways into Computing are unclear (Margolis, 2008; Margolis et al., 2003; Margolis, Goode, & Bernier, 2011), I remain amazed how I landed on a pathway into Computing. Based on my experiences, I wondered: "What are the experiences of other African American women who have entered into and persisted in postsecondary Computing programs, in particular at the graduate level? How did they develop an initial interest in Computing? What pathways did they follow, or construct into postsecondary Computing Education? What barriers or supports did they encounter in Computing Education? From their perspective, what improvements are needed to broaden the participation of African American women in Computing?" I believe the answers to these questions will enable educators and policymakers to develop strategies to expand the involvement of African American women in Computing.

Background of the Problem

State of the U.S. Computing workforce. The United States (U.S.) faces a critical shortage of qualified workers in the science, technology, engineering, and mathematics (STEM) workforce. By 2020, researchers predict one in every two STEM jobs (51%) will be in Computing (Association for Computing Machinery [ACM], 2014; Bureau of Labor Statistics

[BLS], 2010). Consequently, they foresee approximately 100,000 college graduates with Bachelor's degrees in Computing disciplines (e.g., Computer Science, Computer Engineering, and Information Technology) will be needed to fill more than 150,000 annual job openings (e.g., computer and Information Systems managers, software developers, and database administrators) with an average annual salary of $78,730 (BLS, 2010, 2014). Based on these factors, Computing is considered one of the fastest growing occupational groups in the U.S. (ACM, 2014; BLS, 2010), which places a demand on U.S. postsecondary Computing Education to produce enough qualified workers to enter the U.S. Computing workforce (ACM, 2014; BLS, 2010, 2014; Stephenson, Gal-Ezer, Haberman, & Verno, 2005; Varma & Hahn, 2007). In 2010, only two percent of all ACT-tested high school graduates (n=1.569 million) indicated an interest in Computer Sciences on the ACT college and career readiness survey (American College Testing, 2010), which presents an area of national need. However, policymakers and researchers believe the Computing workforce shortage would dissipate if more women and minorities were attracted to postsecondary Computing Education programs, since ethnic minorities will represent the majority population by 2042 (Bordonaro et al., 2000; Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline, 2011; National Science Foundation [NSF], 2015; Varma & Hahn, 2008; Vincent & Velkoff, 2010).

Participation of women and minorities in U.S. Computing Education. Since the 1990's, policymakers and researchers have noted the underrepresentation of women and minorities (i.e., leaky or shrinking pipeline) in U.S. Computing Education, since they fail to enter or persist at all degree levels (NSF, 2011, 2015; Singh, Allen, Scheckler & Darlington, 2007; Varma, 2009). Historically, women and minorities have lacked access to computers and technology, which has deterred their entry into Computing disciplines (Varma, 2009).

Furthermore, their lack of adequate academic preparation and undefined pathways into Computing have resulted in their low enrollments, and low degree attainments (Margolis, 2008; Margolis et al., 2003; Margolis, Goode, & Bernier, 2011). Since women currently outnumber men in U.S. postsecondary education, but men (84.7%) significantly outnumber women (15.3%) in undergraduate Computer Science programs (Zweben & Bizot, 2014), women of color are a viable group to focus our attention.

Enrollment and degree attainment of women of color in U.S. Computing Education. As indicated by enrollment and degree attainment trends, women of color have trailed behind white women at all postsecondary degree levels in U.S. Computing Education.

Enrollment trends. In 2012, white women (41%) were enrolled at considerably higher rates than Asian/Pacific Islander women (28%), Hispanic women (8%), Black women (7%), Multiracial women (4%), and American Indian/Alaska Native women (1%) in undergraduate Computer Science programs (Zweben & Bizot, 2014). Though white women (12%) and Black women (12%) achieved equivalent enrollment numbers at the Master's level, white women (23%) surpassed all women of color (12%) at the Ph.D. degree level.

Degree attainment trends. In 2012, white women (48%) received almost half of all U.S. Bachelor's degrees in Computer Science in comparison to women of color (NSF, 2015). As the degree level increased, white women continued to surpass women of color in postsecondary U.S. Computing Education. For example, white women (41%) attained the majority of Master's degrees in Computer Science followed by Black women (19%), Asian/Pacific Islander women (17%), unknown/multi-race women (16%), Hispanic women (7%), and American Indian/Alaska Native women (0.6%). Furthermore, white women (54%) attained significantly more Ph.D. degrees in Computer Science than Asian/Pacific Islander women (23%), Black women (10%),

unknown/multi-race women (9%), Hispanic women (3.7%) and American Indian/Alaska Native women (0.6%).

Based on these trends, the U.S. Computing Education pipeline (e.g., primary, secondary, postsecondary) retains even fewer women of color as the degree level increases, which warrants further study. To narrow my focus, I targeted African American women for this study.

Statement of the Problem

As indicated by enrollment and degree attainment trends, African American women in U.S. Computing Education are considerably underrepresented in U.S. Computing Education programs at all degree levels, especially in comparison to white women. Despite their increased enrollments (14%) in U.S. postsecondary education institutions from 1994-2012 (Lopez & Gonzalez-Barrera, 2014), African American women have experienced diminishing returns in degree attainment along the U.S. Computing Education trajectory (NSF, 2015). In 2012, Black women (i.e., includes African American women) attained 18% (n=1,460) of U.S. Bachelor's degrees, 19% (n=580) of U.S. Master's degrees and 10% (n=16) of U.S. Ph.D. degrees awarded to women in Computer Science, which warrants an exploration of their experiences in U.S. Computing Education to broaden their participation.

African American women are underrepresented in the U.S. Computing workforce because they fail to persist all levels of U.S. Computing Education (NSF, 2015; Ong, 2015; Ong, Wright, Espinosa, & Orfield, 2011; Zweben & Bizot, 2014). Often African American girls do not enter postsecondary Computing Education because they are discouraged from participating in pre-college programs, rigorous mathematics, and science courses, and they face significant barriers in these programs (Smith-Evans & George, 2014). Though their college enrollments have increased by 14% since 1994 (Lopez & Gonzalez-Barrera, 2014), they likely will not

choose STEM or Computing degrees (George-Jackson & Lichtenberger, 2012; NSF, 2015). In addition, African American women professors are drastically underrepresented in postsecondary U.S. Computing Education programs (NSF, 2015). Though researchers have identified gender and racial barriers (e. g. double bind), which contribute to their double oppression (Ong, Wright, Espinosa, & Orfield, 2011), further research is needed on their experiences at all levels of U.S. Computing Education.

African American women's voices about their experiences and pathways throughout the U.S. Computing Education pipeline (e.g., primary, secondary, postsecondary) are essentially silent in comparison white women. In U.S. Computing Education, white women's experiences represent the master narrative (i.e., majoritarian perspective), because they outnumber women of color. Other researchers give voice to African American women's experiences in U.S. STEM education at various levels (Borum & Walker, 2012; Bush, 2013; Jackson, 2013), but fewer studies have done so in U.S. Computing Education (Charleston, Adserias, Lang & Jackson, 2014). Charleston, Adserias, Lang and Jackson (2014) explored the role of race and gender in African American women's experiences at various degree levels (e.g., Bachelor's, Master's, and Ph.D.) rather than giving voice to their continuous experiences in the U.S. Computing Education pipeline. They also recommended future studies should highlight African American women's successes, rather than focus on barriers to entry and persistence. Since existing studies have not given voice to African American women's experiences throughout the U.S. Computing Education pipeline, in particular at the graduate level, their voices are silenced and little is known about their unique educational experiences and career trajectories.

Jackson (2013) pinpointed the critical need to magnify African American women's voices to operationalize their experiences in U.S. STEM education. We have a similar need in

U.S. Computing Education to aid policymakers, administrators, and educators at all levels in broadening their participation. Since the U.S. has a national interest to diversify the STEM and Computing workforces, I have an opportunity to "strike while the iron is hot" (Baber, 2015; Palmer & Wood, 2013, p. xiii) and give voice to the Counter-Life Herstories of African American women faculty in Computing Education to counter the master narrative about their experiences in Computing.

Purpose of this Study

The purpose of this life history qualitative study was to explore the Counter-Life Herstories of African American women faculty in U.S. Computing Education (e.g., Information Systems, Computer Science, and Computer Engineering). Because Counterstories give voice to marginalized people groups to counter the master narrative (i.e., majoritarian perspective) about their experiences (Closson, 2010; Bernal & Villalpando, 2002), life histories are individuals' retrospective accounts about their life stories (Watson & Watson-Franke, 1985), and herstories represent "the rewriting or respeaking of history" from a woman's perspective (Mills, 1992), Counter-Life Herstories offer a powerful approach for African American women, and other people of color, to break the silence (i.e., reveal hidden truths) of racism and racial discrimination. As an emerging African American woman scholar, with a Bachelor's degree in Computer Science, I have a "unique angle of vision" (Collins, 2009, p. 39), and I follow a social justice agenda, to situate African American women's unique educational experiences in the social-political context of U.S. Computing Education, from an Afrocentric feminist epistemological perspective (Collins, 2009). Although research questions are not essential in life history research, I constructed the following exploratory questions to guide my study.

Exploratory Questions

1. How do African American women faculty in U.S. Computing Education describe their educational experiences (i.e., elementary school, middle school, high school, Master's, Ph.D.)?
2. How do African American women faculty in U.S. Computing Education describe the experiences that impacted their persistence (e.g., high points, low points, turning points, challenges) to achieve a postsecondary degree in U.S. Computing Education?
3. What improvements do African American women with faculty in a Computing discipline suggest to broaden the participation of African American women in U.S. Computing Education?

Integrative Conceptual Framework

I employed an integrative conceptual framework (King, 2013), which integrates an overarching Afrocentric Feminist Epistemology, and the interpretive frameworks of critical race theory (Bell, 1980, 1993; Crenshaw, 2011; Delgado & Stefancic, 2012; Ladson-Billings & Tate, 1995) and Black feminist thought (Collins, 1990), to explore African American women's unique educational experiences (i.e., Counter-Life Herstories) throughout the U.S. Computing Education pipeline (Figure 1).

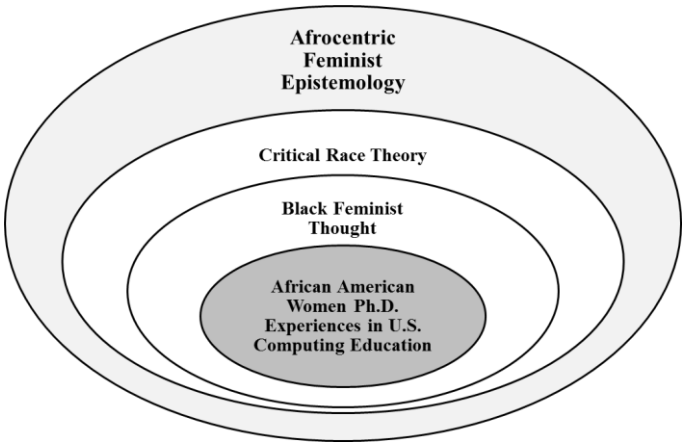

Figure 1. High-Level Integrative Conceptual Framework

Afrocentric feminist epistemology. Epistemology establishes an overarching theoretical framework to evaluate the standards we use in knowledge validation processes (Harding, 1987), and it exposes power relationships, which determine whose voices are believed and heard (Collins, 2009). Historically, knowledge validation processes in the U.S. have been dominated by *Eurocentric masculinist (EM) epistemologies*, transcending time, and space, which represent the white male standpoint and overshadow the Black female standpoint (Collins, 2003). As an African American woman emerging scholar, I have a unique position to follow an AFE (Collins, 2003, 2009), which utilizes CRT and BFT as interpretive frameworks to appropriately examine African American women's experiences in U.S. Computing Education (Collins, 2003; Howard-Hamilton, 2003). Furthermore, AFE serves as a type of transformative paradigm (Mertens, 2010a) or worldview (Creswell, 2014) because it directly engages participants of marginalized persons and follows a social justice agenda (Mertens, 2010b). As such, I governed my knowledge validation process through a) concrete experience as a criterion of meaning, b) dialogue to assess knowledge claims, c) an ethic of caring, d) and an ethic of personal accountability.

Critical race theory. As a compilation of theories, critical race theory (CRT) offers a framework to expose the "the persistence of racism" in the United States (U.S.) (Closson, 2010, p. 261). Although critical legal scholars first introduced CRT in the 1970s (i.e., Derrick Bell, Alan Freeman, Kimberlé Crenshaw, and Richard Delgado), they conducted the first official meeting in the summer of 1989 in response to a series of civil rights legislation, which nullified the progress of previous movements (i.e., African American civil rights movement, Black power movement, and the Chicano movement) (Bell, 1980, 1993; Crenshaw, 2011; Delgado & Stefancic, 2012; Phillips, 2014). In this study, I used prominent CRT tenets to situate African

American women experiences in the social and political (socio-political) contexts of U.S. Computing Education to include a) endemic racism, b) experiential knowledge: Counterstories and Counternarratives, c) interest convergence, and d) a social justice agenda.

Endemic racism. In the U.S., endemic racism (i.e., racial realism) describes the normality of racism in the U.S. African American women may experience its discriminatory effects and microaggressions in school-based settings and on college campuses. In response, African American women may create counterspaces (i.e., sister circles) to shield themselves (Solórzano, Ceja, & Yosso, 2000). CRT scholars produce experiential knowledge through Counternarratives or Counterstories to nullify majoritarian stories (Closson, 2010; Bernal & Villalpando, 2002). Counternarratives are powerful social justice tools for African American women, and other people of color, to break the silence of racism and racial discrimination, especially in light of interest convergence. In this study, I used Counter-Life Herstories (i.e., Counternarratives) to place participants' stories in a broader context.

Interest convergence. Derrick Bell (1980) suggested African American's concerns (civil, economic, and social) are only addressed when they converge with whites' concerns. He, along with other CRT scholars, believed prominent civil rights advancements for Blacks also benefited whites. In the case of Brown v. Board of Education, Bell (1980) believed the U.S. Supreme court's favorable decision was based on foreign policy during the Cold War and instead of social justice for African Americans (Delgado & Stefancic, 2012; Dudziak, 1998; Ladson-Billings & Tate, 1995). Overall, CRT scholars believe affirmative action has benefited white women more than African Americans (Brown & Jackson, 2013; Delgado & Stefancic, 2001).

A social justice agenda. In light of these challenges, CRT promotes a social justice agenda to eradicate all discriminatory practices based on race, gender, language, age, or class.

CRT scholars have promoted a social justice agenda, from theory to praxis, in education (Solórzano & Yosso, 2001; Somekh & Lewin, 2011) through the use of student Counternarratives (Solórzano & Yosso, 2001) and counterspaces, which is a vital social justice strategy for students of color survival in higher education (Solórzano & Villalpando, 1998).

CRT is an appropriate interpretive framework to describe the socio-political environment in U.S. Computing Education. Through the use of CRT, I follow a social justice agenda to rouse African American women's (and other women) consciousness about their exposure to endemic racism (e.g., microaggressions) and the effects of interest convergence on their experiences. Since CRT does not account for intersectionality (e.g. race, gender, or other social statuses), I also plan to employ the Black Feminist Thought framework.

Black feminist thought. I purposely chose Black Feminist Though (BFT), rather than white feminist standpoint (Hartsock, 1983), intersectionality (Crenshaw, 1991), or critical race feminism (Evans-Winters & Esposito, 2010) to emphasize African American women's unique experiences in U.S. Computing Education. In the U.S., African American women experience a double oppression (racism and sexism) and adopt an "outsider within" disposition, which dramatically impacts their experiences in comparison to white women (Collins, 2009; Ong, Wright, Espinosa, & Orfield, 2011). Collins (2009) introduced BFT to illuminate their standpoint, from the perspective of other African American women. I will use the following BFT distinguishing features to examine their experiences in U. S. Computing Education: a) African American women represent an oppressed group in the U.S., b) African American women have unique experiences, despite their commonality, and c) African American women scholars have a social justice agenda (Collins, 2009).

African American women represent an oppressed group. Patricia Collins (2009) compiled BFT as a tool to help African American women resist their oppression. She posited if an African American woman's "consciousness concerning how she understands her everyday life undergoes change, she can become empowered" (Collins, 2009, p. xi). She included documented stories to amplify African American women experiences, and their marginalization, and to challenge the colorblind and majoritarian perspective.

African American women have unique experiences. Though African American women share common experiences, their experiences are unique. They also have different viewpoints about the significance of their individual experiences, as they encounter race and gender discrimination in various settings (i.e., educational, workplace, housing, and everyday life) (Collins, 2009). To gain power over their double oppression, they have traditionally used spirituality (Dillard, 2000, 2012). During this study, African American women will share their experiences freely in Computing Education, and personal points of view as Counternarratives against the oppression, which has silenced their voices (Howard-Hamilton, 2003).

African American intellectuals have a social justice agenda. Existing literature on African American women's experiences in U.S. Computing Education is rather limited. As an African American woman, and the primary qualitative research instrument, I follow a social justice agenda to give voice to the unique educational experiences (e.g. Counter-Life Herstories) of other African American with faculty in Computer Science, from my perspective. In particular, I used BFT as an interpretive lens to examine their Counter-Life Herstories.

In conjunction, CRT and BFT are appropriate interpretive frameworks (lenses) to examine African American women's unique experiences in U.S. Computing Education, from an Afrocentric feminist epistemological perspective. In this study, I follow a social justice agenda

to give voice to their Counter-Life Herstories (e.g. Counternarratives) throughout U.S. Computing Education.

Significance of this Study

My study fills existing gaps in the literature about African American women's unique experiences and career trajectories, in particular at the graduate level, in the U.S. Computing Education pipeline (e.g. primary, secondary, postsecondary). Since little is known about African American women's experiences, and their voices are inherently silenced, my study will give voice to their unique educational experiences (e.g. Counter-Life Herstories) throughout U.S. Computing Education (e.g. primary, secondary, and postsecondary). Furthermore, policymakers, administrators, and educators at all levels have an opportunity to operationalize African American women's unique experiences in U.S. Computing Education in an effort to broaden their participation. As an African American woman emerging scholar, with a Bachelor's degree in Computer science, I have a "unique angle of vision" (Collins, 2009, p. 39) to give voice to the Counter-Life Herstories of African American women who have entered, persisted, and attained Ph.D. degrees in Computer Science to counter the master narrative about their experiences. Since my study aligns with the U.S.'s national interest to diversify the STEM and Computing workforce to "strike while the iron is hot" (Baber, 2015; Palmer & Wood, 2013, p. xiii).

Limitations

Some participants may have bypassed Master's degree programs to pursue Ph.D. degrees in Computer Science, or a related Computing discipline. Therefore, I anticipate limited data about participants' unique educational experiences at the Master's degree level.

Delimitations

In this study, I targeted African American women faculty who are native-born U.S.

citizens, and who have attained a Ph.D. degree in Computer Science or a related Computing degree (e.g. Computer Engineering, Information Technology) to ensure an accurate depiction of African American women's experiences throughout the U.S. Computing Education trajectory. These women will also be categorized as members of the Black racial group (Rastogi, Johnson, Hoeffel, & Drewery, 2011)

Definition of Terms

African American women. According to the U.S. Census Bureau, a "Black or African American" is "a person having origins in any of the Black racial groups of Africa" (Rastogi, Johnson, Hoeffel, & Drewery, 2011, p. 2).

Computing. The Computing discipline is as a family of disciplines, which includes: Computer Science, Computer Engineering, Information Systems, Information Technology, and Software Engineering postsecondary Bachelor's, Master's, and Ph.D. degrees (ACM, 2006, 2012).

Computer Science. Computer Science is the study of computers, algorithmic processes (theoretical and programming knowledge), hardware and software designs, applications, and their impact on society (Tucker et al., 2011, p. 68).

Computer Engineering. Computer Engineering embodies the science and technology of design, construction, implementation, and maintenance of software and hardware components of modern Computing systems, and computer-controlled equipment. Traditionally, it has been viewed as a combination of both Computer Science and Electrical Engineering (ACM, 2006).

Counterstories or Counternarratives. Counterstories are also referred to as Counternarratives. They highlight people of color's experiences to "belie meritocratic, color-blind, and liberal majoritarian stories" (Closson, 2010, p. 267).

Herstory or Herstories. Herstory was coined in the early 1970s by the feminist movement as a counter to history. Feminists have purposely used this term to emphasize the "the rewriting or respeaking of history" (Mills, 1992) from a woman's perspective. Critics argue historia (i.e., Ancient Greek origin: ἱστορία meaning "knowledge obtained by inquiry"), is etymologically unrelated to the masculine term history (Conde Silvestre & Hernández Campoy, 2012). Herstories are a plural form of herstory.

Information Technology. The terms "Computing" and "Information Technology" are often used interchangeably. In particular, Information Technology focuses on the information component of Computing. (ACM, 2006).

Life histories or Life herstories. Life histories are defined "as a type of narrative" (Wisniewski & Hatch, 1995, p. 114) that are defined in a broader context (Cole & Knowles, 2001). As such, Life Herstories (see Herstory or Herstories) depict narratives of women that are defined in a broader context. The terms life herstories and life histories also overlap with terms such as "oral history, folklore, memory, déjá-vu, storytelling, autobiography, autoethnography, portraiture, biography, the long interview, reminiscence, photovoice, and photoethnography" (Janesick, 2010, p. 15).

Resilience. Resilience is more than an innate quality that enables individuals to rebound from adversity or setbacks; it is a quality developed over time through life experiences (Benard, 1993). Oftentimes, individuals who have bounced back from adverse experiences are labeled as "invincible," "hardy," or "invulnerable" (Werner & Smith, 1982).

Shrinking or Leaking pipeline. Researchers use the term pipeline to describe the STEM or Computing pathway or trajectory from elementary school to initial employment. They often use terms such as "shrinking" or "leaking" to define the shortage (or underrepresentation)

of women and minorities in Computing (Varma & Hahn, 2008, p. 3).

Social justice agenda. In education, researchers follow a social justice agenda to eradicate all discriminatory practices based on race, gender, language, age, or class through the use of student Counternarratives (Solórzano & Yosso, 2002) and counterspaces (Matsuda, 1996; Solórzano & Yosso, 2001; Somekh & Lewin, 2011Solórzano & Villalpando, 1998).

STEM. Science, Technology, Engineering, and Mathematics (NSF, 2011).

Organization of this Study

In Chapter 1, I introduce my Counter-Life Herstory, motivation to conduct this study, background of the problem, statement of the problem, the purpose of this study, exploratory questions, a summary of the integrated conceptual framework, significance of the study, limitations and delimitations, and definitions of terms. In Chapter 2, I include a review of the literature on the STEM workforce, African American women's experiences in U.S. Computing Education, barriers and supports for African American women in Computing Education, life history and life herstory research, a detailed integrative conceptual framework, and a summary. In Chapter 3, I discuss my life history qualitative approach, provide the life history (i.e., Counter-Life Herstory research design, discuss my role as researcher, participant selection and profiles, data collection methods, data analysis, narrative analysis, my process for constructing participants' Counter-Life Herstories, trustworthiness, and ethical considerations. In Chapter 4, as a result of the thematic analysis, I present six emergent discoveries based on exploratory questions, and I share our final reflections. In Chapter 5, I provide a summary of the study, a discussion of my discoveries; discuss critical emergent themes and their connections to critical race theory and Black feminist thought. To conclude, I provide implications for policymakers, administrators, and educators, and recommendations for future research.

CHAPTER TWO: REVIEW OF LITERATURE

Introduction

My goal for this review of the literature was to identify existing empirical studies that describe the experiences of African American women throughout the U.S. Computing Education pipeline (e.g. primary, secondary, postsecondary). In light of African American women's underrepresentation (e.g. low enrollment and degree attainment trends) in U.S. Computing Education at all levels of (Bachelor's, Master's, and Ph.D.), I sought to understand where in the literature their voices were whispered or silenced. As such, I conducted an exhaustive literature search to identify existing qualitative empirical studies, that "give voice" to African American women's experiences in U.S. Computing Education. Upon completion, I identified 11 empirical studies (including three dissertations) which met my search term criteria (e.g. African American; women or female; Computing, Computer Science, Information Technology, technology or STEM; experiences), and were published between 2009 and 2015 (Table 3). To provide contextual information about African American women's experiences, I also incorporated research and demographical information from national reports (e.g. National Science Foundation) to compare African American women's experiences to the majority group (e.g. white women). Specifically, I have structured this review of the literature as follows.

First, I expound on the national call to diversity the U.S. STEM workforce with more ethnic minorities, which also informs analogous activities in the U.S. Computing workforce. Second, I describe themes found in the existing literature about African American women's experiences throughout the U.S. Computing Education pipeline (elementary, middle, and high

school). Third, I describe the barriers and supports, which may negatively or positively impact African American women's pursuit and persistence in attaining a Ph.D. degree in Computer Science or a related Computing discipline. Fourth, I operationalize definitions about narrative and life history research. Finally, I expound on the integrative conceptual framework, which will govern my knowledge validation process and provide the interpretive frameworks (lenses) to examine African American women's experiences in U.S. Computing Education.

A National Call to Action: U.S. STEM Workforce at a Crossroads

Since World War II, the United States (U.S.) has been a world leader in science and technology innovation (Committee on Prospering in the Global Economy of the 21st Century [COPGE21C], 2007). Today, the U.S. is striving to maintain its global economic competitiveness due to the effects of globalization. In a recent Global Competitiveness Report, the U.S. rose to third place, behind Switzerland and Singapore (Schwab, 2014), though its intellectual merits in science and technology are steadily losing ground when other countries are sustained (COPGE21C, 2007). Specifically, the U.S. faces a severe shortage of qualified workers in its STEM and Computing workforce. Of the 164 million jobs in the U.S. workforce, 9.2 million are projected to be STEM jobs and 4.6 million are projected to be Computing jobs between 2010 and 2020 (BLS, 2010). During this period, the Computing and mathematics occupational group are forecasted to be among the top 10 fastest growing group. One in every two STEM jobs (51%) will be in Computing, which equates to more than 150,000 annual job openings, which require Bachelor's degrees in Computer Science. These high-skilled and high-wage Computing jobs (e.g. computer and Information Systems managers, software developers, and database administrators) will yield an average annual income of $78,730, which enhances the earning potential of qualified U.S. workers and drives innovation to improve the country's

global competitiveness. To fill these jobs, the U.S. will need approximately 100,000 graduates annually with bachelor degrees in Computer Science by the year 2020 (BLS, 2010). However, only two percent of all ACT-tested high school graduates (n=1.569 million) indicated an interest in Computing on a recent college and career readiness survey (ACT, 2010).

Rising above the gathering storm in the STEM workforce. In 2005, the National Academies formed the Committee on Prospering in the Global Economy of the 21st Century (COPGE21) to delve further into this issue, which published a seminal report entitled: *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future (Gathering Storm)*. In this report, the COPGE21 proposed the erosion of the U.S. economy was due to a) a decade of outsourcing science and technology jobs to other countries, b) loss of human capital (underprepared and disinterested students), c) decreased funding for public educational institutions, d) rising tuition costs, e) decreased funding for corporate research and development, and f) restrictions on H1-B visas and exports due to 9/11 (COPGE21, 2007, pp. 23-40). Moreover, the U.S. has seen countries like England and Ireland gradually rise to positions of power and, in particular, Russia's increased prosperity after the Cold War. In light of these factors, the COPGE21 made several recommendations and actions to improve the U.S.'s future prosperity. In particular, I believe the following recommendations and actions are most relevant to this study: 1) improve K-12 science and mathematics education, 2) increase the pipeline of students who are prepared to enter college and graduate with a degree in science, engineering, technology, or mathematics (STEM), 3) increase the number of U.S. citizens who earn Bachelor's degrees in the physical sciences, life sciences, engineering, and mathematics, and 4) increase the number of U.S. citizens pursuing graduate study in "areas of national need" (Committee on Prospering in the Global Economy of the 21st Century [COPGE21], 2007, pp. 4-

13). They also issued a call to action, which suggested the U.S. is at a *crossroads*. To sustain its global leadership and competitiveness in STEM, which are critical to achieve national goals, the U.S. must: invest in research, encourage technological innovation, and grow a strong, talented, and innovative STEM workforce (Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline [CUGESEWP], 2010, pp. 17-18). In response to this call to action, policymakers enacted the American Competitiveness Initiative, the Academic Competitiveness Council, the America COMPETES (Americans Creating Opportunities to Meaningfully Promote Excellence in Technology, Education and Science) Act, and spending provisions in the American Recovery and Reinvestment Act of 2009, which provided funding for the Committee's recommendations (CUGESEWP, 2010).

Shifting focus: underrepresented minorities in the STEM workforce. Following the Gathering Storm report (COPGE21, 2007), in the 2007 COMPETES Act, the U.S. Congress mandated a study committee to "explore the role of diversity in the STEM workforce and its value in keeping America innovative and competitive" (CUGESEWP, p. 2) since the Gathering Storm recommendations were not sufficient to address the looming U.S. demographic changes. In response, the National Academies formed the CUGESEWP with a twofold purpose of strengthening the overall U.S. STEM workforce and improving the underrepresentation of racial and ethnic minorities (African Americans, Hispanics, Latinos, Native Americans, Alaska Natives, Native Hawaiians, and Pacific Islanders) in the U.S. STEM workforce. In the new Committee's report (Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline [CUGESEWP], 2011), they provided the following three compelling reasons for the U.S. to shift its focus: 1) talent sources for the future STEM workforce are unknown, 2) demographics of the U.S. population are shifting dramatically, and 3)

diversity in STEM is an asset because increasing the participation and success of underrepresented minorities contributes to nation's health, technological innovation, and global economic leadership (pp. 2-3). This report served as the impetus for initiatives to broaden the participation of African American women, and other minorities, in STEM and Computing.

Shifting demographics in the U.S. population. In the year 2012, women represented about 50% of the population. white women represented the majority, followed by Hispanic women (16%), Black women (13%), Asian women (six percent), and other ethnic groups (American Indians or Alaska Natives, Native Hawaiians, Pacific Islanders, and Multi-race), which represented two percent of women's share of the population. By the year 2042, historically underrepresented minorities are forecasted to make up the majority population (Vincent & Velkoff, 2010), and in the year 2060, they are forecasted to represent 57% of the population, of which Hispanics, Asians, and Other/Unknown race or ethnicity persons will account for most of the new majority population (NSF, 2015). In foresight of these trends, the Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology Development (the Commission) stated in its *Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering, and Technology* report. "Yet, if women, underrepresented minorities, and persons with disabilities were represented in the U.S. science**,** engineering, and technology workforce in parity with their percentages in the overall workforce population, the threat could largely be ameliorated" (Bordonaro et al., 2000, p. 1).

Broadening the participation of underrepresented minorities in Computing. Since the 1990s, policymakers and researchers have had increasing concerns about the steady decline of women and underrepresented minorities, including women of color, in the Computing discipline (NSF, 2011; Singh, Allen, Scheckler & Darlington, 2007; Varma, 2009). Today, the

U.S. is focused on expanding the participation of underrepresented minorities in STEM and Computing. Traditionally the STEM workforce has been dominated by white and Asian males (CUGESEWP, 2011). However, due to recent demographic shifts, women and international student participation have increased. Although the U.S. has achieved greater opportunities for women overall in the STEM workforce, white women (69%) are represented more than minority women (11%). Moreover, women's participation in Computer Science has declined, and they represent a small share of the faculty at research institutions. The U.S. is most concerned about losing international student talent due to recent declines in H1-B visas. International students (non-U.S. citizens), primarily from China and India, have attained more advanced degrees (Ph.D.) in STEM, over U.S. citizens. The U.S. is unsure if new international graduates will remain in the U.S. and participate in the U.S. STEM workforce or return home, which is problematic for the U.S. STEM workforce. Therefore, the U.S. has shifted its focus to increasing the number of domestic minorities (U.S. citizens) in STEM, because of forecasted demographic changes in the U.S. population and its uncertainty of the future production of international students. By 2042, minorities in the U.S. population are projected to represent over 65% of the total population (Vincent & Velkoff, 2010).

Broadening participation in Computing. To address these concerns, the NSF has funded numerous projects, aimed to improve educational pathways for women and minorities in Computing. New collaborations with government, P-20 educational institutions, nonprofits, and corporations have spurred through its Broadening Participation in Computing (BPC) program (NSF, 2008). These efforts have primarily influenced the attraction, retention, and persistence of women and girls, including women of color, in postsecondary Computing degree programs. NSF also formed a BPC Alliance, which has funded statewide interventions in Georgia (Guzdial,

Ericson, McKlin, & Engelman, 2012; Guzdial, Ericson, McKlin, & Engelman, 2014) and Massachusetts (Adrion et al., 2008). Many of these programs have offered recruitment and outreach programs, summer camps, enrichment programs, and mentoring programs to attract and retain underrepresented minorities (e.g. African Americans and Hispanics) and women in secondary and postsecondary Computing Education programs. In this study, I will focus in particular on broadening the participation of African American women in U.S. Computing Education.

Leaky or shrinking pipeline metaphor. Studies focused on Computing or STEM may incorporate the "pipeline" metaphor to describe the "pathway" that students matriculate on from elementary-to-secondary-to-postsecondary education, the workforce, or the academy (ACM, 2014; Fealing & Myers, 2012; Margolis et al., 2003; Varma & Hahn, 2008). The Computing pipeline is characterized as "leaky", or "shrinking" to describe the steady decline in participation of historically underrepresented groups, such as women and minorities as they enter and fail to persist in the pipeline (Margolis et al., 2003; Varma & Hahn, 2008). As the U.S. population becomes more diverse, policy makers have had increased concerns about the underrepresentation of women, minorities (Blacks, Hispanics, and American Indians or Alaska natives), and disabled persons in the pipeline, because their STEM/Computing degree attainment and workforce participation rates are far less than their representation in the U.S. population (NSF, 2011, 2015; Oakes, 1990). Asians are excluded from other ethnic minorities, because they are overrepresented, along with white males, in the STEM/Computing pipeline (NSF, 2011, 2015). Since the existing literature is sparse about success strategies, more research is needed. During this study, I will elicit suggestions from participants about how to broaden the participation of African American women in U.S. Computing Education.

Summary. Based on these factors, the U.S. has an opportunity, and a vested interest, to broaden the participation of underrepresented minorities in the U.S. STEM workforce. Since Computing is one of the fastest growing occupational groups in the U.S. (ACM, 2014; ACT, 2010; BLS, 2010), the U.S. P-20 education system must focus its efforts on improving the pipeline of underrepresented minorities who enter and persist in U.S. Computing Education (ACM, 2014; BLS, 2010, 2014; Stephenson, Gal-Ezer, Haberman, & Verno, 2005; Varma & Hahn, 2008). During this study, I will focus on African American women to ascertain their unique experiences throughout the U.S. Computing Education pipeline at all degree levels.

African American Women Experiences in U.S. Computing Education (CE)

Since African American women persist at lower rates than white women in U.S. Computing Education (Margolis et al., 2011), numerous researchers have identified the perceived barriers that influence their departure or failure to persist in postsecondary degree attainment (Borum & Walker, 2012; Bush, 2013; Charleston, Adserias, Lang, & Jackson, 2014; Charleston, George, Jackson, Berhanu, & Amechi, 2014; Galloway, 2012; Ong, Wright, Espinosa, & Orfield, 2011; Perna et al., 2009). Other researchers have either generally focused on African Americans' experiences (Charleston, 2012; Charleston, Charleston & Jackson, 2014; Gilbert, Jackson, Dillon, & Charleston, 2015; Newman, 2011), African American men's experiences (Jackson, Gilbert, Charleston, & Gosha, 2009; Stone, 2008), or students of color experiences (Strayhorn, 2010) in STEM or Computing Education at various degree levels. Albeit, some researchers have explored African American women's experiences (Borum & Walker, 2012; Bush, 2013; Galloway, 2012; Hanson, 2004; Joseph, 2012; King, 2013) or women of color's experiences (Carlone & Johnson, 2007; Ong, 2011; Ong, Wright, Espinosa, & Orfield, 2011) throughout the STEM education pipeline to broaden their participation or to closely

examine a particular phenomenon (e.g. science identity). In this section, I endeavor to describe African American women's unique experiences throughout the U.S. Computing Education pipeline (e.g. primary, secondary, and postsecondary education), and illuminate their voices, in contrast to the dominant experiences of white women.

Elementary, middle school, and high school experiences. Traditionally, U.S. Computing Education has been dominated by white and Asian men (NSF, 2011, 2015; Singh, Allen, Scheckler & Darlington, 2007; Varma, 2009). As such, few researchers, if any, have isolated African American women's secondary education experiences in preparation for postsecondary Computing Education. In the existing literature, researchers have mostly described African American women's experiences in Computing Education, because their individual voices are essentially silent, especially in primary education (elementary school).

Initial interest and early exposure (engagement). Young women's sustained interest in STEM has been confounded by numerous factors such as male-dominated stereotypes, lack of culturally relevant pedagogical techniques and curricula (Brickhouse, Lowery, & Schultz, 2000; Charleston, Adserias, Lang, & Jackson, 2014). Since young women typically make career decisions before the age of 17, it is important for them to gain exposure to Computing as early as middle school to stimulate their initial interest and to prepare them for postsecondary Computing Education (American Association of University Women, 2000, 2004; Bruckman et al., 2009; Varma, 2009). Moreover, young women are equally interested in STEM as young men but are often discouraged by gendered socialization practices early in their schooling (AAUW, 2004; Galloway, 2012). However, young African American women have had limited exposure to Computing at a young age due to limited access to computers in comparison to white women (ACM, 2014; Bruckman et al., 2009; Cooper & Weaver, 2003; Margolis et al., 2003; McInerney,

DiDonato, Giagnacova, & O'Donnell, 2006). Conversely, African American women have demonstrated high levels of interest in STEM majors, despite their underrepresentation throughout the Computing Education pipeline (Ong, Wright, Espinosa & Orfield, 2011). Charleston (2012) magnified the voices of three African American women (graduate students) who remembered their initial exposure to Computing during elementary and middle school. As a result, he found they were primarily influenced by their early exposure to Computing as early as age six (primary education). For example, one student had exclusive, but limited exposure to computers in elementary school (p. 227):

> Elementary school, it was an old computer; the gifted students were allowed to use the computers. It was a select group. It was a gap, I saw and didn't think much of it [a computer] until my dad bought one, and we were hooked.

The other graduate students remembered their initial exposure to Computing during middle school. One student recalled her first introduction to the desktop computer (p. 228):

> We got a Gateway desktop when I was in 7th– 8th grade. I didn't really use it a lot but when I used it, I typed up papers. It was a one-time thing until I got to high school, and I had to type papers, do PowerPoint, and so forth. .. Actual work on it.

Another student had limited computer usage, but she gained valuable experience with the computer's ability to perform rigorous computational algorithms (p. 228):

> In middle school, it was like three hours every other week and we were doing math programs on the computer. We did problems and exercises on the computer, and that's it. My mom got a computer at home a little later, but my interactions were still limited.

Though not always sustained, these students were apparently impacted by their early exposure to Computing since they were currently pursuing undergraduate and graduate degrees in Computer Science. Charleston (2012) found African American students' initial interest and exposure to Computing also influenced other factors that contributed to their postsecondary enrollment and degree attainment such as cohort-building activities, rigorous mathematics, and

science course-taking, and technological incubation activities, which are further described as follows (Charleston, 2012, p. 233).

Rigorous mathematics and science course-taking. Despite needed improvements in U.S. STEM education, African American women have been characterized as underprepared in mathematics and science at all education levels in comparison to their white counterparts, (Buzzetto-More, Ukoha, & Rustagi, 2010; Charleston, Adserias, Lang, & Jackson, 2014; Perna et al., 2009). Although successful models (e.g. Meyerhoff Scholars Program) exist (Maton, Hrabowsik, & Schmitt; 2000), K-12 educational institutions are challenged to increase its efforts to develop sustainable solutions (Charleston, Adserias, Lang & Jackson, 2014). However, Bush (2013) highlighted positive examples of African American women who had taken rigorous K-12 mathematics and science courses. For instance, Mary shared her success as follows (p. 77):

> I've always been really good in school, really good, always good in math, always good in science and it just came naturally to me. I always was the best student everywhere I went. I don't know how else to say it. I graduated in the top 10 % in high school, elementary school and junior high. I wasn't in the top 10 percent in college, but I was up there.

In the context of Computing Education, additional studies about African American women's experiences in rigorous mathematics and science course-taking have only described their experiences, based on existing literature (Charleston, Adserias, Lang, & Jackson, 2014; Perna et al., 2009). As such, the literature is sparse on positive examples of African American women who have successfully engaged in rigorous mathematics and science courses.

Advanced placement exams. Advanced placement (AP) exams enforce rigorous mathematics and science course-taking and provide a national measurement of students' exposure to rigorous content before college (The College Board [TCB], 2014). After nearly 30 years, women and minorities are still underrepresented on the advanced placement (AP) Computer Science exam (Yettick, 2014). In 2013, there were no Black students who took the

exam in 11 states: Maryland, Texas, Georgia, Florida, Virginia, California, New York, New Jersey, Massachusetts, and North Carolina. Furthermore, only 3.3% of Black students (n=22,273) took the AP Computer Science exam in the U.S in 2014. The AP Calculus exam is often a secondary indicator of students' likelihood to enroll and persist in postsecondary Computing Education programs (TCB, 2014).

Of these students, I remain unsure how many were African American females. Also, their experiences with AP exams were not explicitly mentioned. As such, I believe more research is needed on African American women's successful experiences with taking AP courses and exams, in preparation for postsecondary STEM and Computing Education.

***Technological incubation activities*.** Women of color who participate in technological incubation activities, such as pre-college programs, are more likely to pursue Computer Science degrees (Bruckman et al., 2009; Guzdial, Ericson, McKlin, & Engelman, 2012; Munson, Moskal, Harriger, Lauriski-Karriker, & Heersink, 2011). However, researchers have posited African American women may not enter or persist in STEM or Computing Education during high school because they are discouraged from participating in pre-college STEM or Computing programs, rigorous mathematics, and science courses, and they face significant barriers once they enter the pipeline (Ong, Wright, Espinosa, & Orfield, 2011; Smith-Evans & George, 2014). Numerous universities and community-based organizations (e.g. YWCA) have offered various afterschool and summer programs to K-12 students within targeted communities to recruit students in general to STEM and Computing disciplines (Bruckman et al., 2009). Underrepresented minorities, including African American women, have also been targeted by various programs. For example, The Level Playing Field Institute in California developed the SMASH (Summer Math and Science Honors Academy) to target low-income, high-achieving underrepresented

students to pursue STEM careers (Bush, 2013).

Recruitment and outreach programs. Colleges and universities, such as Carnegie Mellon and Harvey Mudd have remarkably increased their recruitment, marketing and outreach efforts to increase women and underrepresented minorities' enrollment rates and overall success in undergraduate Computing programs (Alvarado & Dodds, 2010; Margolis & Fisher, 2002). In particular, their enrollment rates in undergraduate Computer Science programs increased by 30% over a short period of time through targeted intervention activities (e.g. active recruiting, mentoring, and culturally relevant pedagogy) for female and underrepresented (African American and Hispanic) students. Their efforts have been spotlighted in the literature as successful models for targeting underrepresented students, which have spurred new reform efforts at other colleges and universities across the nation. Since these models target such a broad audience (e.g. underrepresented minorities), they may not be applicable to recruitment and outreach activities, which target African American women.

I found few examples of technological incubation activities, which targeted African American women to provide Computing experience. Instead, I found most of the mentioned programs provided collective experiences for underrepresented minorities. As such, African American women's voices were silenced about their technological incubation experiences. During this study, participants will be asked to share their experiences with Computing outside of school, which will shed light on their unique educational experiences.

Undergraduate and graduate experiences. Since the 1990's, women and underrepresented minorities have experienced a steady decline (e.g. leaky or shrinking pipeline) in postsecondary U.S. Computing Education since they fail to enter or persist at all degree levels (Margolis et al., 2003; Varma & Hahn, 2008). Since African American women lack early access

to computers and technology and they obtain an inadequate preparation in secondary education, their pathways into postsecondary Computing Education are not well defined (Varma, 2009). As indicated by their low enrollment and degree attainment trends, African American women are trailing behind white women in U.S. Computing Education (Margolis, 2008; Margolis et al., 2003; Margolis, Goode, & Bernier, 2011; NSF, 2015).

Enrollment trends. Although women overall outnumber men in enrollments at U.S. postsecondary education institutions, men (n=59,663) outnumber women (n=10,723) in U.S. postsecondary Computing Education programs (Siebens & Ryan, 2012; Zweben & Bizot, 2014). However, white women (41%) in U.S. Bachelor's degree programs in Computer Science (CS) participate at higher rates than Asian and Pacific Islander (28%), Hispanic (8%), Black (7%), Multiracial (4%), and American Indian and Alaska Native (1%) women (Table 1). Although white (12%) and Black (12%) women achieved equivalent enrollment numbers at the Master's level, white women (23%) far outnumbered Black women (3%) at the Ph.D. degree level (Table 1). These enrollment trends suggest African American women are not well represented in U.S. Computing Education programs at all degree levels.

Table 1

2012 Women's Enrollment Trends in U.S. CS Programs (Zweben & Bizot, 2014)

		white		Black		Multiracial, not Hispanic		Asian or Pacific Islander		Hispanic		American Indian or Alaska Native	
Level	Total	n	%	n	%	n	%	n	%	n	%	n	%
Bachelor's	10,723	3,351	41	601	7	290	4	2313	28	665	8	45	1
Master's	4,405	467	12	75	2	12	0	298	8	45	1	4	0
Ph.D.	2,284*	462	23	50	3	8	0	143	7	30	2	3	0

Note: *There were a significant number of Ph.D. enrollees who did not indicate their sex (n=178), which accounts for the missing number of enrollees.

Degree attainment trends. Since 1998, women have surpassed men in college enrollments, but they have earned less than 15% of Bachelor's degrees in the STEM education pipeline (Siebens & Ryan, 2012). Similarly, women (n=8,243) have attained Bachelor's degrees in CS at considerably lower rates than men (n=45,595) in postsecondary Computing Education. Not surprisingly, white women have received 48% of all Bachelor's degrees awarded to women (n=3,986), while African American women received only 18% (n=1,460) of these degrees (Table 2). Furthermore, white women have attained significantly more degrees than African American women at the Master's and Ph.D. levels. Based on these trends, white women attain more CS degrees than African American women at all degree levels in U.S. Computing Education.

Table 2

2012 Women Degree Attainment Trends in U.S. Computing Education by Race (NSF, 2015)

		white		Black		Other/Unknown race or ethnicity		Asian or Pacific Islander		Hispanic		American Indian or Alaska Native	
Level	Total	n	%	n	%	n	%	n	%	n	%	n	%
Bachelor's	8243	3986	48	1460	18	1082	13	874	11	791	10	50	0.6
Master's	3060	1245	41	580	19	488	16	506	17	225	7	18	0.6
Ph.D.	164	90	54	16	10	14	9	37	23	6	3.7	1	0.6

Though, African American women (32.1%) are more likely than white women (24.2%) to pursue STEM or Computing degrees (Borum & Walker, 2012; Hanson, 2004; NSF, 2009), African American women fail to persist at all degree levels in U.S. Computing Education in comparison to white women. Furthermore, they have earned significantly fewer postsecondary degrees than white women at the Bachelor's (18%), Master's (19%), and Ph.D. (10%) education levels (NSF, 2015).

Community colleges. The community college is increasingly becoming an entry point for underrepresented minority students to pursue postsecondary STEM disciplines, including African American women (Hernandez & Fletcher, 2013; Palmer & Wood, 2013). Professional

organizations such as NACME (National Action Council for Minorities in Engineering) have identified the community college as a "stepping stone to higher education", which help to diversify the STEM workforce (Bush, 2013, p. 31; Koebler, 2011). Notably, community colleges have successfully prepared African American women to transfer into four-year historically black colleges and universities (Jackson, 2013) and predominately white institutions (Ong, Wright, Espinosa, & Orfield, 2011). Malcom and Malcom (2011) posit community colleges create new pathways, which repair the leaky pipeline of underrepresented women who are more likely to enroll initially in a community college than a four-year university due to access barriers. In Jackson's (2013) study, she used the photovoice method to elicit the experiences of African American women (n=12) who transferred from community colleges to historically Black colleges and universities (HBCUs). Though participants were pursuing a broad range of STEM degrees, their positives experiences may provide insight for African American women Computing aspirants. For example, Lilian (third-year statistics student) shared her positive experiences as follows (p. 263):

> Yeah . speaking of academics, the community college provided me with a good foundation in math and science areas. In fact, that is why I decided to pursue a degree in statistics. Even when I came here [SPU], everyone was clear about my courses and that I needed to study often and what the courses would entail . Yes, I knew about some careers, such as medical doctor, statistician, biologist, etc. but I know that's not all the STEM careers that exist. At what point do I learn about that? Is that something I should explore on my own? Is that information in a class?

Still, African American women's voices about their unique experiences in community colleges, along the Computing Education pipeline, are largely silent in the literature, especially along the U.S. Computing Education pipeline. The existing literature suggests community colleges provide a positive environment for African American women entering postsecondary Computing Education. However, participants in these studies pursued STEM degrees and not

specifically Computing degrees. African American women who pursue Computing degrees may not share the same experiences as STEM degree aspirants in community colleges. To fill this gap, participants in this study were asked to share their entry and pathways into postsecondary Computing Education.

Historically Black colleges and universities. After the U.S. Civil War (1861-1865), Historically Black Colleges and Universities (HBCUs) were established to provide African American students with equitable access to postsecondary education (Gasman, Baez, & Turner, 2008). From the 1860's to 1950's, HBCUs served as the primary source for African Americans to obtain a postsecondary degree to improve their quality of life in the U.S. (Anderson, 1988). Today, HBCUs (n=103) are the top producers of African American degree recipients in STEM disciplines (Owens, Shelton, Bloom, & Cavil, 2012; Perna et al., 2009). Furthermore, 17 of 21 HBCUs serve as the top producers of African American Ph.D. degree recipients in Science disciplines, including Computer Science. In Perna et al.'s (2009) study at Spelman College (an HBCU for women), one-third of the total participants (n=19) indicated an interest in pursuing graduate STEM education programs upon graduation. Furthermore, African American women who attended HBCUs expressed having positive experiences due to its small class sizes, supportive and nurturing environment and (Borum & Walker, 2012; Jackson, 2013; Perna et al., 2009). In Borum and Walker's (2012) study, seven of 12 Ph.D. students had positive experiences while attending an HBCU. Robin believed she had an effortless experience (p. 371), "We did our homework together. I think I came out of the program because everyone was so open and helpful. I didn't feel like I was competing against people to get the right answer." Another participant Taryn shared about her closeness with peers (p. 371): "The chair would leave the building open on a Saturday so that we could do mathematics problems. We were very

close as a class unit." As a result of their positive experiences, African American women enter and persist at higher rates in postsecondary STEM education programs at HBCUs (Perna et al., 2009).

Since the participants in Borum & Walker's (2012) study were STEM degree aspirants, it revealed limited insight into the experiences of African American women who pursue Computing degrees at HBCUs. Therefore, additional research about African American women's positives experiences in Computing programs at HBCUs is warranted.

Predominately white institutions. Since the 1950's, predominately white institutions have gradually increased its enrollments of women and ethnic minorities, including African Americans (Anderson, 1988). However, African American women's steady decline in STEM and Computing Education, in particular at the graduate level, has primarily occurred at PWIs as indicated by enrollment and degree attainment trends (Perna et al., 2009). In contrast to students' experiences at HBCUs, African American women who attended PWIs made note of its "chilly climate", lack of support, and feelings of isolation (Borum & Walker, 2012). For example, Emily shared how she believed her gender and race negatively influenced her interactions in study groups and with faculty (p. 372):

> There were times where you knew that either your classmates or professors automatically didn't think that you were going to cut it. Right? Like one of my study partners, I remember him saying on one of our exams, we did okay. Not as good as any of us had wanted to, and I got a higher B than he'd gotten. I think he had a low B or high C. And he says, "You know I thought I'd done at least as good as you." That's how bad he did. He did worse than the Black girl.

In other studies, researchers did not explicitly state the type of educational institution (e.g. HBCU or PWI) participants had attended (Bush, 2013; Charleston, Adserias, Lang, & Jackson, 2014), but due to the nature of their experiences, I inferred they occurred at PWIs. As such, I believe further research is needed to ascertain African American women's unique experiences

while enrolled in U.S. Computing Education programs at PWIs.

Graduate experiences. In 2012, African American women attained 2.8% (n=580) of the total U.S. Master's degrees (n=21,001) and less than one percent (n=16) of the total U.S. Ph.D. degrees (1,690) in Computer Science (NSF, 2015). As indicated by their low enrollment and degree attainment trends, African American women are extremely underrepresented in graduate Computing Education programs. As graduate students, African American women undergo a socialization process which influences a different identity as they become acclimated to their new institutional culture (Joseph, 2012). In particular, African American women who transition from HBCU undergraduate programs into PWI graduate programs experience a disconnection between the two environments (Joseph, 2012; Ong, Wright, Espinosa, & Orfield, 2011). Joseph (2012) interviewed six African American women who transitioned from the HBCU environment into PWI environment to pursue graduate school. The participants expressed their feelings of discomfort due to larger class sizes and the "chilly climate" they experienced. For example, Keisha described the culture in graduate school as "cordial". On the other hand, Kerry believed she was "totally alone" and Paulette replied, "They did not do anything to make me want to stay here." In contrast, Shavanna complimented her department by saying "[My] department is not hostile, and the people within the department are friendly." African American women in Borum and Walker's (2012) had similar experiences. For example, Lydia described her experiences as "traumatic" at a PWI while pursuing a Ph.D. degree. She believed the white men in her department, who represented the majority, "did not feel like women could do the math, let alone a Black woman from a Black college." As a result, she believed the lack of support from faculty deeply impacted her self-esteem (Borum & Walker, 2012, p. 373):

> I just had to sit down and say to myself, "Okay, I know I wanted a Ph.D. from here, but in some respects a Ph.D. is conferred. So if they don't want you to get it, you won't get

it.

In Charleston, Adserias, Lang and Jackson's (2014) study, all graduate students (n=12) and Ph.D. holders (n=2) were attending or had attended a PWI, though 17 of 21 HBCUs have produced the most African American women faculty in Computer Science (Perna et al., 2009). In light of the barriers African American women face at PWIs, some researchers believe some women are "dropping out" of STEM graduate programs instead of "failing out" (Grundman, 2009, p. 1116).

Due to the small population of African American women in graduate Computing programs, their unique experiences and voices are relatively silent in the existing literature. Though Charleston, Adserias, Lang and Jackson (2014) had participants who were current Ph.D. students (n=12) in Computing Education, their goal was to understand the participants' shared experiences as African American women. As such, their usage of focus group interviews and phenomenology were most appropriate for their study. For the purposes of this dissertation study, I chose a life history approach to more appropriately magnify participants' voices to ascertain their individual educational experiences in U.S. Computing Education.

Faculty experiences. African American women's experiences as professors in academia are essentially absent from the relevant literature (Charleston, Adserias, Lang & Jackson, 2014; Galloway, 2012; King, 2013; Ong, Wright, Espinosa, & Orfield, 2011). Since most of these studies provide only a description of African American women faculty's experiences, their voices in U.S. Computing Education are virtually silent. However, researchers acknowledge the severe underrepresentation of African American women faculty in STEM and Computing Education, specifically at the associate and full professor levels (Galloway, 2012; King, 2013; Ong, Wright, Espinosa, & Orfield, 2011). As a result, they encounter increased barriers in their

faculty positions, especially at PWIs (Syed & Chemers, 2011). However, participants in Galloway's (2012) shared their successes and challenges from a feminist perspective, since they did not view their experiences through a marginalized lens. As depicted in the following response, one participant did not identify her race as an obstacle.

> One of the barriers that I had been that I wasn't a particularly strong test taker. When I was applying for graduate school - for my Ph.D. that became an issue. So, I started initiating interviews so I could figure out the best fit. I kind of got used to people saying, "You may not do too well based on your scores." I have always been able to push through and do pretty well with my academic career. I feel like another barrier—it wasn't quite a barrier, but it turned into one because it was not the best for me. It ended up being more hurtful towards my success. The obstacle was I felt that sometimes some of my professors gave me too much assistance. Instead of me finding my way and figuring it out on my own, they would come to my rescue. So, while I was in "the moment," I would say, "Okay, yes, I need some help." Now, as I am mentoring minority students, I want to help make them pass, but don't want to give them so much help that it's like I am doing the work for them, because it really doesn't benefit the student at all in the long run. A couple of times they had good intentions, but they made it not as challenging.

Other studies about African American women faculty experiences mostly included descriptions (King, 2013; Ong, Wright, Espinosa, & Orfield, 2011) or focused more on how their intersectionality influenced their identities (Charleston, Adserias, Lang & Jackson, 2014). Though Charleston, Adserias, Lang and Jackson (2014) had participants who were current faculty members (n=2), their goal was to understand the participants' shared experiences through focus group interviews. Since there is a lack of knowledge about African American women's faculty experiences in U.S. Computing Education, I believe more research is needed.

U.S. Computing workforce experiences. The U.S. Computing workforce is a white male dominated field since women, and underrepresented minorities have been historically underrepresented (NSF, 2015; Ong, Wright, Espinosa, & Orfield, 2011). Overall, women have been less employed in the STEM workforce than in the overall U.S. workforce (Charleston, Adserias, Lang, & Jackson, 2014). Conversely, African American women have been employed

in the STEM workforce at a lower rate than their representation in the U.S. population (NSF, 2015). Moreover, they have typically earned 25% less than white women in computer Information Systems jobs (NSF, 2013). Furthermore, African American women have been underrepresented in the overall STEM workforce since the 1970s (Ong, Wright, Espinosa, & Orfield, 2011).

As indicated by workforce participation trends, African American women are clearly underrepresented in the U.S. Computing Education workforce. However, their perspectives about their individual experiences in the Computing workforce are fairly unknown. In the scarce literature available, researchers have focused on African American women's experiences in the STEM workforce (Bush, 2013), rather than Computing. Therefore, we know little about their experiences in the U.S. Computing workforce. My focus in this study is on participants' experiences throughout the U.S. Computing Education pipeline. Therefore, I have included this section to provide contextual information about participants' potential current experiences.

Improvements to broaden the participation of African American women. During Galloway's (2012) study, participants shared their suggestions on how educators and researchers may improve the STEM pipeline. I believe this suggestion is relevant for Computing Education. One participant explained (pp. 92-93):

> It has to start early in elementary school. I discovered math in that it was interesting and easy for me to do. I was continually inspired. We need teachers to encourage us, to actually 'do' math and science. I will be honest with you, the teacher that I had for four years was a white male in a small town of mostly African American children. He saw us. The color and gender did not matter, and the worst teacher I ever had been an African American female math teacher. She was my 6th-grade teacher. I really didn't look forward to going to 7th grade because 6th was so bad. She taught other classes, but the math was what stuck out. It wasn't because she didn't know the discipline or anything like that. It was because she did not care about the students. And at that age, students need to know that you see them and that you care about them. They are willing to do anything for you in the sense that "I want you to do well," and they will do well. They will do their best. So, programs that support the students, and, of course, parental

involvement. If parents don't get involved, it can be hard to keep the students interested.

In Galloway's (2012) dissertation study, she elicited African American women's suggestions on how to improve the STEM pipeline. Though helpful, their suggestions targeted African American women who are STEM degree aspirants. In this study, I elicited participants' suggestions on how to improve the participation of African American women who desire to pursue Computing degrees.

Summary. In this section, I described African American women's unique experiences throughout the U.S. Computing Education pipeline (e.g. primary, secondary, and postsecondary education), and magnify their voices, in contrast to the dominant experiences of white women. Due to the scarcity of literature about their experiences, I also drew from the literature on similar experiences of African American women in the STEM education pipeline. With the exception of personal reflections and brief narratives, I was unable to ascertain their continuous experiences along the U.S. Computing Education trajectory. Moreover, researchers often grouped African American women's experiences together with white women or other women of color (Ong, Wright, Espinosa, & Orfield, 2011), explored their collective experiences (Charleston, George, Jackson, Berhanu, & Amechi, 2014), or provided descriptions of their experiences (Borum & Walker, 2012), which have convoluted their individual voices and diluted their unique pathways in the Computing Education pipeline. As a result, their individual voices have been silenced, and their unique experiences have been unnoticed. In order to broaden the participation of African American women in Computing, their voices must be unsilenced. During this study, I will capture their Counter-Life Herstories to belie the majoritarian perspective about their continuous experiences throughout the U.S. Computing Education pipeline.

Table 3

List of Relevant Literature

Study	Discipline	Type	Framework	Study Design	n	Sampling	Degree	Data Sources	Data Analysis
Borum & Walker (2012)	STEM	Journal Article	Black Feminist Thought (BFT)	Phenomenology	12	Purposive	PhD	In-depth Interviews, Historical Documents	Grounded Theory, Open & Axial Coding
Bush (2013)	STEM	Dissertation	Intersectionality	Phenomenology	5	Criterion-based, Snowball	BS	Demographic data, Interviews, Observations	Qualitative Analysis
Charleston (2012)	CS	Journal Article	n/a	Grounded theory	37	N/A	BS, MS, PhD	Individual Interviews	Grounded Theory
Charleston, Adserias, Lang, & Jackson (2014)	CS	Journal Article	Intersectionality	Phenomenology	15	Purposeful	BS, MS, PhD	Focus Groups*	Naturalistic Approach
Charleston, George, Jackson, Berhanu, Amechi (2014)	CS	Journal Article	BFT, Critical Race Feminism	Phenomenology	15	Purposeful	BS, MS, PhD	Focus Groups*	Naturalistic Approach
Galloway (2012)	STEM	Dissertation	BFT	Case Study, Life Narratives	8	Purposive	PhD	Semi-Structured Interviews	Narrative Analysis
Jackson (2013)	STEM	Journal Article	Triple Quandary Theory	Participatory Action Research, Photovoice	12	Email invitation, Snowball	BS	Photos, Semi-structured Interviews	Qualitative Analysis
Joseph (2012)	STEM	Journal Article	N/A	Case Study	6	Email invitation, Snowball	PhD	Interviews, Observations, Reflective Notes, Participant Journals, Documents	N/A
King (2013)	Computing	Dissertation	Integrative Conceptual Framework with BFT and Critical Race Theory	Phenomenology	n/a	Purposeful	PhD	Semi-structured Interviews	Open Coding
Ong, Wright, Espinosa, & Orfield (2011)	Computing	Journal Article	n/a	Literature Search	n/a	N/A	N/A	N/A	Open Coding
Perna et al., (2009)	STEM	Journal Article	n/a	Case Study	19	Purposively		Documents, Focus Groups, Interviews	N/A

Note: These studies emphasize African American women's experiences in Computing/STEM. *An African American woman conducted these focus groups and/or interviews.

Barriers and Supports for African American Women in U.S. CE

Since African American women persist at lower rates than white women at all levels of U.S. Computing Education, further research is warranted about the barriers they encounter (Margolis et al., 2011). Several researchers have described the barriers (Borum & Walker, 2012; Bush, 2013; Galloway, 2012; Jackson, 2013; Ong, Wright, Espinosa, & Orfield, 2011; Perna et al., 2009) and supports (Borum & Walker, 2012; Bush, 2013; Charleston, Adserias, Lang, & Jackson, 2014; Charleston, George, Jackson, Berhanu, & Amechi, 2014; Ong, Wright, Espinosa, & Orfield, 2011; Perna et al., 2009) African American women face while pursuing postsecondary STEM degrees. However, fewer researchers have described the barriers and supports African American women encounter in the U.S. Computing Education pipeline (Charleston, Adserias, Lang, & Jackson, 2014; Charleston, George, Jackson, Berhanu, and Amechi's, 2014). In this section, I define the most prominent barriers and supports found in the relevant literature (Table 3). Likewise, I anticipate participants may describe these barriers and supports in their Counter-Life Herstories about their unique educational experiences throughout the U.S. Computing Education pipeline.

Barriers. As early as 1976, researchers began to shed light on the barriers faced by women of color in STEM (Malcom, Hall, & Brown, 1976). In the context of U.S. STEM and Computing Education, several researchers have described the barriers African American women may encounter (Borum & Walker, 2012; Bush, 2013; Charleston, Adserias, Lang, & Jackson, 2014; Charleston, George, Jackson, Berhanu, & Amechi, 2014; Galloway, 2012; Jackson, 2013; Ong, Wright, Espinosa, & Orfield, 2011; Perna et al., 2009).

"Chilly" climate. In several studies, participants used the term "chilly" describe the overall campus and classroom climates within U.S. educational institutions, in particular,

Computer Science and engineering departments (Borum & Walker, 2012; Bush, 2013; Jackson, 2013; Ong, Wright, Espinosa, & Orfield, 2011). African American women's responses were in agreement with reviewed literature on their marginalized experiences at predominately white institutions (PWIs). Specifically, African American women described U.S. Computer Science education departments as predominately white male, environments (Charleston, George, Jackson, Berhanu, and Amechi, 2014). One participant described the sexist nature of her Computer Science department as follows: "This isn't seen as a discipline for women." Other participants relayed the following responses from their white male peers: "Why are you still in school?" and "Why aren't you married and taking care of somebody?" In alignment with Black Feminist Thought and critical race theory tenets, participants' responses revealed the emphasis on race and gender in Computer Science departments at PWIs.

Double bind. Malcom, Hall, and Brown (1976) produced a report entitled *The Double Bind: The Price of Being a Minority Woman in Science.* In this landmark report, they shared how women of color in STEM met for the first time to discuss their unique placement as the most underrepresented and stigmatized group in their disciplines. Most African American women recognize the enduring presence of racism and sexism in educational institutions workplaces (Charleston, Adserias, Lang & Jackson, 2014). Although they represented different disciplines, backgrounds, and ethnicities, they shared a common bond of double oppression – sexism and racism. Since African American women encounter a double oppression or "double bind" due to gender and racial barriers (Borum & Walker, 2012; Charleston, Adserias, Lang & Jackson, 2014; Malcom & Malcom, 2011; Ong, Wright, Espinosa, & Orfield, 2011), they persist in Computing Education at even lower rates than white women. However, some African American women may identify more with gender barriers than racial barriers, which minimizes

their marginal position (Galloway, 2012).

Stereotype threat. As a psychological theory, Steele and Aronson (1995) defined *stereotype threat* as viewing or treating someone according to a negative stereotype. Upon studying Black students in standardized testing environments, they found stereotype threat affected their academic performance, and the student performed poorly. However, when students were told they were being tested for informational purposes only, they performed as well as their white peers. Therefore, African American women who are subjected to stereotype threat, often internalize the projected stereotypes and then, in turn, perform as expected (e.g. self-fulfilling prophecy) (Bush, 2013; Steele & Aronson, 1995). Ultimately, stereotype threat negatively impacts African American women's decisions to persist in the STEM and Computing Education pipeline (Perna et al., 2009).

Isolation, alienation, and imposter syndrome. Historically, STEM and Computing Education and workforce environments have been dominated by white males. As a result, African American women have often experienced a shared sense of isolation in these environments (Borum & Walker, 2012; Charleston, Adserias, Lang & Jackson, 2014). Moreover, in male-dominated environments, women may internalize an imposter syndrome complex, which impacts their sense of belonging in STEM and Computing disciplines (Stout, Dasgupta, Hunsinger, & McManus, 2011). Powell, Bagilhole, & Dainty (2009) found women may "undo their gender" (p. 411) to cope with feelings of isolation and the imposter syndrome. As a result, they adopt male mannerisms to assimilate into the male-dominated culture.

Inadequate academic preparation and prior experience. African American women, often enroll in postsecondary Computer Science programs but fail to obtain their degree (Margolis et al., 2003), since they were underprepared for its rigorous nature – keyboarding

skills, computer application usage, problem-solving, algorithmic and scientific reasoning, complexity, and analytical thinking (Herling, 2011; Heo & Myrick, 2009). African American women and other women of color, often lack access to computers at home or in school, which is described as the digital divide (Varma, 2006). As a result, they become confused about the Computer Science discipline and ultimately are disengaged from the field (Margolis, Goode, & Bernier, 2011). The digital divide is defined as the gap between those who have access to technology and those who do not (Irving, Klegar-Levy, Everette, Reynolds, & Lader, 1999).

Supports. Since researchers have focused more on barriers than supports, less research is available on African American women's descriptions about the supports which have influenced their persistence throughout the U.S. Computing Education pipeline. As such, I believe this study was warranted.

Mentoring and role models. Mentoring is a significant factor in women's persistence in STEM education, in particular at the graduate level (Borum & Walker, 2012). In Borum & Walker's (2012) study, African American women were impacted by mentors who shared the same race or gender as themselves. For example, participants who had Black female or Black male mentors acknowledged a stronger sense of encouragement to pursue the mathematics field, though they were positively impacted by mentors of any race or gender. Mentoring and support systems were the two primary codes used during the data analysis of in-depth interviews (n=12).

Church community, faith, and spirituality. Historically, the Black Church has played an enormous role in the lives of African American people (Dillard, 2000; Dillard, 2012; Dillard & Okpalaoka, 2011). In particular, African American women have traditionally used spirituality to gain power over their double oppression (Dillard, 2000, 2012). African American women have also turned to their church community for support as they persisted in STEM and Computing

Education (Bush, 2013).

Self-Determination and resilience. African American women who persist in U.S. STEM and Computing Education programs demonstrate a high-level of self-determination and resilience due to internal perseverance, mathematics and science self-efficacy, and spirituality (e.g. faith and prayer) (Bush, 2013). Self-determination may be classified as a theory, which was derived from empirical research that distinguished autonomy in human motivation (Deci & Ryan, 2011). Highly autonomous students reveal strong self-determination in educational settings (Reeve, 2002). Resilience is more than an innate quality that enables individuals to rebound from adversity or setbacks; it is a quality developed over time through life experiences (Benard, 1993). Oftentimes, individuals who have bounced back from adverse experiences are labeled as "invincible," "hardy," or "invulnerable" (Werner & Smith, 1982). Moreover, they have accessed protective factors that divert individuals from adverse conditions (Garmezy, 1993) to overcome risk factors that buffer, intercept, or prevent risk (Werner & Smith, 1982). African American women who persist in U.S. STEM and Computing Education programs demonstrate a high-level of determination and resilience due to internal perseverance, mathematics and science self-efficacy, and spirituality (e.g. faith and prayer) (Bush, 2013).

Family support. The family unit plays a significant role in the persistence of African American women, and other women of color. In particular, mothers have played an enormous role in the lives of African American women who persist in both STEM and Computing Education (Bush, 2013). The family unit has also influenced African American women's participation in the Black Church community.

Teachers and college professors. African American women who receive encouragement from their teachers during high school and professors in college are most likely to pursue and

persist in the STEM and Computing workforces (Schumacher, Johnson, Floyd, Reid, Noland, & Leukefeld, 2008). In the absence of encouragement, they are less likely to pursue or persist in a STEM or Computing job.

Summary. Despite efforts to influence students' pursuit of postsecondary Computing degrees, we have not seen significant increases in college enrollment, specifically among African American women (Hussar & Bailey, 2009). In this section, I described the most prominent barriers and supports found in the relevant literature that connected to my participants' Counter-Life Herstories about their unique educational experiences throughout the U.S. Computing Education pipeline. Since researchers recommended future studies should highlight African American women's successes, rather than focus solely on their barriers, I asked participants to describe the experiences that impacted their persistence in U.S. Computing Education. Upon completion, my participants and I identified the supports and barriers that contributed to their overall persistence.

Life History and Life Herstory Research

During my review of the literature, I discovered several definitions of life history (or life herstory), narrative, and closely related terms (Table 4). Initially, I assumed these terms were used interchangeably due to the significant overlap in definitions and the lack of consensus among researchers about their distinctions (Cole & Knowles, 2001; Wisniewski & Hatch, 1995; Janesick, 2010). For example, I noted the term life history overlapped with terms such as life story, "oral history, folklore, memory, déjá-vu, storytelling, autobiography, autoethnography, portraiture, biography, the long interview, reminiscence, photovoice, and photoethnography" (Janesick, 2010, p. 15).

Table 4

Definitions of the Life History Method and Related Terms

Term	Definition
1. Life history (Watson & Watson-Franke, 1985)	"any retrospective account by the individual of his/her life in whole or in part, in written or oral form that has been elicited or prompted by another person" (p. 2).
2. Life story (Goodson & Sikes, 2001)	The story a person tells about their life.
3. Life history (Goodson & Sikes, 2001)	The life history places the life story into its historical context.
4. Life history (Denzin, 1989)	"an account of a life based on interviews and conversations" (p. 48)
5. Narrative inquiry (Cole & Knowles, 2001)	Narrative inquiry captures and reconstructs life stories.
6. Narrative (Clandinin & Connelly, 1994)	"both phenomenon and method. Narrative names the structured quality of experience to be studied, and it names the patterns of inquiry for its study" (p. 416).

Life history versus narrative inquiry. After further reading, I discovered life history and narrative are two distinct research methods. Both narrative inquiry and life history research focus on individuals' educational experiences, which gain significance as they reflect on them in retrospect (Manen, 1990). However, the life history research method extends narrative inquiry by placing individuals' narratives (or stories) into a broader context (Cole & Knowles, 2001). Life history inquiry also places the researcher as directly engaged in the process (constructing, analyzing, and interpreting) (Hatch & Wisniewski, 1995). Hatch and Wisniewski's (1995) surveyed life history and narrative inquiry researchers to understand the distinctions between these two methods. Many of the survey respondents indicated the "analysis of the social, historical, political, and economic contexts of a life story by the researcher is what turns a narrative into a life history" (p. 125). Furthermore, since our lives are influenced by multiple contexts (e.g. social, political, educational, cultural, religious, familial), life history research

methods help us to interpret individuals' educational experiences in a broader context, while narrative inquiry focuses on deriving meaning from individuals' experiences (Cole & Knowles, 2001). Based on these distinctions, I have chosen to define life history as a method of narrative inquiry during this study (Wisniewski & Hatch, 1995).

Life history versus life story. The terms life history and life story are quite often used interchangeably (Atkinson, 2002). Since these terms are deceptively similar, researchers have debated their meanings (Adriansen, 2012). The life story is the story people tell about their life (Goodson & Sikes, 2001) while life history seeks to "understand how the patterns of different life stories can be related to their wider historical, social, environmental, and political context" (Adriansen, 2012, p. 41). During this study, I will collect each participant's counter-life stories over a period to construct their Counter-Life Herstory. Since qualitative methods such as narrative inquiry and life history (or life herstory) help to counter master narratives (Solórzano & Yosso, 2002), I refer to life herstories and life stories as Counter-Life Herstories and counter-life stories during this study. Using the interpretive frameworks of critical race theory and Black feminist thought, I situate their Counter-Life Herstories (a collection of counter-life stories) in the broader socio-political context of U.S. Computing Education.

Counter-life herstories or counter-life histories. "People resist [oppression] by identifying themselves as subjects, by defining their reality, shaping their new identity, naming their history, telling their story" (Hooks, 1990, p. 43). Counter-histories (Bagley & Castro-Salazar, 2012), also referred to as critical life histories (Diniz-Pereira, 2008), illuminate the voices of marginalized persons because they provide an alternative perspective of official history, which is based on a majoritarian viewpoint. During this study, I refer to counter-histories as Counter-Life Herstories to emphasize the illumination of marginalized persons'

voices, from an Afrocentric feminist epistemological perspective. Specifically, I collected, analyzed, and interpreted the Counter-Life Herstories of African American women faculty in U.S. Computing Education, who are classified as a marginalized group in the U.S. STEM and Computing workforces (and in general).

The rationale. Since there is a deficit of empirical studies, that examine African American women's educational experiences in U.S. Computing Education, from the perspective of African American women researchers, I believe the Counter-Life Herstory method is warranted for this study. Although studies have used the life history method to capture the educational experiences of African American women teacher educators through the lens of critical race theory (Agosto & Karanxha, 2011) and African American women principals through the prism of womanist theory (Witherspoon & Taylor, 2010), they did not classify it as a counter-life history or Counter-Life Herstory method. Since "oppressed groups have known stories are an essential tool for their own survival and liberation" (Delgado, 1989, p. 2436), critical race theorists have proposed the methodological use of counter stories (or Counternarratives) in education research (Solórzano & Yosso, 2001, 2002; Yosso, 2013) to highlight people of color's experiences and to "belie meritocratic, color-blind, and liberal majoritarian stories" (Closson, 2010, p. 267). While Bagley and Castro-Salazar (2012) [or Castro-Salazar and Bagley (2010)] explicitly collected counter-histories during their study, they seemed to use the term counter-histories interchangeably with the term Counternarratives. Since I believe the relationship between the counter-life history and counter-narrative research methods is analogous to the relationship between the life history and narrative research methods, I have chosen to view the counter-life history method (or counter life-herstory) as a type of counter-narrative. As such, I purposely chose to use the Counter-Life Herstory method, because it

places my participants' unique educational experiences in a broader socio-political context, unlike Counternarratives (or counter stories), which focus on "making meaning" of lived experiences (Cole & Knowles, 2001).

Summary. In the context of U.S. Computing Education, empirical studies about African American women's individual educational experiences, at any level, are seemingly inexistent. Therefore, this study will elicit Counter-Life Herstories to provide a holistic view of African American women's educational experiences in the broader socio-political context of U.S. Computing Education (Cole & Knowles, 2001).

Integrative Conceptual Framework

I used an integrative conceptual framework (King, 2013), that employs an overarching Afrocentric Feminist Epistemology, two interpretive frameworks (critical race theory and Black feminist thought), to manage my knowledge validation process about African American (AA) women's educational experiences (e.g. Counter-Life Herstories) throughout U.S. Computing Education (Figure 2). These theories provide the appropriate paradigms (lenses) to understand African American women's experiences (Howard-Hamilton, 2003), especially from an African American woman's perspective (e.g. Afrocentric Feminist Epistemology).

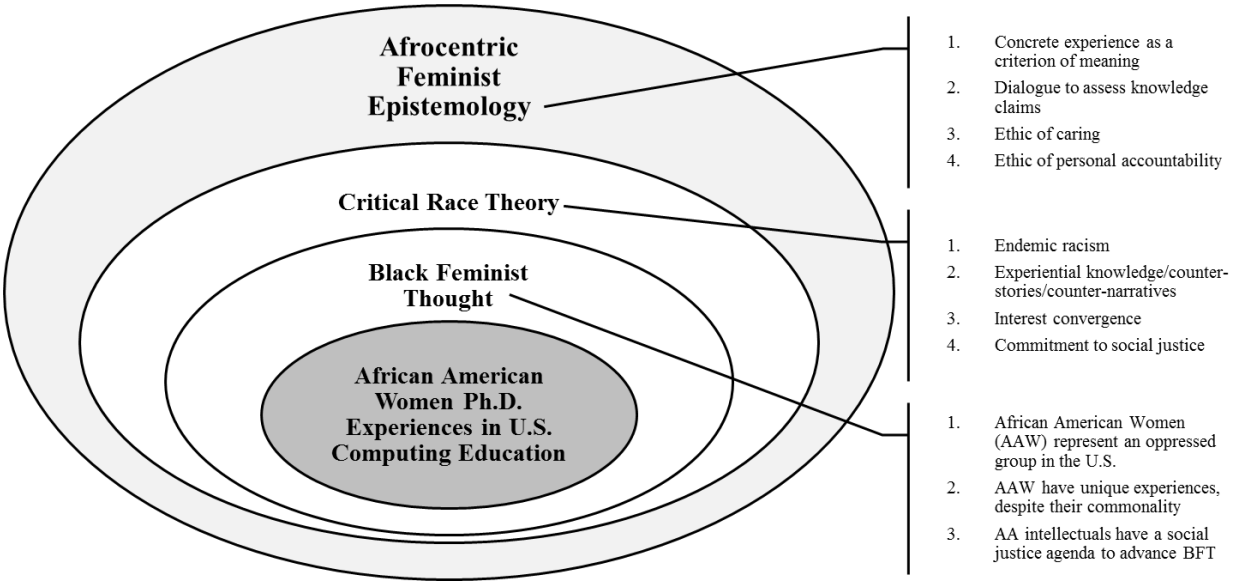

Figure 2. Detailed Integrative Conceptual Framework

Afrocentric feminist epistemology. Epistemology establishes an overarching theoretical framework to evaluate the standards we use in knowledge validation processes (Harding, 1987) and exposes power relationships to determine whose voices are believed and heard (Collins, 2009). I think it is essential to establish a detailed integrative conceptual framework when conducting research, which counters the majoritarian perspective (Harding, 1987).

Eurocentric masculinist epistemologies. In particular, an Afrocentric Feminist Epistemology produces knowledge in contrast to a Eurocentric Masculinist Epistemology. Historically, knowledge validation processes in the U.S. have been dominated by the Eurocentric masculinist (EM) epistemologies, which has represented the white male standpoint and have overshadowed the female standpoint and Black female standpoint (Collins, 2003).

Transformative paradigm. As interpretive frameworks, critical race theory and Black feminist thought align with the transformative paradigm (Mertens, 2010a) or worldview (Creswell, 2014), which serves as "a framework of belief systems that directly engages members

of culturally diverse groups with a focus on increased social justice" (Mertens, 2010b, p. 470). In qualitative research, transformative paradigms have: (1) an emphasis on the lived experiences of oppressed marginalized persons and the strategies they used to resist or challenge their oppression, (2) a focus on the imbalance of power and its influence on intersectionality (e.g. gender, race, ethnicity, socioeconomic class), (3) linkages to socio-political action, and (4) a belief system about systemic issues of oppression, domination and the origins of power relationships (Mertens, 2010a). According to Creswell (2014), qualitative researchers embrace a transformative worldview based on their personal experiences and their desire to "examine an issue related to the oppression of individuals" (p. 19). He suggests they collect personal stories about oppression, through open-ended interviewing, using a narrative inquiry design. Instead of narrative inquiry, I used the life history method (or life herstory), to elicit the Counter-Life Herstories of African American women faculty' experiences in U.S. Computing Education. As such, I governed my knowledge validation process through the usage of:

a) concrete experience as a criterion of meaning,

b) dialogue to assess knowledge claims,

c) an ethic of caring,

d) and an ethic of personal accountability.

As an African American woman emerging scholar, I have a unique position to follow an Afrocentric Feminist Epistemology (Collins, 2003, 2009), which utilizes CRT and BFT as interpretive frameworks to appropriately examine African American women's experiences in U.S. Computing Education (Collins, 2003; Howard-Hamilton, 2003).

Critical race theory. As a compilation of theories, critical race theory (CRT) originates from critical social theory (Karl Marx, Horkheimer - Frankfurt School), the African American

civil rights movement (Sojourner Truth, Frederick Douglas, W. E. B. Du Bois, César Chávez, Martin Luther King), Black Power movement (Malcolm X), and the Chicano movement (Delgado & Stefancic, 2012). During the 1970s, critical legal scholars of color (i.e., Derrick Bell [father of CRT], Alan Freeman, Kimberlé Crenshaw, and Richard Delgado) advanced CRT as a movement to address "the persistence of racism" (Closson, 2010, p. 261). For over a century, U.S. Supreme Court decisions perpetuated a cycle of racism and white supremacy towards Blacks. In the summer of 1989, twenty-three legal scholars of color (Anita Allen, Taunya Banks, Derrick Bell, Kevin Brown, Paulette Caldwell (New York University), John Calmore, Kimberlé Crenshaw, Harlon Dalton, Richard Delgado, Neil Gotanda, Linda Greene, Trina Grillo, Isabelle Gunning, Angela Harris, Mari Matsuda, Teresa Miller, Philip T. Nash, Elizabeth Patterson, Stephanie Phillips, Benita Ramsey, Robert Suggs, Kendall Thomas, and Patricia Williams) met during a weeklong workshop in Madison, Wisconsin, for the first recorded CRT meeting (Brown & Jackson, . Many of these scholars were the first persons of color hired as law professors at their predominantly white law schools. During this meeting, they discussed recent historical events, potential solutions for the slow and ineffective process in place to address inequality of Blacks, and their response to the critical legal studies (CLS) conferences. CLS was a movement spearheaded by predominately white liberal legal scholars to negate claims about the neutrality of legal discourse by educating the legal community about race, gender, and class (Bell, 1980, 1993; Crenshaw, 2011; Delgado & Stefancic, 2012; Phillips, 2014). Scholars of color who participated in the CLS conferences believed white legal scholars did not fully comprehend the impact of racism on people of color and thus marginalized Black people's experiences. Moreover, they found CLS too flippantly dismissed legal rights, which were the premise for desegregation, voting rights, and anti-discrimination for Blacks. In response,

scholars of color forged the CRT movement full speed ahead out of frustration (Brown & Jackson, 2013).

CRT in education. As CRT transitioned from legal studies into education, and other disciplines, the descriptions of its core tenets, premises, themes, or characteristics became unclear (Closson, 2010). CRT was introduced into education by Gloria Ladson-Billings and William Tate (1995) in their seminal work "*Toward a Critical Race Theory of Education*". Ladson-Billings (1998) and Tate (1997) also followed with subsequent individual works (Agosto, Karanxha, & Ballara, 2014). The prominent CRT tenets emphasized in education literature (Agosto, Karanxha, & Ballara, 2014; Closson, 2010; Delgado & Stefancic, 2012) include endemic racism/ racial realism/permanence of racism (Bell, 1993), interest convergence (Bell, 1980), experiential knowledge/ counter stories/Counternarratives (Brown & Jackson, 2013; Delgado & Stefancic, 2012), critique of liberalism (DeCuir & Dixson, 2004; Gotanda, 1991), whiteness as property (Harris, 1993), interdisciplinarity, the law, and social justice orientation (Matsuda, 1996; Solórzano, 1997; Solórzano, Ceja, & Yosso, 2000; Solórzano & Bernal, 2001; Solórzano & Yosso, 2002). These tenets comprise an interpretive framework, which exposes racism and inequality in education in the United States (Howard-Hamilton, 2003; Parker, 2015). This study will use the tenets of endemic racism, experiential knowledge/counter stories/Counternarratives, interest convergence, and the commitment to social justice to place African American women's experiences in the relevant socio-political context in Computing Education.

Endemic racism. Endemic racism is one of the central tenets in CRT (Closson, 2010). Racism is defined as a "system of ignorance, exploitation, and power used to oppress African Americans, Latinos, Asians, Pacific Americans, American Indians and other people on the basis

of ethnicity, culture, mannerisms, and color" (Marable, 1992, p. 5). In the U.S., race is socially constructed to differentiate racial and ethnic groups based on the superiority of the dominant race (Banks, 1995), which situates African Americans in an institution of power they have never possessed (Solórzano, Ceja, & Yosso, 2000). Moreover, educationists, sociologists, psychologists, and political scientists consider race as a social construct, although it is refuted by science (Phillips, 2014). In the U.S., endemic racism also referred to as racial realism or the permanence of racism, describes the normality of racism in the U.S., although non-CRT scholars may not admit to it (Ladson-Billings, 2013). This section describes racism's discriminatory effects and microaggressions, which African Americans encounter in school-based settings and on college campuses, to describe the socio-political context of endemic racism. It concludes with an explanation of counter space, which students of color create in response to microaggressions (Solórzano, Ceja, & Yosso, 2000).

Discriminatory effects of racism. Historically, white lawmakers have regulated acts of racism to conscious perpetrators and have ignored the unconscious impact of racism on people of color. As a CLS scholar, Alan Freeman (1978) introduced the concept of racial realism in his article *Legitimizing Racial Discrimination through Antidiscrimination Law: A Critical Review of Supreme Court Doctrine*. In 1987, Charles Lawrence further extended Freeman's argument in his article *The Id, the Ego, and Equal Protection Clause: Reckoning with Unconscious Racism*. CRT scholars credited Freeman's article as one of the best in CLS discourse (Brown & Jackson, 2013). Freeman believed the Supreme Court has viewed racism and racial discrimination from the perpetrator's standpoint and not the victim's standpoint. As such, the Supreme Court has defined discrimination in the context of discriminatory intent instead of discriminatory effects (i.e., Washington v. Davis). Discriminatory intent only accounts for conscious decisions of

discrimination, while discriminatory effects account for unconscious racism – the unintentional actions which inflict harm or negatively impact people of color. From the victim's perspective, racial discrimination is a social phenomenon which impacts every aspect of their life (i.e., college acceptance, degree attainment, employment, income, housing, etc.). Unfortunately, perpetrators have not viewed racial discrimination as a social phenomenon, nor have they realized their neutrality or colorblind perspective. From the victim's perspective, racial discrimination, in the form of microaggressions, must be eliminated to improve their educational attainment, income potential, and overall quality of life (Freeman, 1987).

Microaggressions. Psychiatrist Chester Pierce described microaggressions as the effects of daily subtle and cumulative put downs, which "contribute to diminished mortality, augmented morbidity, and flattened confidence" (1995, p. 281). These daily "microaggressions, such as being pulled over by the police in an affluent neighborhood or being mistaken for a subordinate employee (Phillips, 2014), are the "conscious, unconscious, verbal, nonverbal, and visual forms of insults directed toward people of color" (Delgado & Stefancic, 2012; Solórzano, Ceja, & Yosso, 2000). African Americans experience the "everydayness" of racism as described in Derrick Bell's (1993) "rules of racial standing", albeit their statements and complaints about racism are often disregarded by the majority race, even in cases of justifiable racism (pp. 111-121). In educational settings, African Americans experience the effects of microaggressions based on the racial climate (Solórzano, Ceja, & Yosso, 2000).

Effects of racial microaggressions. Solórzano, Ceja, & Yosso (2000) conducted a qualitative study on college racial climate (i.e., racial environment) and the impact of microaggressions on 34 African American students through 10 focus group interviews at three elite PWIs. They discovered African American students' experiences in racial college climates,

both academic and social spaces, resulted in their isolation, self-doubt, and frustration, even in seemingly race-neutral environments. Racial environments on college campuses play an integral role when examining college entry, persistence, degree attainment and upward transfer to graduate degree programs of African American students. Positive racial environments for African American students on college campuses consist of the following elements: (a) inclusion of students, faculty, and administrators of color, (b) culturally-relevant curriculum, (c) programs to support recruitment, retention, and degree attainment, and (d) institutional mission statements, which reflect a commitment to racial equality. These elements are likely inexistent in negative racial environments, which contribute to subpar academic performance and attrition of African American students in undergraduate programs (Hurtado, Milem, Clayton-Pedersen, & Allen, 1999). Therefore, African American students and other students of color create counterspaces in response to racial microaggressions (Solórzano, Ceja, & Yosso, 2000).

Counterspaces: A response to microaggressions. In response to daily microaggressions, African American college students create academic and social "*counterspaces*" to shelter themselves from negative racial climates (Howard-Hamilton, 2003; Solórzano, Ceja, & Yosso, 2000, p. 66). Both on-campus and off-campus academic counterspaces for African American students include peer study groups, student organizations, sororities and fraternities, and study halls. In these positive environments, African American students take the initiative to learn and develop supportive environments in which they are valued and validated (Solórzano & Villalpando, 1998). They also develop social counterspaces, outside of the classroom, to release frustrations and bond with colleagues who share their experiences of microaggressions and blatant discrimination.

In Solórzano, Ceja, and Yosso's (2000) study, African American students expressed their perspectives about the need for academic and social counterspaces at their universities. One African American female student pursued academic counterspaces because of her comfort level with other African Americans. "I just feel more comfortable dealing with African American people in every aspect ... counseling, financial aid. I just look for the first African American face I find because I feel like they're going to be more sympathetic." (p. 70). Another African American student suggested social counterspaces often derive from academic counterspaces.

> ... the benefit that I have gained from [a study group of African American students] is that my involvement in the African American community has grown, and that's where I found a lot of my support. Even in terms of academics, I go study with the "homies" all the time. Go to [a certain student lounge] and you're going to a million African American faces, and it's going to be cool.... You might not get that much studying done, but it's a cool little network that's created because classes are so uncomfortable (p. 70).

Although African American students' study habits are adversely affected in academic counterspaces, which transition into social counterspaces, they serve as excellent outlets for these marginalized students to have a "voice". Oftentimes, these marginalized students' voices are silenced by dominant groups in campus racial climates (Solórzano, Ceja, & Yosso, 2000).

> When the ideology of racism is examined, and racist injuries are named, victims of racism can find their voice. Further, those injured by racism discover they are not alone in their marginality. They become empowered participants, hearing their own narratives (or stories) of others, listening to how the arguments are framed and learning to make the arguments themselves (Solórzano, Ceja, and Yosso, 2000, p. 64).

Therefore, counterspaces are excellent tools to empower African American women on college campuses. Often African American women use counterspaces as "sister circles" to share *counter stories* which reflect their experiences in campus racial environments.

Counterstories and Counternarratives. Experiential knowledge in CRT is expressed in various ways across legal and education scholarship. In essence, it follows a Eurocentric masculinist or constructivist epistemological approach to uncovering truth. In legal scholarship,

CRT scholars believe experiential knowledge may only be expressed by people of color because white scholars are disconnected from people of color's experiences and unique histories. As such, CRT scholars have typically disapproved of white scholars using the CRT framework (Delgado, 1995). In higher education, CRT scholars apply experiential knowledge to describe race, fictional character backgrounds, and to corroborate student and faculty stories (Closson, 2010). This section further describes the power of Counterstories to nullify majoritarian stories (Closson, 2010; Bernal & Villalpando, 2002).

The power of Counterstories. Traditionally, lawyers have used storytelling (or stories) in legal scholarship, and civil rights cases, to construct realities to persuade favorable judge and jury decisions. CRT scholars have extended a legal scholarship to use storytelling in the forms of parables, discussions, autobiographies, personal testimonies, and counter stories to influence how race is portrayed in the U.S. and to uncover hidden facts (Delgado & Stefancic, 2001, 2012; Solórzano, 1997; Bernal & Villalpando, 2002). Counterstories also referred to as Counternarratives, highlight people of color's experiences to "belie meritocratic, color-blind, and liberal majoritarian stories" (Closson, 2010, p. 267). They challenge the existing ideologies of the dominant group with untold stories of people of color's lived experiences. For example, CRT scholars Derrick Bell and Patricia Williams used slave Counternarratives to expose knowledge about plantation life from their perspectives (Delgado & Stefancic, 2012). In Solórzano, Ceja, and Yosso's (2000) study, they used African American student counter stories to expose microaggressions at a PWI. Although, some CRT scholars believe studies in education are too engrossed with counter stories or Counternarratives of African Americans and other people of color (Dixson & Rousseau, 2005), others believe narrative analysis aids African Americans with breaking the silence and finding their voices (Delgado & Stefancic, 2012;

Solórzano, Ceja, & Yosso, 2000). For African Americans and other people of color, Counternarratives are powerful tools to break the silence of racism and racial discrimination because they magnify their experiences. African Americans often may remain silent and impose blame upon themselves, rather than raise awareness about their victimization. Upon voicing racial discrimination and recognizing others have had similar experiences, they become empowered to challenge their beliefs and ideologies (Delgado & Stefancic, 2012). In light of interest convergence, Counternarratives may be used as social justice tools to help African American women regain their voice in the dominant socio-political culture.

***Interest convergence*.** Derrick Bell (1980) posited Blacks' concerns (civil, economic, and social) are only addressed if they converge with the concerns of whites. Bell and other CRT scholars claimed significant civil rights legislation only benefited Blacks because they equally benefited whites. The most relevant examples for this study include Brown v. Board of Education and affirmative action.

Brown v. Board of Education. In the 1954 Brown v. Board of Education case, the Supreme Court's unanimous decision of *separate is inherently unequal* overturned the 1896 Plessy v. Ferguson case's *separate but equal* ruling. The Brown ruling was supposed to set precedence for abolishing segregation in education and other public venues. However, Bell (1980) hypothesized that Brown benefited whites more than Blacks because it advanced the U.S. Cold War's foreign policy agenda while addressing racial inequality. Prior to this case, the NAACP (National Association for the Advancement of Colored People) Legal Defense Fund had litigated school desegregation cases to no avail. Bell (1980) argued the Court's sudden favorable decision was not precipitated because of social justice concerns but because of the world and domestic concerns (Delgado & Stefancic, 2012; Dudziak, 1998; Ladson-Billings & Tate, 2004).

From a domestic perspective, the U.S. feared African American service members would cause mass unrest if they returned home to segregated conditions after experiencing democracy during World War II and the Korean War (Dudziak, 1998; Ladson-Billings, 2004). Simultaneously, the U.S. desired to protect its world image as a democratic nation, since it was a proponent of the Soviet Union not spreading communism to developing Third World countries (Dudziak, 1998; Ladson-Billings, 2004). The United States Department of Justice (1954) stated, "The United States is trying to prove to the people of the world, of every nationality, race, and color, that a free democracy is the most civilized and secure form of government yet devised by man." (Dudziak, 1998; Ladson-Billings, 2004). Furthermore, the Court followed up with the Brown II decision in 1955, which ordered public school districts in 21 states to desegregate (i.e., adhere to the 1868 equal protection clause of the Fourteenth Amendment) "with all deliberate speed". After forty years since the Brown decision, Ladson-Billings and Tate (1995) found school districts are still largely segregated. African Americans represented the majority population in 21 of 22 large urban U.S. school districts, although they equated to 12% of the overall population. In retrospect, Tate, Ladson-Billings, & Grant (1993) suggested the Court tried to solve a social justice problem mathematically and permitted racist states to desegregate at their own pace. Unfortunately, the notion of affirmative action presented another case of interest convergence.

*Affirmative action***.** Although the Civil Rights Act of 1964 was one of the most important civil rights legislation since Reconstruction, it was an ineffective solution to correct inequality for Blacks. President Lyndon B. Johnson signed the Act on July 2, 1964, to ban "any discrimination based on race, ethnicity, color, religion, or national origin" (Phillips, 2014, p. 190). However, he later suggested affirmative action was needed to ensure Blacks were treated

fairly and given the same opportunities as whites during a commencement address at Howard University (an HBCU).

> You do not take a person who, for years, has been hobbled by chains and liberate him, bring him up to the starting line of a race and then say, 'you are free to compete with all the others,' and still justly believe that you have been completely fair…We seek not just freedom but opportunity—not just legal equity but human ability—not just equality as a right and a theory, but equality as a fact and as a result. (pp. 635-640)

Shortly following his address, President Johnson issued Executive Order 11,246 on September 24, 1965, to enforce government contractors to "take affirmative action" (para. 8) and document hiring practices when considering minority employees for prospective job opportunities. The order was amended on October 13, 1967, to include potential employee considerations based on gender. CRT scholars believe this amendment circumvented affirmative action benefits from people of color to the interest of white women (Phillips, 2014). During this timeframe, colleges also adopted affirmative action in their admission policies to open up opportunities for Blacks, and likely white women (Brown & Jackson, 2013). Some whites feel victimized by affirmative action because they seemingly sacrifice employment (or college acceptances) for less qualified Black applicants (or prospective students) (Delgado & Stefancic, 2012). However, they disregard their white privilege (fringe benefits of being white: favors, exchanges, and courtesies) which automatically places Blacks, and people of color, at a disadvantage for job placement and college acceptances, regardless of race and socioeconomic status (Delgado & Stefancic, 2012). Today, minority enrollment continues to suffer because public universities have still opposed affirmative action (Chace, 2011), which infers a social justice intervention is needed.

A social justice agenda. A social justice agenda strives to eradicate all discriminatory practices based on race, gender, language, age, or class (Matsuda, 1996). In legal scholarship, CRT's focus on social justice is evident (Capeheart & Milovanic, 2007). When legal CRT

scholars met for the first meeting in the summer of 1989, they had a social justice agenda – to address endemic racism. Loretta Capeheart and Dragan Milovanic (2007) further described strategies CRT has used to advance social justice agenda such as jurisprudence of color, retelling stories, consciousness-raising (counterspaces) in their book *Social Justice: Theories, Issues, and Movements*. In education, CRT scholars' goal was to advance the social justice agenda from theory to praxis (Solórzano & Yosso, 2002; Somekh & Lewin, 2011). For example, Solórzano, Ceja, & Yosso's (2000) used African American students' Counternarratives during focus group interviews to expose racial microaggressions and its effects on a college campus (i.e., campus racial climate). To combat microaggressions, African American students created counterspaces to shield themselves from microaggressions, which is a vital social justice strategy for students of color survival in higher education (Solórzano & Villalpando, 1998). The nature of this study demonstrated a commitment to social justice by "giving voice" to marginalized students. (Solórzano & Yosso, 2002). During this study, I follow a social justice agenda to capture African American women's Counternarratives about their experiences in secondary and postsecondary Computing Education.

CRT provides a solid epistemological framework to describe the socio-political environment in U.S. education. Specifically, this section highlighted the most relevant CRT tenets for the examination of African American women in secondary and postsecondary education settings to include endemic racism, counter stories/Counternarratives, interest convergence, and the need for a social justice agenda. Howard-Hamilton (2003) declared methods such as exposure to microaggressions, counterspaces, and counter stories are appropriate tools to rouse the consciousness of African American women and other disadvantaged groups. Although CRT describes the socio-political environment based on race,

in U.S. education, it does not account for intersectionality of race, gender, class, religion, and other social statuses which impact a comprehensive understanding of African American women's experiences.

Black feminist thought. This section outlines Black feminist thought (BFT) to understand better the educational experiences of African American women. BFT derived from both Afrocentric and feminist standpoints; however, feminist standpoints are different from Afrocentric standpoints (Collins, 1989). While feminist standpoint primarily focuses on white women's oppression and experiences, from their perspective, it does not address African American women's experiences (Collins, 1989). Although intersectionality (Crenshaw, 1991) is an appropriate lens to describe multifaceted racial and social identities, it does not lend itself to African American women's unique experiences. Similarly, critical race feminism, which emerged from CRT, describes women of color's experiences (Evans-Winters & Esposito, 2010). However, BFT was chosen for this study because it more appropriately targets African American women.

In the U.S., African American women have experienced a double oppression (racism and sexism), which has dramatically impacted their experiences in comparison to white women (Ong, Wright, Espinosa, & Orfield, 2011). Particularly, their marginalization in higher education has caused us to feel like an outsider in comparison to members of the dominant group. As a result, they often lack a sense of belonging and fail to persist in higher education. Patricia Hill Collins (2009) defined BFT to illuminate the standpoint of African American women, from their perspective. BFT has five distinguishing features to describe African American women's experiences (Collins, 2009): 1) African American women represent an oppressed group in the U.S., 2) African American women have unique experiences, despite their commonality, 3)

African American women's collective experiences influence their individual standpoints and activism, 4) African American intellectuals have a social justice agenda to advance BFT, and (5) BFT is dynamic. In this study, I applied the following BFT features (1, 2, and 4) to understand African American women experiences in Computing Education.

African American women represent an oppressed group. BFT was developed as a tool to help African American women resist their oppression. Patricia Collins (2009) supposed if an African American woman's "consciousness concerning how she understands her everyday life undergoes change, she can become empowered" (Collins, 2009, p. xi). As such, she included documented stories of African American women to depict their experiences with negative self-images and oppressive stereotypes, which were imposed upon us by the dominant group in the U.S. BFT is an appropriate framework because it was developed for African American women and is based on the experiential knowledge of African American women. Although the U.S., proclaims social justice is available to all Americans, African American women, along with other oppressed groups, still face institutionalized racism due to racial segregation and discrimination in sociopolitical settings (Collins, 2009). As a result, African American women share a common bond (i.e., standpoint) in their struggle against racism and sexism. Many institutions which embrace a colorblindness standpoint believe an emphasis on race perpetuates racism, which masks the existence of social injustices (Collins, 2009). BFT gives voice to African American women experiences, and their marginalization, to challenge this colorblind and majoritarian perspective. Collectively, as African American women's voices are unsilenced, they raise their consciousness and help us obtain independence (Collins, 2009). During this study, African American women will express their experiences in Computing Education, as Counternarratives to the dominant group's experiences. African American women exhibit an

important aspect of gaining independence when they voice their unique experiences.

African American women have unique experiences. While African American women share common experiences as a marginalized person, their experiences are unique, and they have different perspectives on the significance of their experiences (Collins, 2009). Regardless of their intersectionality (i.e., socioeconomic status, age, class, or religion), African American women encounter race and gender discrimination in various settings (i.e., educational, workplace, housing, and everyday life), which constitutes their individual experiences. Traditionally, African American women have used spirituality to gain power over these multiple oppressions (Dillard, 2000, 2012; Dillard, Abdur-Rashid, & Tyson, 2000; Dillard & Okpalaoka, 2011). For many of us, this is "our path to self-liberation and self-discovery" (Dillard, 2012, p. 449). As such, African American women must share their individual experiences and personal points of view freely to counteract oppressive images and values, which have silenced them (Howard-Hamilton, 2003). As African American women share their experiences, their recurring themes of injustice will constitute their standpoint. During this study, African American women will share their unique experiences in Computing Education to develop a Counter-Life Herstory account, from their perspective.

African American women have a social justice agenda. Patricia Collins (2009) suggests African American women intellectuals have a social justice agenda to serve as leaders in the production of experiential knowledge, by African American women. She asserts (pp. 39-40):

> Black women intellectuals are central to Black feminist thought for several reasons. First, their experiences as African American women provide us with a unique angle of vision concerning Black womanhood unavailable to other groups, should we choose to embrace it. Second, Black women intellectuals both inside and outside the academy are less likely to walk away from Black women's struggles when the obstacles seem overwhelming or when the rewards for staying diminish. Third, Black women intellectuals from all backgrounds must aggressively push the theme of self-definition because speaking for oneself and crafting one's own agenda is essential to empowerment.

> Fourth, Black women intellectuals are central in the production of Black feminist thought because we alone can foster the group autonomy that fosters effective coalitions with other groups.

In Computing Education research, there is limited scholarly literature which has been produced by and for African American women. During this study, I served as the qualitative instrument to describe African American women experiences in Computing Education, from the same perspective. As such, I illuminated their unique experiences in Computing Education to develop their counter-life-history account. This research will add to the body of knowledge about African American women experiences in both secondary and postsecondary Computing Education, from the perspective of an emerging African American woman scholar.

Summary. BFT provides an appropriate lens to understand the experiences of African American women in Computing Education. It extends the groundwork of feminist thought to provide further insight into African American women's experiences, from their perspective (Howard-Hamilton, 2003). In partnership with CRT, BFT constructs the appropriate lens to examine African American women's unique experiences in U.S. Computing Education, from their perspective.

Review of Literature Summary

The review of the literature revealed considerable gaps concerning the unique educational experiences of African American women throughout the U.S. Computing Education pipeline. First, I found much of the relevant research (Table 3) focused on African American women's experiences in STEM Education rather than Computing Education, and it revealed little about their unique experiences at all levels of Computing Education (e.g., primary, secondary, postsecondary). In particular, the literature revealed little about African American women's pathways into postsecondary Computing Education, their graduate experiences, in particular at

the Ph.D. level, and their faculty experiences. I perceive participants will be college faculty though there is a small population of African American women professors or faculty members. Therefore, my participants' confidentiality and ethical considerations will be of high importance during this study. I believe a life history approach is warranted to elicit their individual, yet confidential, educational experiences in U.S. Computing Education.

Though most studies followed a phenomenological design to understand participants' shared experiences, I will follow a life history approach to give voice to their unique experiences. Existing studies used appropriate frameworks, such as Black feminist thought, critical race theory, or intersectionality. King (2013) employed both Black feminist thought and critical race theory in an integrative conceptual framework, which I have extended to include Afrocentric Feminist Epistemology. As suggested by Howard-Hamilton (2003), I gave voice to African American women's educational experiences in the socio-political context of U.S. Computing Education through the interpretive lenses of critical race theory and Black feminist thought, from an Afrocentric feminist epistemological perspective. Since U.S. educational institutions are attributed to the underrepresentation of African American women, and other women of color, at all levels of U.S. STEM and Computing Education (Margolis et al., 2003; Ong, Wright, Espinosa, & Orfield, 2011), I believe the life history method is most appropriate to situate African American women's experiences in the proper context.

Most importantly, I found few, if any, existing studies which give voice to African American women's experiences throughout the U.S. Computing Education pipeline are nearly nonexistent, especially from an African American woman scholar's perspective. As an African American woman, with similar Computing Education experiences, I have a "unique angle of vision" to illuminate the voices of African American women using an Afrocentric feminist

epistemological perspective.

Overall, I believe the collective gaps in the literature revealed a need for my Counter-Life Herstory study to give voice to African American women's unique educational experiences throughout the U.S. Computing Education pipeline.

CHAPTER THREE: METHODS

Introduction

In this life history qualitative study, my purpose was to explore the Counter-Life Herstories (i.e., life histories) of African American women faculty in U.S. Computing Education (e.g., Information Systems, Computer Science, and Computer Engineering). Similar to Counterstories, Counter-Life Herstories give voice to marginalized persons to counter the master narrative (i.e., majoritarian perspective) about their experiences (Closson, 2010; Bernal & Villalpando, 2002). They also provide a powerful method for African American women, and other people of color, to break the silence (i.e., uncover hidden truths) of racism and racial discrimination (Delgado & Stefancic, 2012). As an emerging African American woman scholar, with a Bachelor's degree in Computer Science, I have a "unique angle of vision" (Collins, 2009, p. 39), and I follow a social justice agenda, to situate African American women's unique educational experiences in the social-political context of U.S. Computing Education, from an Afrocentric feminist epistemological perspective (Collins, 2009).

Exploratory questions. Because research questions are not essential in life history research, I constructed the following exploratory questions to guide my study.

1. How do African American women faculty in U.S. Computing Education describe their educational experiences (i.e., elementary school, middle school, high school, Master's, Ph.D.)?
2. How do African American women faculty in U.S. Computing Education describe the experiences that impacted their persistence (e.g., high points, low points, turning points,

challenges) to achieve a postsecondary degree in U.S. Computing Education?

3. What improvements do African American women with faculty in a Computing discipline suggest to broaden the participation of African American women in U.S. Computing Education?

In this chapter, I describe the methods I selected for this study. First, I describe my rationale for choosing a narrative qualitative research approach, based on a transformative worldview and the Counter-Life Herstory design. Second, I discuss my role as the researcher and my participant selection process. Finally, I detail the data collection, data analyses and interpretation methods used in this study, followed by a discussion of trustworthiness and ethical considerations.

Life History Qualitative Research Approach

During this study, I followed a life history qualitative research approach (Creswell, 2014), which is defined as "an approach to exploring and understanding the meaning individuals or groups ascribe to a social or human problem" (Creswell, 2014, p. 4). Qualitative inquiries are "concerned with moral discourse" as it constructs "sites for critical conversations about democracy, race, gender, class, nation-states, globalization, freedom and community" (Denzin & Lincoln, 2005, p. 3), which creates the appropriate setting for marginalized persons, such as African American women, to discuss their U.S. educational experiences at all levels. Qualitative research is also most suitable when a little research is available on a particular phenomenon (Creswell, 2014). Specifically, I followed a transformative qualitative research approach, based on my Afrocentric feminist epistemological perspective.

Life History Research Design

Since individuals' lives are influenced by multiple contexts (e.g., social, political, educational, cultural, religious, familial), life history research methods help us to interpret their lived experiences in a broader context, while narrative inquiry focuses solely on deriving meaning from individuals' experiences (Cole & Knowles, 2001). As qualitative methods, such as narrative inquiry and life history, help to counter master narratives about marginalized person's experiences (Solórzano & Yosso, 2002), I refer to life histories and life stories as Counter-Life Histories and counter-life stories during this study. Furthermore, I introduce a femininized method of Counter-Life History into this genre of research – the *Counter-Life Herstory* , which is constructed based on the analysis of artifacts (e.g., timelines) and counter-life stories voiced by marginalized women to reflect their retrospective experiences over the course of their lives. Collectively, I refer to my participants' stories as Counter-Life Herstories.

Counter-life herstories. In this study, I re-conceptualized the collection of Life Histories as Counter-Life Herstories to give voice to African American women, from an Afrocentric feminist epistemological perspective. Specifically, I collected, analyzed, and interpreted the Counter-Life Herstories of African American women faculty who attained Ph.D. degrees in a Computing discipline because they are classified as a marginalized group in the U.S. STEM and Computing workforces (and in general). In the context of U.S. K-20 Computing Education, empirical research about African American women's individual educational experiences, at any level, is seemingly inexistent, particularly from the perspective of African American women scholars, which warrants my conceptualization of the Counter-Life Herstory method.

Though educational researchers have used the life history method to capture the lived experiences of African American women teacher educators, through the lens of critical race theory (Agosto & Karanxha, 2011) and African American women principals through the prism of womanist theory (Witherspoon & Taylor, 2010), they have not yet classified it as a counter-life history or Counter-Life Herstory method. Since I believe the relationship between the Counter-Life Herstory and counter-narrative research methods is analogous to the relationship between the life herstory and narrative research methods, I viewed the Counter-Life Herstory method as a type of counter-narrative. As such, I intentionally used the Counter-Life Herstory method to place participants' educational experiences in a broader socio-political context, instead of using Counternarratives (or counter stories), which focus solely on "making meaning" of lived experiences (Cole & Knowles, 2001). During this study, I elicited the Counter-Life Herstories of African American women faculty to provide a holistic view of their educational experiences in the broader socio-political context of U.S. Computing Education (Cole & Knowles, 2001).

My Role as the Researcher

As an emerging African American woman scholar, with a Bachelor's degree in Computer Science and thirteen years of Computing industry experience, I followed a social justice agenda to conduct this study from an Afrocentric feminist epistemological perspective (Collins, 2009). Since I shared similar educational experiences as my African American women participants, I had a "unique angle of vision" to illuminate their voices (Collins, 2009, p. 39), which is informed by my commitment to broadening the participation of African Americans in the STEM and Computing workforces. During this study, I frequently reflected on my experiences in U.S. Computing Education to articulate questions such as: "What were the supports and barriers that attributed to their success?", and "What pathways did they construct into U.S. Computing

Education, since distinct pathways are unclear? (Margolis, 2008; Margolis et al., 2003; Margolis, Goode, & Bernier, 2011). As the qualitative instrument in this study, I structured my exploratory questions, review of the literature and integrated conceptual framework based on these questions.

Utilizing an Afrocentric feminist epistemology to govern my knowledge validation process, I engaged directly with participants in a series of four interviews (e.g., timeline interview, semi-structured Counter-Life Story interviews) to collect their Counter-Life Herstories. I accepted their stories as concrete evidence and employed ethics of caring and personal accountability to maintain their anonymity through the usage of pseudonyms. Moreover, the participants and I shared our perspectives and personal experiences throughout the process in reflective journals. Additionally, I used my journal to expose my biases and to capture participants' unspoken responses (Atkinson, 2002). Through thematic analysis and the classification of emergent themes, I identified their collective standpoint about African American women faculty experiences in U.S. Computing Education. Using the interpretive frameworks (lenses) of critical race theory and Black feminist thought, I situated their Counter-Life Herstories in the appropriate socio-political context to interpret their stories (Janesick, 2007).

Participant Selection

In this study, I targeted African American women who had attained a Ph.D. degree in a Computing discipline (e.g., Computer Science, Computer Engineering, Information Technology, Information Systems, and Information Science) and who currently worked as a professor in a Computing Education department at a college or university in the United States. In 2012, Black women attained 1,460 of 45,595 U.S. Bachelor's degrees, 580 of 21,001 U.S. Master's degrees and 16 of 1,690 U.S. Ph.D. degrees awarded in Computing Sciences (NSF, 2015). Based on these trends, my projected population of African American women who had received faculty in a

Computing discipline in the U.S. since 2012 was relatively small (n=48). Therefore, I conducted a nationwide search to recruit the participants in my study.

Purposeful sampling. Sample sizes in qualitative studies are justifiably small to capture insightful and rich data (Krueger & Casey, 2009; Merriam & Tisdell, 2015; Miles & Huberman, 1994). Therefore, I selected the first five respondents to fulfill the requirements of this dissertation study, which is a reasonable sample size (e.g., approximately 5-12% of the population).

Criteria. To obtain the most insight into the educational experiences of African American women in U.S. Computing Education, participants met the following criteria (Merriam & Tisdell, 2015): (a) African American women who are U.S. citizens, (b) African American women who have a Ph.D. degree in a Computing discipline (e.g., Computer Science, Computer Engineering, Information Systems, Information Technology) from a U.S. doctoral-granting institution, (c) African American women who work in postsecondary U.S. Computing Education, and (d) African American women who are willing to share openly about their educational experiences over a series of four in-depth interviews.

Recruitment strategy. Initially, I planned a mass recruitment effort to identify potential participants at national conferences and by using the Google.com search engine. I also planned to email a recruitment flyer to my identified contacts at national organizations (e.g., National Committee of Women in Information Technology, Association for Computing Machinery for Women) and program administrators in Computer Science and engineering departments at U.S. postsecondary education institutions. Upon obtaining IRB approval, I emailed the recruitment flyer (Appendix H) to a program chair of a Computer Science, engineering, and information science department who forwarded it to his national listserv of African American Ph.Ds. in

Computer Science (AAPHDCS). Within the day, I received responses from two participants and I used the snowball sampling method (Sadler, Lee, Lim, & Fullerton, 2010) to identify the three additional participants, based on the initial participants' recommendations.

Compensation. Upon completion of four interviews, each of the five participants received a $50 Amazon gift card for their participation in the study. Since I did not receive the National Science Foundation Doctoral Dissertation Research Improvement Grant (NSF DDRIG) as planned, I requested approval to launch a funding campaign to raise support for the participant stipends, and I limited the compensation for subsequent participants to receive three $50 Amazon gift cards through a drawing at the end of the study.

Data Collection Methods

Life history data are primarily collected through individual interviews (Atkinson, 2007; Cole & Knowles, 2001; Janesick, 2010). As such, I engaged directly with participants to begin construction of their Counter-Life Herstories through one-on-one, in-depth, rich descriptions of their unique educational experiences (Creswell, 2014; Merriam & Tisdell, 2015; Yin, 2003). Specifically, I collected confidential data elements through (a) timeline interviews (i.e., audio files, handwritten or Microsoft PowerPoint documents), (b) semi-structured Counter-Life Story interviews (i.e., audio files), and (c) participant reflective journals writings (i.e., handwritten journal entries and Google Docs documents). Additionally, I used my reflective journal to capture observational notes during interviews, record an audit trail and reflect on my experiences during the research process (Figure 3).

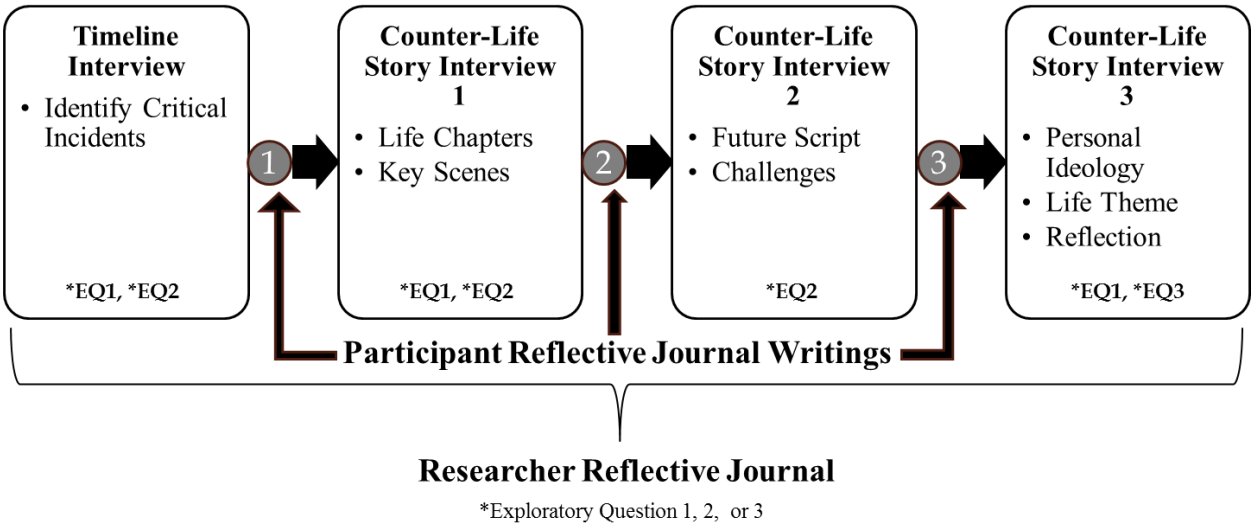

Figure 3. Summary of Data Collection Process

Data collection process. I conducted in-person and online interviews, which were driven by participants' availability, location, and available funding based on my data collection schedule (Table 5). However, my first four sets of on-site interviews (Dana, Alona, Jeanne, and Susan) followed different scheduling patterns. For example, I traveled by airplane twice to Dana's university to conduct in-person interviews. Since Alona and Jeanne were located at the same university, within driving distance of my university, I drove once a week (for four weeks) to conduct back-to-back in-person interviews. I spent four days conducting interviews at Susan's location because she was the furthest away. In summary, I conducted in-person interviews at locations most convenient for the first four participants, which included faculty offices and conference rooms on university campuses. However, I conducted the fifth set of interviews with Bianca virtually using Skype. Due to the nature of this study, I persuaded participants to choose a place that allowed for in-depth interviewing, without distractions or interruptions, for an extended period of time.

Table 5

Data Collection Schedule

Step	Activity	Allotted Time	Person Responsible
1	Conduct Timeline Interview	60 minutes	Participant & Researcher
2	Record Reflective Journal Writing #1	30 minutes	Participant & Researcher
3	Conduct Counter-Life Story Interview 1	60 minutes	Participant & Researcher
4	Record Reflective Journal Writing 2	30 minutes	Participant & Researcher
5	Conduct Counter-Life Story Interview 22	60 minutes	Participant & Researcher
6	Record Reflective Journal Writing 3	30 minutes	Participant & Researcher
7	Conduct Counter-Life Story Interview 3, Collect Reflective Journal Writings 1-3	60 minutes	Participant & Researcher
	Total Allotted Time Per Participant	330 minutes	

Timeline interview protocol. The timeline interview (or lifeline interview) is a useful method in life history (or life herstory) research to allow participants to share analytical power and take ownership of creating their timelines of life events (Adriansen, 2012). Additionally, it provides a "visual representation of main events in a person's life and for engaging the interviewee in constructing this story", though these events are not linear in nature (Adriansen, 2012, p. 43). Upon obtaining IRB approval (Appendix G), I contacted each participant to schedule our initial timeline interview for up to 60 minutes. Prior to the interview, I emailed each participant the informed consent form for their review and signature. Participants either bought a signed copy of the consent form to the interview or signed it onsite, with the exception of Bianca who emailed me a digitally signed copy in advance. During the interview, I first asked participants for permission to audiotape our interviews. Second, I verbally shared a summary of my personal experiences in U.S. Computing Education to set the tone and build rapport. Next, I followed an adapted version of the timeline interview protocol (Appendix A), provided by Hanne Kirstine Adriansen (2012), to link participants' stories to the "wider social, political, and environmental context" of U.S. Computing Education (Adriansen, 2012, p. 40).

Counter-life story interview protocol. I conducted a series of three semi-structured, in-depth Counter-Life Story interviews with each participant for up to 60 minutes, as recommended by Atkinson (2002) to provide sufficient data for transcription and analyses. I conducted the interviews over the course of three months primarily during the Fall 2015 semester. However, I added a fifth participant at the beginning of Spring 2016 during the analysis phase. Specifically, I adapted the Dan P. McAdams' (2008) Life Story Interview protocol for use during the interviews as follows (Appendix B).

Counter-life story interview #1. During this interview, I asked participants to describe their experiences in U.S. Computing Education, from childhood until now, as if they were life chapters in a book or a novel. Initially, they provided a brief overview of the main chapters and the transitions from one chapter to the next. Next, they proceeded to discuss the key scenes that represented their experiences in Computing Education. Specifically, they shared the high points, low points, turning points, childhood memories, adult memories, and wisdom events. We used the timeline (i.e., created during the initial Timeline Interview) as a guide.

Counter-life story interview #2. During this interview, participants and I continued where we left off. I asked them to describe their future life story in detail to include: the next chapter in their life, dreams, hopes, and plans for the future. Additionally, they described their life project (i.e., an initiative they have been working on or may plan to work on in the future), most significant challenges in Computing Education, failures, and any regrets.

Counter-life story interview #3. During the final interview, I asked participants to talk about their personal ideologies (i.e., religious/ethical values, political/social values), perspectives on the value of Computing Education, and other things which were noteworthy. They also summarized their collection of counter-life stories with a central life theme. I ended the

interviews with a time of reflection for participants to share: suggestions for other African American women and girls who desire to pursue a Computing degree (at any level), and insight on how to improve U.S. Computing Education at all levels.

Due to its extremely contextualized nature and personalized approach, life history research "demands many spontaneous, individual judgments on the part of the interviewer while the interview is in progress" (Atkinson, 2002, p. 132). Therefore, I used my interview protocols as guides to allow for flexibility and spontaneity during the interview process. To provide transparency, I added prompts to my interview protocols as examples.

Reflective journals. Participant and researcher reflective journals are warranted during qualitative studies to enforce data triangulation (Janesick, 2010). During this study, each participant and I captured our personal reflections and experiences in reflective journals throughout the data collection process (Table 5).

Participant reflective journals. During the course of our four interviews, participants captured three reflective writings in Google Docs or in a soft-cover journal I provided them. Specifically, I encouraged them to write express their free-form thoughts freely in response to their experiences during the previous interviews. Specifically, I prompted them to write in their journal after the Timeline Interview, Counter-Life Story Interview #1, and Counter-Life Story Interview #2. I captured their final responses and reflections during Counter-Life Story Interview #3. I also encouraged them to write as often as they liked. However, the participants only adhered to writing the three required reflections. During the final interview, I collected their soft-copy journals, or they shared with me their Google Docs electronic copy.

Researcher reflective journal. Throughout the study, I used my journal to expose any potential biases, based on my previous experiences in U.S. Computing Education (Creswell,

2014). Since I had similar experiences with my participants, I found it important to acknowledge my personal biases and preconceived notions about their experiences. I did not want my personal biases to distort or convolute participants' voices in any way (McAdams, 2001). I also used my journal to capture observational notes during interviews, which were critical to providing rich detailed descriptions about the interview settings and participants' unspoken questions (DeWalt & DeWalt, 2011). I also used my journal as an audit trail throughout the study to capture various research activities (e.g., data collection, data analysis, interpretation, decision-making processes, and reflections) (Merriam & Tisdell, 2015).

Data Analysis

As the primary research instrument, I simultaneously collected and co-analyzed the data elements of participants' Counter-Life Herstories as key themes emerged in my researcher reflective journal, which is essential to the life history research process (Labaree, 2006; Suárez-Ortega, 2013). Due to the nature of the timeline and life story interview protocols, participants identified their critical incidents and coded them as prompted (e.g., high point, low point, turning point) during the interviews, which represented the first and second iterations of data analyses respectively. Upon completion of the interviews, data elements (i.e., timelines, Counter-Life Story interviews, reflective journals) were transcribed verbatim with only minor edits, such as eliminating repetitions, question prompts, or comments from the transcript, to produce a narrative account of their Counter-Life Herstories (Atkinson, 2002, p. 131). I conducted a third iteration of analysis (i.e., thematic analysis) to answer my exploratory questions (Table 6). Upon identification of the themes, I constructed participants' Counter-Life Herstories (i.e., collective standpoint) using a narrative writing approach. Finally, participants reviewed their timelines and Counter-Life Story interview transcripts for accuracy (i.e., member checking). In Figure 4, I

provide a visual representation of my data analyses process, which consisted of narrative analysis (i.e., thematic analysis and open coding) of relevant participant data elements that aligned with my research purposes and best-supported answers to my exploratory questions.

Table 6.

Data Analysis Iterations

Iteration	Activity	Research Procedure	Responsible
First	During Timeline Interviews	Identified Critical Incidents	Participants & Researcher
Second	During Counter-Life Story Interviews 1-3	Coded Key Critical Incidents	Participants & Researcher
Third	Narrative Analysis (After Counter-Life Story Interviews)	Performed thematic analysis of: • Counter-Life Story Interviews 1-3	Researcher
Fourth	Construction of Participants' Counter-Life Herstories	Constructed Counter-Life Herstories using: • Participant quotations • Participant and Researcher Reflection Journals	Researcher
Final	Member Checking	Reviewed timelines and Counter-Life Herstory interview transcripts for accuracy.	Participants

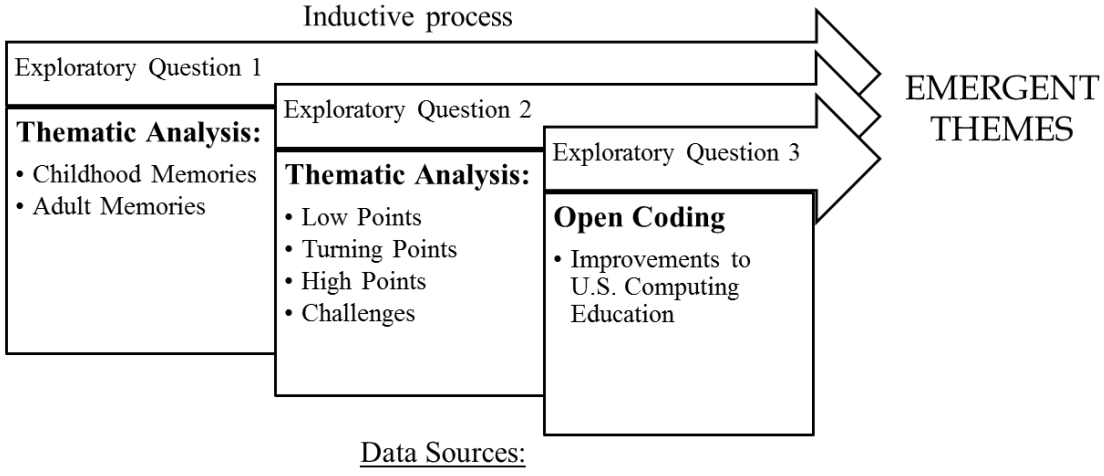

Figure 4. Data Analyses Process

Narrative Analysis

Narrative analysis (or narratology) is informed by hermeneutical and interpretive perspectives (Patton, 2002). Hermeneutics (referred to as hermeneuein in the Greek) has historically been used to interpret biblical and legal texts. Since the 19th and 20th centuries, it has provided a theoretical framework for interpreting written legends, and stories in modern cultural contexts (Patton, 2002). Narrative analysis has extended the initial use of hermeneutics to include the interpretation of "in-depth interview transcripts, life stories, historical memoirs, and creative nonfiction" (Patton, 2002, p. 115). It also adopts an "emphasis on understanding the educational experience and perceptions of experience" (Patton, 2002, p. 115) from the concept of phenomenology. Although I believed my participants' Counter-Life Herstories are sufficient alone to magnify their unique educational experiences (Clandinin & Connelly, 1994), I used thematic analysis to further interpret their responses. As customary in qualitative research, thematic analysis is a useful approach to conducting narrative analysis (Reissman, 2008).

Thematic analysis. To identify, analyze, and summarize themes, I followed Braun and Clark's (2006) six-step process for thematic analysis (Table 7). First, I familiarized myself with participants' data elements (i.e., timelines, Counter-Life Story interviews, reflective journals) through listening to interview audio files, reading transcribed interviews, and reading notes in my researcher's journal. I also created a new Hermeneutic Unit in the ATLAS.ti 6.5 qualitative data analysis software, and loaded the data elements for ease of accessibility during the analysis process (Appendix C). Second, I created a list of codes (i.e., Codebook), which I derived from the interview protocols and research questions (Appendix D), and loaded them into the ATLAS.ti Code Manager. Third, I followed an inductive process to code data elements using a pre-defined Codebook, and I performed Open Coding (Saldaña, 2012) (i.e., developed codes

while reading the data elements) as needed. Additionally, as I read the texts, I highlighted keywords that represented the central focus of my exploratory questions. Fourth, I reviewed and refined my list of codes (i.e., codebook) as needed. Fifth, I identified high-level themes. Finally, I produced a report of emergent themes by exploratory questions to reflect my participants' responses. I created a total of 118 codes.

Table 7

Six-Step Thematic Analysis Process (Braun & Clark, 2006)

Step	Research Procedure
1	I familiarized myself with data elements of participants' Counter-Life Herstories and loaded them into an ATLAS.ti Hermeneutic Unit
2	I created a list of codes (i.e., codebook) derived from participants' identification and codification of their critical incidents, and exploratory questions one, two and three
3	I read participants' data elements to search for codes in the code book,
4	I reviewed and refined the list of codes,
5	I identified high-level themes (i.e., emergent themes), and
6	I produced a final report of emergent themes in response to my exploratory questions (i.e., Chapter 4).

Construction of Counter-Life Herstories

During the thematic analysis process, I identified emergent themes for each exploratory question. I performed a final step of thematic analysis to produce a comprehensive list of the emergent themes across their experiences in U.S. Computing Education (i.e., childhood memories, adult memories, low points, challenges, turning points, and high points). Collectively, these emergent themes, along with the associated stories, represent *Our Counter-Life Herstories* (Figure 5).

Research text selection. I selected the top salient emergent themes to include in this final dissertation report. Specifically, I selected emergent themes that had three or more participant quotations.

Narrative writing style. Since life history research methods are appropriate to interpret educational experiences in a broader context (Cole & Knowles, 2001), my approach to constructing the Counter-Life Herstories reflected an element of my research purpose. I followed a narrative writing style to describe the relevant emergent themes through the use of metaphors and narrative quotes (i.e., short stories) from my participants, similar to other life history and narrative accounts (Richards, 2011). I also inserted my reflections in the descriptions, which is a core characteristic of qualitative research (Creswell, 2014). As I employed ethics of caring and accountability (i.e., Afrocentric feminist epistemology) in my approach, I used participants' quotations to reflect their own voice and words. Furthermore, I performed minor edits (i.e., eliminated repetitions, question prompts, comments) of the transcript, to produce a "flowing, connected, narrative" (Atkinson, 2002, p. 131). In Chapter 5, I further interpret my participants' Counter-Life Herstories using the interpretive frameworks (lenses) of critical race theory and Black Feminist Thought to situate their educational experiences in the broader socio-political context of U.S. Computing Education.

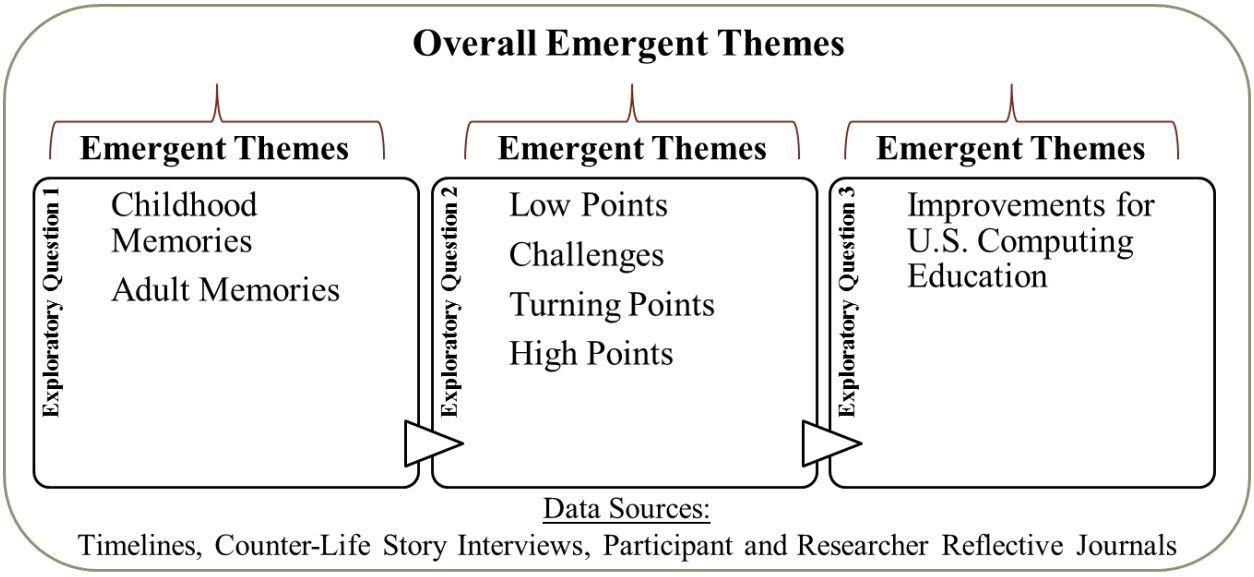

Figure 5. Construction of Our Counter-Life Herstories

Trustworthiness

Life history accounts, such as Counter-Life Herstories, are highly personal and subjective in nature (Atkinson, 2002). Since the central purpose of this study was to magnify participants' unique educational experiences, I incorporated the following methods during this study to ensure the trustworthiness of my results: data triangulation, member checking, and reflexivity.

Data triangulation. I used data triangulation (Brantlinger, Jimenez, Klingner, Pugach, & Richardson, 2005; Creswell, 2014) to confirm the soundness of these data collected (verbal and non-verbal) from each participant: (a) timeline interview (b) Counter-Life Story interviews, and (c) reflective journal writings (participants and me). While constructing the participants' Counter-Life Herstories account, I examined these data sources for internal consistency to ensure there were no contradictions or inconsistencies (Atkinson, 2002).

Member checking. Since I followed an Afrocentric feminist epistemological perspective (Collins, 2009), I accepted their experiences as concrete and did not engage an Expert Panel or Peer Review process to validate their knowledge claims, which would have suggested a Eurocentric masculinist approach. Instead, I employed the member checking process (i.e., personal accountability) to allow participants to review and approve transcribed timelines and Counter-Life Story interviews upon completion (Brantlinger et al., 2005; Creswell, 2014). Each participant was responsible for ensuring these transcripts captured their own words (Atkinson, 2002). Upon completion, I emailed each participant a copy of my final discoveries for their approval before the commencement of the study (Atkinson, 2002). Since I valued their voices and perspectives over my own (i.e., ethic of caring), I vowed to not report or publish anything they had asked me to omit.

Reflexivity. As a researcher and the primary instrument, and as an African American woman with similar experiences to my participants, I exposed my researcher biases in my researcher's reflective journal (Creswell, 2014). Since reflexivity is a core characteristic of qualitative research (Creswell, 2014), I believed it was essential for me to reflect on how my previous experiences in Computing Education shaped my interpretation of the findings, which I also incorporated in the construction of the Counter-Life Herstories account. Moreover, I used my journal to capture rich and thick descriptions about participants' nonverbal cues and the interview settings. I also found it quite useful to capture an audit trail of my key experiences and research activities throughout the study. Collectively, these methods and strategies helped me ensure the trustworthiness of my study (Creswell, 2014).

Ethical Considerations

Due to the nature of life history research, I accounted for the following ethical concerns. First, I asked each participant to sign an informed consent form to participant in the study prior or during our initial timeline interview. Second, I maintained their confidentiality by using pseudonyms to describe given names, places, and specifics to improve the likelihood of approval by my Institutional Review Board (Janesick, 2010) for this method of research. Third, I maintained data elements of participant's Counter-Life Herstories on a password-secured computer and folder structure. Fourth, I kept artifacts such as timelines and reflective journals stored in a locked file cabinet drawer in my home office where I had sole access.

CHAPTER 4: DISCOVERIES

Introduction

Similar to Counterstories, Counter-Life Herstories give voice to marginalized persons to counter the master narrative (i.e., majoritarian perspective) about their experiences (Bernal & Villalpando, 2002; Closson, 2010). They also provide a powerful method for African American women, and other people of color, to break the silence (i.e., uncover hidden truths) of racism and racial discrimination (Delgado & Stefancic, 2012). My purpose in this life history qualitative study was to explore the Counter-Life Herstories (e.g., life histories) of African American women faculty in U.S. Computing Education (e.g., Information Systems, Computer Science, and Computer Engineering).

Exploratory questions. I constructed the following exploratory questions to guide this life history study.

1. How do African American women faculty in U.S. Computing Education describe their educational experiences (i.e., elementary school, middle school, high school, Master's, Ph.D.)?
2. How do African American women faculty in U.S. Computing Education describe the experiences that impacted their persistence (e.g., high points, low points, turning points, challenges) to achieve a postsecondary degree in U.S. Computing Education?
3. What improvements do African American women with faculty in a Computing discipline suggest to broaden the participation of African American women in U.S. Computing?

Narrative thematic analysis. I conducted thematic analysis (Braun & Clark, 2006) on participants' self-identified educational experiences, related to exploratory question 1 (childhood memories and adult memories) and exploratory question 2 (low points, challenges, turning points, and high points), to ascertain emergent themes by research question. Specifically, I familiarized myself with participants' data elements (i.e., timelines, Counter-Life Story interview 1, reflective journals) through listening to interview audio files, reading transcribed interviews, and reading notes in my researcher's journal. I also created a new Hermeneutic Unit in the ATLAS.ti 6.5 qualitative data analysis software, and I loaded the data elements for ease of accessibility (Appendix C). Second, I created a list of codes (i.e., Code Book), which I derived from the interview protocols and exploratory questions (Appendix D), and loaded them into the ATLAS.ti Code Manager. Third, I followed an inductive process to code data elements using a pre-defined Code Book, and I performed Open Coding (Saldaña, 2012) (i.e., developed codes while reading the data elements) as needed. Additionally, as I read the texts, I highlighted keywords that represented the central focus of my exploratory questions. Fourth, I reviewed and refined my list of codes (i.e., codebook) as needed. Fifth, I identified the high-level themes. Sixth, I produced a report on emergent themes for each exploratory question to reflect participants' responses, which are represented in this section.

Summary of Emergent Themes: Our Counter-Life Herstories

Because Counterstories are powerful social justice tools to reveal unhidden truths about marginalized people's experiences (Delgado & Stefancic, 2012), I constructed the Counter-Life Herstories of five African American women with Ph.Ds. in Computer Engineering, Computer Science, and Computer Information Systems. As I employed ethics of caring and accountability (i.e., Afrocentric feminist epistemology) to ensure the narrative account reflected participants'

own voice and words, I only minimally edited their quotations (i.e., removed repetitions, question prompts, comments, and fillers: like, um, you know) to produce a coherent and seamless narrative account (Atkinson, 2002). In summary, I discovered 6 emergent themes (Figure 6) in response to exploratory questions one and two (Table 8). Additionally, I captured participants' recommendations for improvements to U.S. Computing Education in response to exploratory question 3.

In this chapter, I summarized the discoveries (i.e., findings) that emerged during my study. In reference to my research purpose and the exploratory questions that guided my study, I described participants' educational trajectories and the following six emergent themes of their stories, along with my interpretations and reflections, using metaphors, participant quotations, and reflective journal writings from the participants and me. These themes, which were derived from narrative analysis (i.e., thematic analysis), represented the collective experiences of five African American women faculty in U.S. Computing Education – Our Counter-Life Herstories.

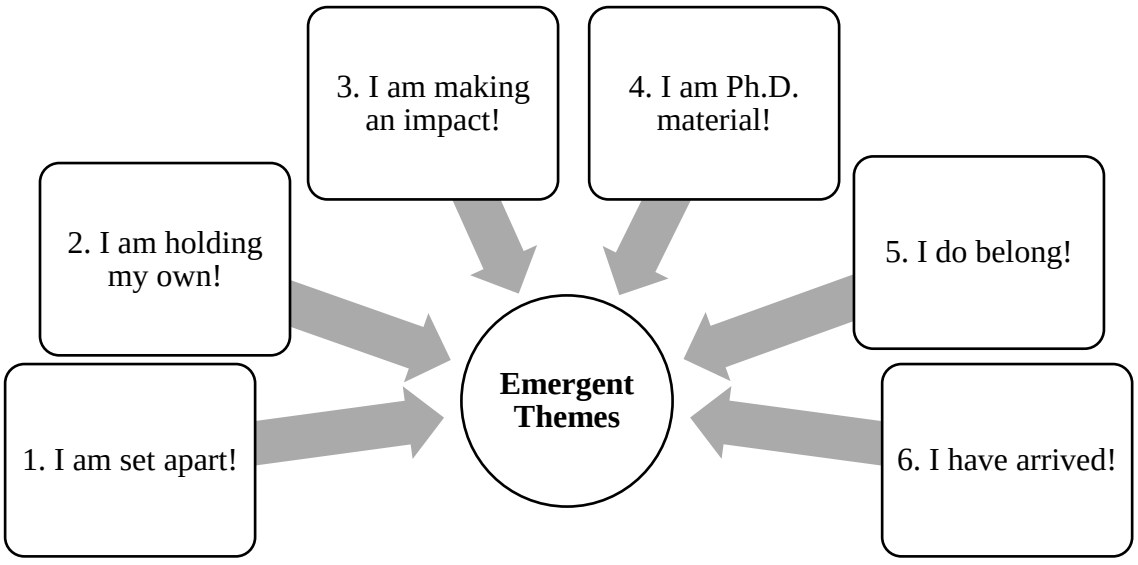

Figure 6. Summary of Emergent Themes

Table 8

Summary of Emergent Themes

Exploratory Questions	Interview Protocol/Questions	Response or Emerging Themes
1. How do African American women faculty in U.S. Computing Education describe their educational experiences (i.e., elementary school, middle school, high school, Master's, Ph.D.)? **(EQ1)**	Timeline Interview Protocol Counter-Life Story Interview Protocol • B4. Childhood Memories • B5. Adult Memories	Educational Trajectories Emergent Themes 1. I am set apart! 2. I am holding my own! 3. I am making an impact!
2. How do African American women faculty describe the experiences that impacted their persistence to achieve postsecondary degrees in U.S. Computing Education? **(EQ2)**	Counter-Life Story Interview Protocol: • B1. High Points • B2. Low Points • B3. Turning Points • D1. Challenges	Emergent Themes 4. I am Ph.D. material! 5. I do belong! 6. I have arrived!
3. What improvements do African American women faculty in U.S. Computing Education suggest to broaden the participation of African American women in K-20 U.S. Computing Education? **(EQ3)**	Counter-Life Story Interview Protocol: • G2. Improvements to Computing Education	Improvements to U.S. Computing Education

Note. EQ is an abbreviation for exploratory question.

Our Educational Trajectories (Exploratory Question 1)

In response to exploratory question 1, I familiarized myself with participants' timelines by reviewing them and reading notes in my researcher's journal. During the Timeline interview (Appendix A), my participants and I recorded the critical incidents that occurred during their U.S. Computing Educational experiences, from elementary school to graduate school, on a timeline. These events represented their educational trajectories, which are summarized below by participant.

Alona (1983). Alona began her Computing Education journey (Appendix E) at a private K-8 Catholic school in the Northeast (i.e., Washington DC) where she was academically well-prepared. At age 13, Alona first interacted with computers when the underfunded school was gifted a computer lab. Because she didn't have a computer at home, Alona experienced an

apparent economic divide between herself and peers with computer access at home. Alona's uncle built her a computer upon entry into high school. She was the only participant who completed AP Computer Science, and Computer Math class at a magnet Science and Technology high school, which influenced her decision to major in Computer Science. Alona attained Bachelor of Science, Master of Science, and Ph.D. degrees in Computer Science. Currently, Alona is an Assistant Professor of Computer Science and Engineering at a predominately white university in the Southeast region of the United States.

Bianca (1977). Bianca, who was raised in Michigan, was academically well-prepared early in her schooling experiences. She was first introduced to computers by her mother at home, who often worked on computers as a hobby. Bianca completed Pre-Calculus in the eighth grade along with ninth graders at a local high school. She decided to attend after participating in an HBCU College Tour. Bianca attained Bachelor of Science, Master of Science, and Ph.D. degrees in Computer Science. Currently, she is an Associate Professor of Computer Science at a historically Black college and university in the Mid-Atlantic region of the United States. She is also married and the proud mother of two young children.

Dana (1977). Dana had a strong academic background and confidence, which was formed early during elementary school in the Virginia area. Both of Dana's parents were Master degree holders. Dana's mom was a Media Specialist, which influenced her avid reading skills. She often partnered with diverse groups of people in high school and college, which contributed to her success. She attended a prestigious Science and Technology high school, which influenced her interest in STEM and Computing. Dana attained a Bachelor of Science degree in Systems Engineering, and a Ph.D. degree in Computer Information Systems. Currently, Dana is a tenured Associate Professor of Information Systems at a predominately white university in the

Southeast region of the United States. She was the only participant with tenure at the time of this study.

Jeanne (1977). Jeanne was raised as a first-generation Haitian-American in south Florida. She described her parents as "functioning illiterate". Over the course of her lifespan, Jeanne struggled with a sense of not belonging. Early on, she had an affinity for theatrical arts. During middle school, Jeanne was called the "in-house nerd", because she was markedly smart. In high school, and in the early parts of her undergraduate experience, Jeanne was surrounded by negative influences that caused her to misuse her intellect. In college, she majored in Electrical Engineering because she wanted to initially become a Patent Attorney. Jeanne's decision to pursue Computing was not formed until graduate school. Jeanne attained a Bachelor of Science in Electrical Engineering, a Master of Science degree in Industrial Engineering and a Master of Education degree in Instructional Technology, and a Ph.D. degree in Computer Science. Currently, Jeanne is Postdoctoral Researcher at a predominately white university in the Southeast region of the United States.

Susan (1977). Susan had limited memories of her early childhood in Tennessee, but she recalled being introduced to Computing in a high school typing class. She attended a magnet high school as part of a Business Technology program and Future Business Leaders of America. Susan received a solid foundation in high school as she completed the minimum graduation requirements. Moreover, Susan exhibited a strong sense of determination and perseverance in her childhood experiences. Susan decided to attend college after she participated in an HBCU College Tour, and she chose to major in Management Information Systems when she received funding to attend a pre-college program. Susan attained a Bachelor of Science degree in Management Information Systems, a Master of Science degree in Management of Technology,

and a Ph.D. degree in Computer Information Systems. Currently, Susan is an Assistant Professor of Management Information Systems at a predominately white institution in the South region of the United States.

Summary. The five study participants (e.g., respondents) in this inquiry consisted of Assistant Professors, Associate Professors, and a Postdoctoral Researcher within postsecondary U.S. Computing Education departments located in the South, Southeast, and Mid-Atlantic, regions of the United States (Table 9). With the exception of Jeanne who identified as a first-generation Haitian-American, each participant self-identified as African American. The participants and I were close in age (1977-1979), with the exception of Alona (1983). To date, Dana was the only participant who had attained tenure. During our interviews, participants selected their pseudonyms for use during this study. However, I made adjustments to two pseudonyms (Bianca, Dana) for readability purposes.

Table 9

Profiles of Study Participants

Pseudonym	Ethnicity	Birthdate	Degrees	Location	Current Role	Institution
Alona	African American	1983	B.S., CS; M.S., CS; Ph.D., CS	Southeast	Assistant Professor, CS, and CE	PWI
Bianca	African American	1977	B.S., CS; M.S., CS; Ph.D., CS	Mid-Atlantic	Associate Professor, CIS, and CS	HBCU
Dana**	African American	1977	B.S., SE; Ph.D., CIS	Southeast	Associate Professor, IS	PWI
Jeanne	Haitian American	1977	B.S., EE; M.S., IE; M.Ed., IT Ph.D., CS	Southeast	Postdoctoral Researcher	PWI
Susan	African American	1979	B.S., MIS; M.S., MoT; Ph.D., CIS	South	Assistant Professor, MIS	PWI

Notes: *Participants identified pseudonym names during the first interview. **Tenured faculty member.
CS = Computer Science, CE = Computer Engineering, CIS = Computer Information Systems, EE = Electrical Engineering, IE = Industrial Engineering, IS = Information Systems, IT = Instructional Technology, MIS = Management Information Systems, MoT = Management of Technology; SE = Systems Engineering

Our Childhood and Adult Memories (Exploratory Question 1)

During the first Counter-Life Story interview (Appendix B), I asked participants to describe key scenes (Section B), such as their childhood memories and adult memories, which represented their overall educational experiences in U.S. Computing Education, from elementary school to academia. Second, I conducted thematic analysis (i.e., familiarized myself with data elements, created a codebook, inductively coded data elements using ATLAS.ti, reviewed and refined codes, identified high-level themes, and produced a report of emergent themes) on these experiences, which resulted in three emergent themes in response to exploratory question 1: (1) I am set apart, (2) I am holding my own, and (3) I am making an impact (Figure 6).

I am set apart. This theme represents participants' experiences in elementary school as they formed early identities about themselves and their capabilities in Computing Education (Figure 7). Below, I provide quotations, along with interpretations, that aligned directly with this theme from four of five participants (Alona, Bianca, Dana, and Jeanne). I subtitled each story with a salient quote or metaphor to represent the underlying themes in it.

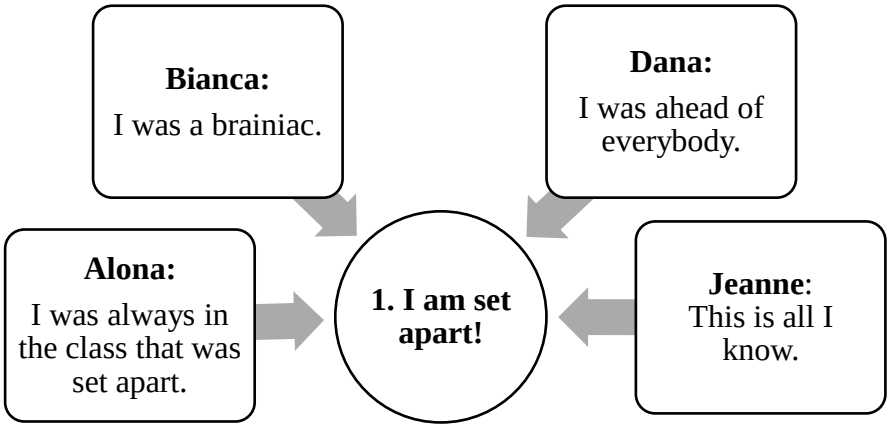

Figure 7. Emergent Theme 1

Alona: I was always in the class that was set apart. From kindergarten to eighth grade, Alona (an Assistant Professor of Computer Science and Engineering at a predominately white institution) attended a private Catholic school in Washington, DC. When asked about her earliest childhood memories in Computing Education, Alona remembered receiving attention from various community members and constant affirmation that she was "smart." In her recollection, Alona was always "set apart" from students in her grade level and placed with students who were one grade level ahead in reading and mathematics.

> Well, growing up, I guess… I don't know how to put this, but I always had reinforcement I was smart. I grew up in a house when I was four, or maybe three, I was on the news for my reading ability. I don't remember if it was something I could read when I was three years old, but they had me reading something. I don't know what it was, but it got a lot of attention. I didn't understand what all of the fuss was about, but I was like, "You can read too!" From that being a big deal at an early age, I was always in the class that was *set apart*.

Additionally, Alona described that her mom played an active role in ensuring she was "set apart" (i.e., moved Alona to a new reading group, assessed if Alona should skip a grade level, making sure I started pre-school at 3 instead of 4), which likely influenced her positive experience. Alona said, "I saw school as being a very positive place where I was constantly reassured that I was smart, I was capable, [and] I could do it." She was placed in classes with low teacher to student ratios (i.e., 1 to 24). She was one of the top six students in her class who competed with one another. Her teachers influenced a "healthy competition" among them when they "passed out the grades in numeric order." Alona said, "I wouldn't know what grade somebody got, but if they got a paper before me, then I knew they did better than me."

Periodically, a new kid would receive one of the top six grades, and the "smart group" of students would ask, "Where you come from?" As Alona recalled her privileged status in school, she reflected on the feelings of kids who were outside of the "smart group:" "What message

were they getting?" "That you're not a smart kid?" Alona's classmates were predominately Black until she matriculated to a Science and Technology high school. In that school, most students were African-American. However, Alona's technical classes consisted of predominately white males. In essence, Alona was "set apart" from other African American students, which raises additional questions for further exploration.

Bianca: I was a brainiac. Bianca (an Associate Professor of Computer Information Systems and Computer Science at a historically Black college and university) began her schooling experiences in the Michigan area. She was a first-generation college graduate and the first person in her family to attain a Ph.D. degree. Since elementary school, she described herself as "always just good in school," which likely influenced confidence in her abilities to succeed in Computing despite the opposition she encountered.

> I would say the earliest one... I have so many negative ones. When I was in elementary school, I was just... I was always just good in school... just math, science... just reading. I was going to be skipped up a grade. You know, just good in school. I guess that, *I was a brainiac*. I was a little, very timid. A little nerdy. I didn't have many friends or anything. I wasn't very outgoing. But, anyway…

Furthermore, Bianca described her school setting as the "Black community" where she received both resistance and positive affirmation from adults, including other parents. Although she markedly performed above grade level, she recalled a particularly negative experience that was spurred by a parent after she received an award at school.

> …I remember a parent saying at one of our events. It was myself and one other little girl. We got an award from the principal, and one of the parents said, "They only received that award because the principal likes light-skinned girls." So, it was another Black girl, and she was about my complexion. And the principal was a man, a dark-skinned Black man. And they said the only reason we received the award is because he liked little dark girls, I mean little light girls. So, it was just something... From that moment on, it's just always been…It should not be the focus on gender, complexion. We're talking about in the Black community. If it's not in the Black community, then it shouldn't be about race, it shouldn't be about gender, it shouldn't be about anything but ability.

Bianca seemed surprised her early schooling experience occurred in the Black community, which demonstrated an "unhealthy competition" that misconstrued an award of her giftedness as an injustice based on her lighter skin complexion. As a result, her status of "set apart" seemed to present a divide between two groups of marginalized students within the Black community.

Dana: I was ahead of everybody. Dana (a tenured Associate Professor of Information Systems at a predominately white institution in the Southeast) was primarily raised in the Virginia area. Both of her parents were well educated with Master's degrees in their disciplines. Because her mom was a Media Specialist, Dana developed an early affection for reading books, which probably influenced her extensive vocabulary (e.g., "I ferociously read books…"). In elementary school, Dana recalled being "ahead" of her peers when her family relocated.

> We moved from North Carolina to Virginia in kindergarten... middle of kindergarten. And everybody was nice enough in class, but I quickly realized that *I was ahead of everybody* in terms of the curriculum. So, whatever we were doing in North Carolina was ahead of, whatever they were doing in Virginia (laughs). And I went, "this is going to be a drag."

Dana noticeably excelled in reading, which placed her in the class with first-grade students. When Dana, as a kindergartener, entered the class with first-grade students, she recalled a classmate questioning her new placement.

> And I remember there was this little blond-haired girl named [Amy], and she... I went into the room, I mean, I was told to go into the room to be with this group. She said, "Why are you here?" I mean, I really didn't understand what her question was. I mean I knew she was being a little turd, I could tell from the tone (laughs). I'm like, um okay. I don't, I don't understand the meaning… because I'm supposed to be here; because I read (laughs). I'm slow because I don't really…In hindsight, I'm like "Oh, yeah" [speaking in a faint voice]. You don't see much of us over here apparently.

Dana's comment "You don't see much of us over here apparently" suggested she was in an environment devoid of other Black students. My immediate response to Dana after she told me this story was "they did not know how to handle you" because of the confidence she exuded

when she told, “blond-haired Amy” I am here “because I’m supposed to be here; because I read.” Dana replied: “I guess I didn’t have a confidence issue about it.” At an early age, Dana established a strong confidence in her status as “set apart,” which influenced her strong sense of belonging in Computing Education, even in unwelcoming environments.

Jeanne: This is all I know. Jeanne (a Postdoctoral Researcher at a predominately white institution in the Southeast) identified herself as a first-generation Haitian-American; she described her parents as “functioning illiterate.” She completed her early schooling in the south Florida area. In elementary school, Jeanne was “set apart” to participate in an enrichment program for high-achieving students. She described her school as a “low-income” school in an impoverished immigrant community. Although she was recognized as a “smart kid” among her peers, Jeanne classified herself as “not the best student” in school. During our interview, she recalled a recent conversation with her parents that evoked a realization about her “STEM identity.”

> So, anytime I have friends over that haven’t been over before, my mom tells them stories. My mom told her a story about the first time she was teaching me table-setting, where the forks go and stuff, and I got frustrated: "I don’t see the point in this! They're all going to the same place." My mouth. “So, I don’t understand why one had to be on one side or the other." And everyone started laughing. It was that realization I have always been...I've always been a very logical thinker, like very. And so, realizing it wasn’t one day I woke up this way, but this is always the way it's been, part of my identity.

As such, Jeanne’s realization about her STEM identity seemed to occur in her adulthood. Even though she was “set apart” in elementary school (i.e., “high-achieving student”), she had a diminished sense of belonging in comparison to other participants. As she continued to reflect on the recent conversation with her parents, Jeanne provided her dad’s interpretation of her identity formation process.

> My dad was always like... I would always ask the most challenging, random questions that would stump the adults. So every once in a while [he was] like "How did she come

> up with this stuff?" But it was just that was always who I was. And so, *I think hearing these stories, now hearing them again, reinforces me to embrace who I am* – speaking to those strengths. Even now, when I kind of talk about the things I am good at, I know how to ask the right question because I am going to keep digging. And it is not like I just woke up like this, I have been doing this since I was two, *this is all I know*. So realizing the things that make me strong in STEM, have always been a part of my identity.

As Jeanne replayed her experience, she began to embrace that she was always "set apart" for STEM and Computing (i.e., STEM identity). As an adult, Jeanne admitted her continual struggle with a sense of belonging in Computing Education, and her strategy to overcome these moments. Jeanne said, "I check myself. Like, this is you! This is what you do. Go back to your fundamentals. Like this is always how I operate." In retrospect, Jeanne acknowledged her natural proclivity to be a logical and analytical thinker despite her lifelong struggle with accepting her "true identity."

Summary. As Alona, Bianca, and Dana shared their childhood memories, they described positive reinforcement received from parents, teachers, and administrators. They also identified themselves as "smart," "always just good in school," or "ahead of everybody." They each acknowledged they were "set apart" in their school settings. Because Alona and Bianca attended school in a similar homogenous environment (i.e., the Black community), they were "set apart" from other African American students while Dana was distinguished in a setting devoid of Black students. Jeanne and Susan (an Assistant Professor of Management Information Systems at a predominately white university in the South) described themselves as 'not the best' or 'not the strongest student' (paraphrased). Although Susan's childhood memory did not directly support this theme, she mentioned her academic status in other segments of our interviews. Overall, the positive reinforcement Alona, Bianca, and Dana received early in their childhood influenced a strong confidence in their abilities to succeed in Computing Education. Conversely, Jeanne's prolonged realization (i.e., as an adult) about her STEM identity was impacted by factors that

were not evident during this study. Based on Jeanne's responses, the school and community environments (i.e., impoverished, low-income) may have influenced her marginalized feelings about her abilities.

I am holding my own. This theme represents participants' academic preparation throughout their Computing Education trajectories (i.e., elementary school, middle school, graduate school) (Figure 8). Below, I provide quotations, along with interpretations, that align directly with this theme. I subtitled each story with a salient quote or metaphor to represent the underlying themes in it. Three of five participants' (Bianca, Dana, Jeanne) responses aligned with theme 2.

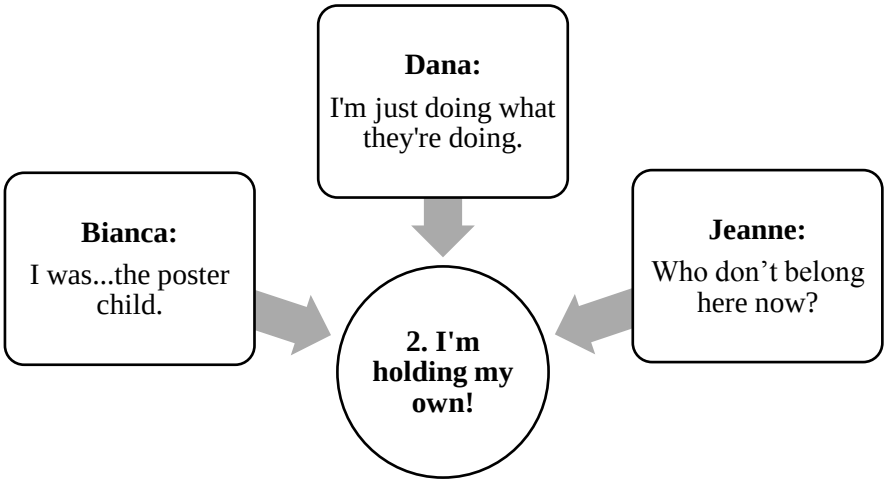

Figure 8. Emergent Theme 2

Bianca: I was…the poster child. Although Bianca did not recall using computers in elementary school, she recalled her mother being quite knowledgeable about computers (e.g., she fixed computers), which influenced her interest in Computing. When I asked about her early childhood memories in Computing Education, Bianca recalled a positive experience in the eighth grade, despite her many other negative experiences.

> When I was bused to the ninth grade for that math program, I was the only Black child for that one that they took from the middle school to the high school for that math [Pre-Calculus program]. And I remember...because...See parents... I'm glad I'm bringing this

> up. I'm going to remember to try and not let my children (laughs) hear this stuff. I remember that the other parents were telling my mom "Make sure she does this and does it well." Like *I was going to be the poster child of how the Black folks in this community, how they needed to be given more opportunities* to look at how well she's doing like.

Though she was confident in her abilities, Bianca could not comprehend why she was the only Black student in the program. She said, "I was not the smartest one in that middle school. I was not the top, the number one student in my grade at all." Moreover, she was surprised other parents had a vested interest in her success. She seemed to be surprised because some parents in elementary school did not appropriately recognize her abilities, but in middle school, she became the "poster child" for the Black community. Bianca recalled other parents telling her mom "Make sure you let us know if you need any support." She resolved they were sincere in their offer of support and truly desired to ensure she was successful.

> I could tell it was more than just "Oh good, let us know if you need anything" [superficial voice]. It was one of those "We are going to make sure that she finishes this and that she does it well because they are looking at us!" type of thing [bold voice]"

As Bianca reflected on possible reasons for their concerted interests, she perceived politics were involved because her middle school principal attended their church, and her mom was quite familiar with the principal.

Nevertheless, Bianca continued to excel in her academic pursuits in high school. She attended an HBCU (historically Black college and university) College Tour, which influenced her decision to attend an HBCU for college. Though she wanted to become a Chemical Engineer, she "majored in Computer Science by accident" when she did not attain the required AP Chemistry exam score. Although she did not participate in any Computing programs in high school, Bianca attended a 12-week pre-college Computer Science program upon acceptance to an HBCU. Furthermore, she decided to pursue a Ph.D. degree in undergraduate school when she discovered the lack of Black faculty with Ph.D. degrees at her HBCU.

Dana: I'm just doing what they're doing. Dana had dispersed memories about her early experiences in Computing Education. She recalled developing an early affinity for science fiction books when her mom brought home "A Wrinkle in Time" by Madeleine L'Engle. She also shared a few brief memories about her exposure to STEM and Computing in elementary school. First, Dana remembered black and green CRT (Cathode Ray Tube) computer screens. Second, she recalled using command line prompts with the Logo Turtle application and to draw pixel-based cartoon characters in elementary or middle school. She said, "I was still creating art on the computer." She also won a coloring contest hosted by a drug store. Next, Dana recalled playing with her father's sack of bricks at the age of six.

> When we were in North Carolina, I remember this big stack of bricks in the backyard. So, I would build…I'd build a house. (laughs) I would lay my perimeter and build up walls and try to figure out how to build a window. Or I'd just make some indentation of a window. Then there's a doorway. And I'm laying bricks, without any mortar or anything [faint voice]. And then, reconfigure it. Real life big'ol Legos. Like heavy bricks...

As she shared these hands-on experiences, I discerned Dana's early interest in art and technology. Dana further explored this interest when she matriculated to high school. Dana enrolled in a renowned Science and Technology high school in the Washington DC area because she was attracted to the art.

Dana continued to gain hands-on experience when she engaged in an AutoCAD senior project, learned to solder an electrical circuit board, and partnered with male students to complete assignments. Most vividly, she remembered playing a video game in the back of her senior design class "with the guys."

> So being in the back row of my high school, senior design project lab with the guys. The teacher…I think he often sat in his office while we were "working" on our projects…I think somebody had loaded Descent…onto the network. Don't know who, don't know when, but apparently, every opportunity... Because we weren't supposed to be doing this, right? We would then...'Alright, he's gone'. So, we would all log on and play Descent…And I'm not into video games, but I played that game. It was interesting.

Dana portrayed a strong sense of confidence alongside her male classmates and enjoyed "the camaraderie." She saw herself as "just one of the folks," not as the only female amongst males. Because of her strong confidence, Dana displayed a strong sense of belonging in Computing Education. Ultimately, she said, "*I'm just doing what they're doing, holding my own in Descent* because that's what we're doing."

Jeanne: Who don't belong here now? Although Jeanne had no early memories of working with computers, she recalled her "about face" experience in elementary school. She said, "I went on doing a lot of reading to my attraction to STEM." Early on, she developed an interest in theater, but she also "loved the consistency in STEM." In retrospect, Jeanne believed she would have had a different outcome if she remained consistent in STEM. In junior high school (i.e., middle school), she attended a "reject" school because most of the students were previously expelled from other schools. However, Jeanne was distinguished among her peers because she was enrolled in AP classes and other enrichment activities. She particularly recalls her excitement when her "reject" school won a math league competition.

> So, every time we'd come to academic type competitions, they would kind of be like "What are they doing here?" I remember when we beat like the boarding school in this math competition; it was like just sheer joy. It was like "Yeah! *Who don't belong here now?* What? What, you'll go to do? What? I can't spell it, but I know I can beat you in math!" (laughs) So, that was all.

Jeanne demonstrated she was "holding her own" as part of the math league, even though her school was labeled as a "reject school". She continued to hold her own in STEM and Computing Education as she demonstrated both cleverness and curiosity. For example, Jeanne demolished her parents' brand new bedroom set, which had an attached entertainment system, as she attempted to assemble it on her own. She played with her brother's electrical "tool box" behind his back. Eventually, she turned a school science project into a liquor selling business from her

school locker.

> I did a time study on alcohol, the effects of the alcohol on the body. For $2 "Yea, you know, drink this liquor, it kills bacteria." "Yeah, it'll make you feel better", stuff like that. I did a study on if alcohol actually has effects on the body? What type of alcohol and etc, etc.? I got a pass from the school that I can actually go into a liquor store like an underage to buy alcohol for my science experiment. I just started…more of my guy friend came up with this great plan; he just hid this liquor out at my locker.

Ultimately, Jeanne devised a scheme to operate a "mini bar" out of her school locker for up to two or three months – "all in the name of science." Perhaps she surrounded herself with the wrong group of students at the school, which interfered with her constructive experiences in STEM and Computing Education.

Jeanne was clearly marked with potential and intellect as she was referred to as the "in-house nerd" and the "smart Computing kid." She was often was called upon by her dad to repair various gadgets and electronics as a child. In college, Jeanne repaired a television that was struck by lightning, which caused her entire apartment building to black out. Moreover, she enjoyed taking a Digital Logic course in college. As Jeanne reflected on her experience, she identified several informal experiences in STEM and Computing Education, which demonstrated she held her own in the absence of formal educational experiences.

Summary. Bianca, Dana, and Jeanne shared a childhood or adult memory related to their academic preparation in STEM or Computing Education. Bianca was the only Black student from her middle school who was bused to a local high school to participate in a Pre-Calculus class. Dana shared snippets of her interactions with computers (i.e., command line prompts) and hands-on activities (i.e., building blocks) in elementary school. She also attended a Science and Technology high school where she followed the Art track, completed an AutoCAD project, soldered an electrical board, and enjoyed "the camaraderie" of playing video games with "the guys." Jeanne was the "in-house nerd" and "smart Computing kid" in her "reject" junior high

school. She also shared short stories about hands-on activities, which described her curiosity and identity development in STEM and Computing Education over time. Overall, they each shared rich experiences in their education trajectories, which demonstrated their abilities to "hold their own."

I am making an impact! This theme captures participants' direct or indirect experiences with impacting various student populations (e.g., general, women, minorities, Blacks) to achieve in STEM or Computing Education (Figure 9). Below, I provide quotations, along with interpretations, that align directly with this theme. I subtitled each story with a salient quote or metaphor to represent the underlying themes in it. Three of five participants' (Alona, Jeanne, and Susan) responses aligned with this theme.

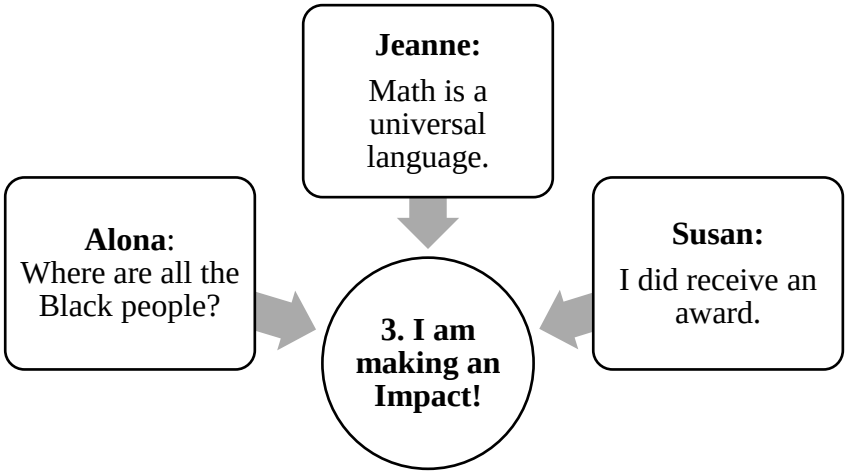

Figure 9. Emergent Theme 3

Alona: Where are all the Black people? During her undergraduate program at a predominately white institution, Alona was impacted by her Department Chair who inquired about the lack of Black students and their families during an orientation session. She had previously taken a class with the chair, but she was astonished he even cared enough to ask specifically about Black students.

> I was very surprised that he was as forward thinking about women and minorities. I was at a session where he had planned an open house for all the new applicants [0:28:36] and I went, I guess I was a student speaker or something. He comes up to me and goes, "Where are all the Black people?" And I was like. 'He cares about this. I didn't even realize he paid attention.' As an undergrad, at an early age like, I thought that that was definitely... It was... that was very pivotal for me to see the department chair cared.

In retrospect, Alona classified this experience as a pivotal event in her undergraduate experiences. As a result of it, Alona acknowledged she was accepted and respected as an underrepresented minority at her predominately white institution. During our interview, Alona was surprised this experience remarkably stood out as a key scene in her Computing Education experiences. However, this experience resonated with her desire to "make an impact" for girls and women in Computer Science.

Jeanne: Math is a universal language. As a first-generation Haitian immigrant, Jeanne had a unique perspective about her experiences in STEM and Computing Education. She described mathematics as a "universal language" that crossed cultural boundaries, as she connected it to her broad understanding of immigrant communities. During our interviews, I was always amazed by her descriptive and detailed stories, which I believe were influenced by her thespian qualities.

> Because I am of Haitian descent, I grew up around people from a lot of different countries, and a lot of different areas. Everyone could relate to it, and it was my way of connecting because I'm very big into families, communities...Even when I was younger. And my way of connecting to those communities was: *math is a universal language.* And so, I would sit with my neighbor that I told you about, the 80-year old. He grew up in a very British culture, and he would do math his way because that was the "right way."

Jeanne continued to describe her interactions with an 80-year-old man (i.e., listening to him tell stories as they did the math) and with other individuals in her community from different countries. They were readily available to assist with her mathematics homework. Alona described each person had their own process and way of doing mathematics, but they all ended

with the same result. She "connected to them, their culture, and their community" through the "universal language" of mathematics. She said, "I felt like I was bilingual all at the same time, and that was very empowering." Jeanne's early childhood experiences in an immigrant community strongly influenced her desire to connect technology and community development.

Susan: I did receive an award. Susan (an Assistant Professor of Management Information Systems at a predominately white university in the South) began her schooling experiences in Tennessee. Although Susan had limited memories of her early childhood experiences, she has had a long-lasting desire to make an impact in the lives of her students, community, and family. Susan's innate desire to make an impact was recognized by her students when they nominated her for a Residence Life Teaching Award.

> Well, *I did receive an award* when I was teaching at [Mid-west University] from my first-year students who were in my Computer Applications class. They were all freshmen, and someone from this class nominated me for the award. Since it was my first ever teaching award, it stands out as a positive memory. It was great! Really, really great!

Susan was overjoyed to receive recognition for impacting the lives of her students. As part of the Residential Life's first-year initiative program, they encouraged students to recognize "faculty who particularly were supportive of students' success." During our interview, Susan and I made an immediate connection to her long-lasting desire to make an impact. She exclaimed: "Yes when I saw your reference to this on the timeline, I thought Oh, *I'm making an impact!"* Susan's recognition by her students also signified the impact she had made on their achievements in U.S. Computing Education.

Summary. As Alona, Jeanne, and Susan shared their indirect and direct experiences with impacting the lives of others in STEM and Computing Education, I gleaned insight into their personal pursuits in Computing Education. For Alona, I discerned she had a desire to influence

the participation of women and minorities in Computing Education. Moreover, Jeanne's multifaceted view of mathematics as a "universal language" revealed her natural proclivity to connect various cultures and indigenous communities to make a broader impact in STEM and Computing Education. Finally, Susan's response to her teaching award confirmed her strong desire to impact the lives of others.

Summary. In response to my first exploratory question, I first summarized my participants' educational trajectories using their timelines. Then, I conducted a thematic analysis (i.e., familiarized myself with data elements, created a codebook, inductively coded data elements using ATLAS.ti, reviewed and refined codes, identified high-level themes, and produced a report of emergent themes) of their childhood and adult memories to ascertain the emergent themes, along with supporting evidence (i.e., participants' quotations, researcher's reflexivity journal), of these experiences related to their trajectories in U.S. Computing Education (Table 10).

Table 10

Emergent Themes for Exploratory Question 1

Emergent Theme	Alona	Bianca	Dana	Jeanne	Susan
I am set apart!	I was always in the class that was set apart.	I was a brainiac.	I was ahead of everybody.	This is all I know.	N/A
I am holding my own!	N/A	I was … the poster child.	I'm just doing what they're doing.	Who don't belong here now?	N/A
I am making an impact!	Where are all the Black people?	N/A	N/A	Math is a universal language.	I did receive an award.

Alona, Bianca, and Dana recognized early on that they were set apart (i.e., "smart," "just always good in school," "ahead of everybody") in Computing Education. They each shared examples of their placement with students in higher grade levels and the consistent positive

reinforcement they received from parents, administrators, and other adults. Ironically, Alona and Bianca were distinguished among other African American students in the Black community. The early positive reinforcement they received seemed to instill a strong sense of confidence, which propelled them forward in Computing Education. Conversely, Jeanne's prolonged realization about her STEM identity influenced a diminished sense of confidence in her abilities. Interestingly, participants labeled their hands-on experiences in Computing Education interchangeably with STEM Education.

Our Low Points, Challenges, Turning Points, and High Points (Exploratory Question 2)

During the first Counter-Life Story interview (Appendix B), I asked participants to describe key scenes (Section B) that represented the experiences that impacted their persistence in U.S. Computing Education, such as low points, challenges, turning points, and high points. During the thematic analysis process, I discovered immediate connections between participants' low points and challenges, turning points, and high points. Yet, during the Counter-Life Story Interviews, they described their positive experiences (i.e., high points) prior to negative experiences (i.e., low points, challenges), and turning points. However, as I read their stories, I realized they described turning points as events that occurred immediately after their negative experiences. Therefore, I reordered the three emergent themes in this section to best reflect the natural flow of experiences in their Computing Education journeys: (4) I am Ph.D. material!, (5) I do belong!, and (6) I have arrived! (Figure 6).

I am Ph.D. material. This theme captures participants' experiences with negative stereotypes and biases in Computing Education (Figure 10). Below, I provide quotations, along with interpretations, that align directly with this theme. I subtitled each story with a salient quote or metaphor to represent the underlying themes in it. Three of five participants' (Bianca, Dana,

and Susan) responses aligned with this theme.

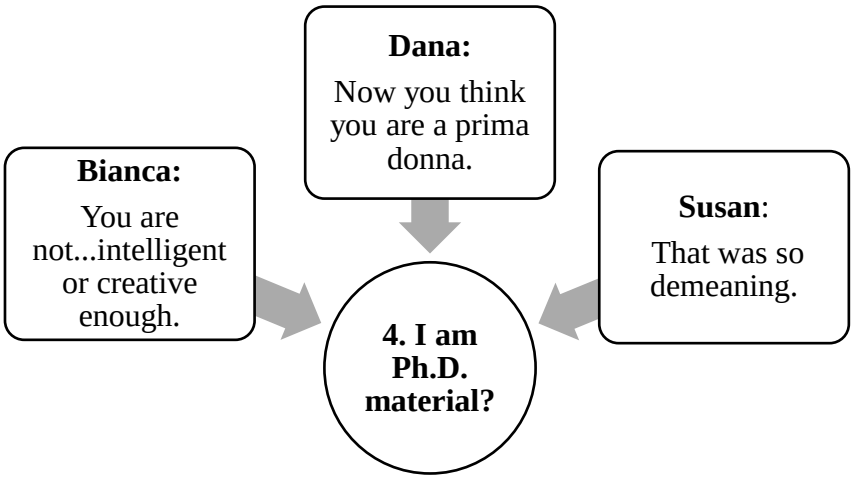

Figure 10. Emergent Theme 4

Bianca: You are not…intelligent or creative enough. Since elementary school, Bianca was distinguished as intelligent and smart. She consistently was a high achiever in middle school (e.g., bused to high school for Pre-Calculus class), high school, and college. She was also an "A" student in graduate school. Despite her impeccable academic record, Bianca encountered several low points and challenges in Computing Education. In particular, while in a Master's degree program at a predominately white institution in the South, she was negatively labeled by a white male college professor.

> I guess the one that would be most impactful would be the professor at [Southeast University] that told me *I wasn't necessarily creative or intelligent enough to get a Ph.D., but I was an excellent affirmative action candidate*. And I was about three and a half semesters of my Master's degree. I told you about that, what I thought when he said a paperwork error. And, I cried…

Bianca was distraught by this white male professor's response to her desire to pursue doctoral studies at her current institution. She further explained the immediate courses of action after her negative encounter. First, Bianca spoke to faculty members in her department, which resulted in a "letter of support" written by the same professor. Next, she visited the graduate school, but they referred to her experience as a "small oversight." Bianca said, "He wrote in his letter 'If the

faculty vote me into the department, then he will work for me.' As opposed to, 'I want to work with this student, so you should vote her in." She discerned his underlying message in this letter was, "If you all decide that she can stay in the program, then I will work with her." Bianca was appalled by his confirmation in writing that "I don't think she's necessarily the best fit." During our interview, she repeatedly recited his exact words *"You are not necessarily intelligent or creative enough to get a Ph.D., but you're an excellent affirmative action candidate."* Bianca had been deeply impacted by this experience. She cried when she left his office, and I cried as she relived her experience. She classified this experience as the lowest point in her Computing Education experiences.

> I've had several biases against me, but I think that was the most direct. For somebody to really look at me and say, "You just really not good enough, but because you've Black..." And that is so not what affirmative action is for…It was a clear case of racism, but I was so beaten down that I didn't even pursue it. And looking back, I wish I had... somebody needed to tell him that this was not right. It's not okay. He's not the "be all, end all"…

Bianca also questioned this professor's authority to declassify her as a viable doctoral student.

To validate her case, Bianca also spoke to the Diversity Officer for the College of Engineering. Although Bianca justifiably experienced racism, she chose not to pursue further action. She established her decision was not fear-based when she said, "I completely understand now why some victims... not because they're scared to come forward, but they're so tired and weak that they just don't have the energy." Although she believed "he needed to be held accountable," Bianca "just didn't have the energy" to move forward. In retrospect, she seemed to mildly regret her decision when the same professor told another African American graduate student "He was not Ph.D. material!"

> No matter how tired or beat up or whatever you think you are, somebody needs to let him know that you can't do this again because he'll just tell the next person that they're not as good." Which he did! He told the only other Black Master's student in the entire [program] *"He was not Ph.D. material!"* That's what he told him. But he didn't write it

> down for that student cause it was a guy. That student was like, whatever! He can't tell me…He's going to be the one to hood me because I'm so not good!

In response, her Black male counterpart wrote on a sheet of paper "You're not Ph.D. material!" and posted it in their shared cubicle as motivation for them to complete their master's degrees. Shortly after this incident, Bianca connected with a Black male faculty member (Ph.D. holder) who became her mentor and provided a strong support system while she pursued her Ph.D. degree at another predominately white institution in the Southeast. She lit up as she described his lab environment in a Computer Science and Engineering department, which was diverse (e.g., Indian, white) and had a high concentration of Black students.

Bianca reflected on her experience from the perspective of a faculty member: "And I don't understand how people can say that. You know, I've used that [experience] to make sure that I don't beat any student down." Her recommendation is for faculty members to provide a concrete reason why a student should not pursue a discipline, such as "It may just be you don't have the time management to necessarily do this part of something," or "You need to work on this in order to be successful." She cautioned against telling any student "you can't do it" because of its dehumanizing effects on the person.

Dana: Now you think you are a prima donna. Prior to pursuing a Ph.D. degree, Dana only recalled one experience in high school with racism and sexism when a white student said she would be accepted into a college program because "she was Black." However, she encountered the most negative experience in her Computing Education journey while enrolled in a Ph.D. program at a predominately white institution in the Southeast. She was the first person in the history of her department to be awarded a National Science Foundation Graduate Fellowship, which relinquished her of teaching responsibilities to focus her attention on research.

Dana had hoped to receive congratulatory responses from the faculty members in her department for this reward of her hard work. Instead, a "slightly balding" white male faculty member who coordinated the teaching assignments for the department made a negative and demeaning remark. She described him as "the workhorse of the department" because he had "graduated from the program and never left." Based on her description, he was not well respected in her department although he was "in some kind of an administrative role." One afternoon while she was on campus in the doctoral seminar room, he approached her and made the following remarks:

> "Oh, you don't have to teach. *Now, you think you're a prima donna* because you don't have to teach anymore." It kind of hit me in the chest – a prima donna? What about me, has ever given that off? I've never stuck my nose in the air. I didn't go around and say, "Hey look at me everybody, Announcement!" Nothing. And to me, it was a fact of [life]. It was very factual, right? Money = [I] don't need to teach anymore. Not, "Oh, I am better than everybody. I don't have to teach anymore." That had nothing to do with the other. And I would say it hurt. It hurt because that wasn't who I was as a person…

Dana expressed deep hurt by this professor's response. During our interview, I experienced a strong sense of emotion as she relived this experience. I visibly watched her become angry all over again because he did not recognize her award as well-deserved due to her hard work. Furthermore, she perceived the award was given to her, not based on race or gender, but based on her academic achievements. As she reflected on her experience, Dana resolved his comments had nothing to do with her.

> And I don't remember if it was soon after that, the same hour, or days, or how long…But I realized 'he's a very unhappy person'. He is very unhappy. Unhappy with his life, where he is. I think his wife is ill. This does not have anything to do with me. If he were happy with his life, he would have talked and wished me well. Congratulate me, because he would have had so much joy in his life that it would have overflowed. So, God, I wish that for him. That's what I wish. That's what made me feel good (laughs).

As Dana concluded her story, her countenance transformed from anger to an overwhelming sense of peace as she determined this experience would not be "ingrained" in her mind. She

deflected his negative response to reveal a potential source of his unhappiness. As she relinquished her anger and embraced "peace," she hoped he would experience overpowering joy in his life.

Susan: That was so demeaning. Susan's lowest point in Computing Education has plagued her for years. While pursuing a Ph.D. degree at a predominately white institution in the "deep south," she was demeaned by a white male Professor. One evening, while enrolled in his marketing class, Susan, and a class partner were assigned discussants of their peers' research papers. Each student was required to read their peers' papers to participate in a class discussion. While leading the class discussion, Susan asked a seemingly challenging question because the class was slow to respond. In response, she improvised by giving the class a hint to evoke their participation. However, Susan's professor was not fond of her approach. She said, "the professor came over to me with a stack of papers, he did this [rolled the stack of papers], and he hit me on my head with the stack of papers." Susan was appalled he hit her on the head as if she were a "dog" in front of the entire class, especially because she was an adult.

As Susan recounted her experience, she described more about the campus racial climate at this university, and how it impacted her overall Ph.D. experience.

> Now we were in [the deep south]. It was already hard enough to come to school every day with the KKK out on the lawn. Then, you're going [to hit me on the head with a stack of papers]. *That was just so demeaning*. You don't do that to adults. [He treated me] like I was just a dog. Now, why would you do that? This is what he said: "Don't give them any hints!" I do not know how in the world I even continued. I was completely caught off guard. I would have never expected anything like that. Of course, I made it through the class. Then right after the class, I cried a flood of tears.

Based on her response, Susan was obviously still affected by this experience as she recalled what the white male professor did and how it made her feel. Susan also provided more details about this experience as she unpacked her story. For instance, Susan called her white male class

partner on the way home from class to vent about what happened. He told her, “I am sorry. He should not have done that to you.” Apparently, the other students in the class were white, and she was one of three minority students (including a Black male) in the entire College of Business. Susan believed her professor “never really respected” her throughout the program. When she had questions about the coursework, the same professor responded: "Well, that's a prerequisite issue, and I know in order to get in here you were supposed to know that.” Overall, Susan believed his responses were quite “unsupportive and just disrespectful”.

> He had just a complete lack of respect toward me. It was just terrible. I never said anything to him. I never said anything to anyone else, and I have always regretted it. I have always felt like I should have said something, especially to him. But you know what, it's not over yet. I still can. I have thought about writing him an email to let him know how he made me feel.

Several years after this experience, Susan was still deeply affected by her negative encounter. Furthermore, she reflected on how this experience has impacted her interactions with students as a faculty member. Susan’s emotions are often evoked when students express similar experiences.

Summary. As Bianca, Dana, and Susan replayed their experiences, the details of what happened and what they were told by white male professors in U.S. Computing Education departments, I naturally invoked an ethic of caring. After each story, I immediately affirmed them and shared my related experience (i.e., When my high school Guidance Counselor told me *"I was not college material!").* I also evoked an ethic of accountability, and I reignited my social justice agenda to share their stories, as they revealed: “hidden truths” they had not shared with anyone (e.g., Bianca, Susan). Furthermore, I recognized their social justice agendas as faculty members when they reflected on how they handle their students with similar experiences. Overall, I was honored they openly shared these low points. Overall, I believe they reflected

barriers to their persistence in U.S. Computing Education.

I do belong. This theme captures participants' turning point experiences related to their sense of belonging in Computing Education (Figure 11). Below, I provide quotations, along with interpretations, that align directly with this theme. I subtitled each story with a salient quote or metaphor to represent the underlying themes in it. Three of five participants' (Bianca, Dana, and Susan) responses aligned with this theme.

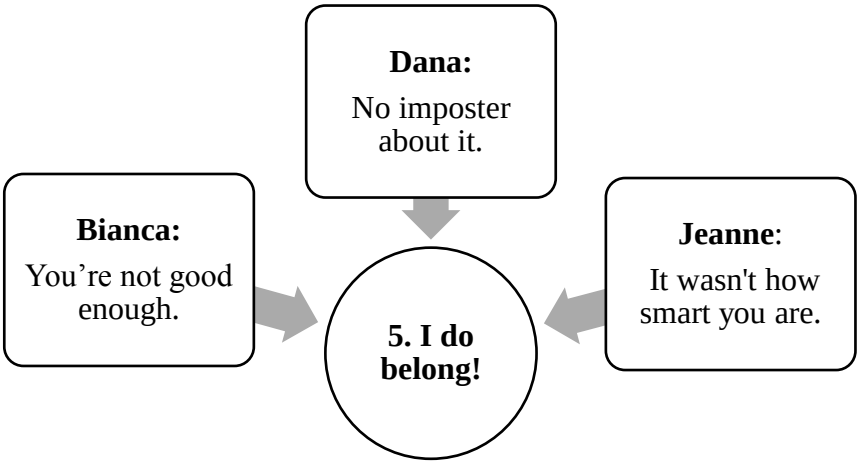

Figure 11. Emergent Theme 5

Bianca: You're not good enough. Bianca's earliest turning point occurred during college in an undergraduate Computer Science program. She declared her belonging (i.e., sense of belonging) in Computer Science after a men's ACM (Association of Computing Machinery) computer programming team at an HBCU dissuaded her to join.

> When I was at [Southeastern HBCU] and that programming team I was on and they said they didn't want any women on their team, and that's when I knew I was going to get my Bachelor's in Computer Science. I mean there was no way you were going to tell me that I wasn't going to... just to be on your team... and these were Black people. It was at an HBCU, the professors might not have been Black, but all the students were Black. But these were Black folks my age telling me "You're not good enough!"

Overall, Bianca's story revealed her experience as an African American woman at an HBCU. She was surprised to be treated in this manner by her Black male counterparts, especially at an HBCU. Unfortunately, she had previous negative encounters in the Black community (i.e., it

was believed by other Blacks that an award was given to her because the dark-skinned principal liked little light-skinned girls). However, Bianca was determined to not allow the rejection she received to deter her. She marked this experience as a turning point in her Computing Education trajectory.

Dana: No imposter about it. Dana's turning point occurred during high school when she ran for Class President during her junior year. During election time, she became so stressed that it affected her physical health (i.e., skipped menstrual cycle). Dana had "contenders for the throne," and she did not want to give up. She confided in her mom who said, "Dana, maybe you would like to give somebody else a chance?" Dana's response was:

> "I can see, your point mom, but Naaah!" Because I don't want to do that. Because I am a good leader and this is my position and I'm going to fight for it. And I did. And I won. I dug down, I got my posters. I did a great speech for the position and ultimately the incumbent came out on top. And I'm glad. I was pleased with myself because that was my decision. It was: "No, my heart says go for it. This is what makes me happy; this is my gift." I didn't have words like a gift at the time, but that's what I was going to do.

Dana was glad she "went for it." She described her turning point as "recognizing the decisions that I make." Although she seemed respectful to her mother's position, she independently made her decision to pursue the Class President position because she was convinced she "belonged" and was a leader among leaders. At her school, Dana described herself as being in a "pool of elites" as follows.

> So does that have to do with Computing? Maybe more around... Yeah, in this pool of elites, we didn't do class rank because everybody was top really. Like if you put us into our base schools, we would have been [in] the top 10 percent [or] 5 percent. So, it didn't make sense to rank at the high school [level]. So, I am the leader of this group. Yeah, there was *no imposter about it*. Like, I'm capable, and I'm good at it. So that's probably just something that carried through.

As she concluded her story, Dana questioned if her experience was directly related to "belonging" in Computing Education, but I saw an immediate connection. I discerned a trend of

her "always being a high achiever." Since elementary school, she established she was "set apart," but she connected with her status in high school through this experience. At this point in her journey, Dana made a strong claim about her identity, and she declared "there was no imposter about it." Overall, Dana was confident in her position as Class President and her sense of belonging as a high achiever.

Jeanne: It wasn't how smart you are. Jeanne experienced a turning point during high school when she discovered an important principle regarding work ethic. In her storytelling, she often provided a background story to provide context for her main point. First, Jeanne painted a picture of her academic status in high school. She thought she would never be described as the "smartest kid" because she "did the bare minimum" and often "the bare minimum was enough." However, she wondered if she only did the bare minimum because of a fear of failure. Jeanne thought if she fully applied herself but failed, then she would be devastated. She also realized "some of the smartest kids in my high school didn't go anywhere in life and weren't going anywhere in life." As she compared herself to other "smart kids" in her school, Jeanne uncovered what she believed set them apart.

> I quickly realized that *it wasn't how smart you are, but how hard are you willing to work by yourself*. I learned that late in the game. I didn't really learn how hard I had to apply myself until later, but some of the smartest kids in my school just threw their life away. "What were you doing?" But then I realized I benefited from that. Like, there would be trip opportunities, scholarship opportunities, etc. that were slated for them but they didn't show up that day, or they didn't take the time to do it. And I just happened to be at the right place, at the right time and they are like, "Hey, you want this? You're here. You're a decent enough student, we'll just give it to you."

In her recollection, Jeanne did not acknowledge she might have been a "smart kid" herself. Instead, she compared herself to other kids whom she considered classified as smart.

Next, Jeanne provided the details of her turning point experience, which occurred during her undergraduate program. At this point in her journey, she identified "herself" as the source of

her sense of not belonging. Although, she said “I am…fighting back, trying to get back to where I needed to be,” she had to resist saying, “I am an imposter who slid my way in here.” Her epiphany about her identity has been a lifelong process, in which her parents and friends have both provided reinforcement. For example, one friend told her, “You worked just as hard to be here as everyone else! Yeah, you're looking at your past, but you don’t realize how many people haven’t made it where you are...!" Jeanne then provided insight into her friend’s comments.

> Basically, there have been people along the path that coming into the engineering program, who had higher credentials than me, who had better schools, had better exposure, had better everything. [They] worked just as hard, [but] just couldn’t cut it, and they fell short. In engineering, they have "weed out courses." So, they got weeded out, and they like tried everything in their power to make it work. And so, my friend was like "Yeah, you're barely getting by because you made some bad decisions, but once you decided to change that path, you're surviving and you're still here!

Jeanne’s friend continued to encourage her and reinforce that she belonged in STEM and Computing Education. She exclaimed: "How many people that started with us, they had all these different opportunities, that ended up in there... you're still here. You're graduating as an Electrical Engineer.”

As Jeanne internalized her friend’s remarks, she finally realized “that counts for something, regardless of how much you think you kinda of slid through the process, no one handed you a grade. No one handed you…." Jeanne described this moment as an epiphany. She said, “Maybe I haven’t just been sliding, maybe I am actually smarter than I think I am, and maybe I'm actually you know, worth my grain and salt, when I say like I actually know this stuff.” For some reason, Jeanne was convinced she only received opportunities because the “smart people” did not apply themselves. She assumed she was getting away with not applying herself and just happened to “be at the right place, at the right time.” In her epiphany, Jeanne finally embraced a sense of belonging.

Summary. Bianca, Dana, and Jeanne each described turning points that helped them overcome potential barriers to their success in Computing Education. Specifically, their turning points were associated with a sense of belonging despite the negative stereotypes and biases imposed on them by white male professors in their Ph.D. degree programs (Bianca and Dana) or a personally diminished sense of belonging (Jeanne). During the turning point experiences, they each accessed an "inner strength" or internal support that seemed stronger than any external supports, such as a mother (Dana) and a friend (Jeanne). Although Jeanne's friend positively influenced her perception of her sense of belonging, her influence was not the sole contributing factor. As she mentioned, Jeanne determined she belonged because she was the source of her sense of not belonging. Overall, these turning points enabled my participants to recover from potential setbacks (i.e., barriers), which helped them reach high points in Computing Education.

I have arrived. This theme captures participants' high point experiences related to their academic achievements in Computing Education (Figure 12). Below, I provide quotations, along with interpretations, that align directly with this theme. I subtitled each story with a salient quote or metaphor to represent the underlying themes in it. Four of five participants' (Alona, Bianca, Dana, and Susan) responses aligned with this theme.

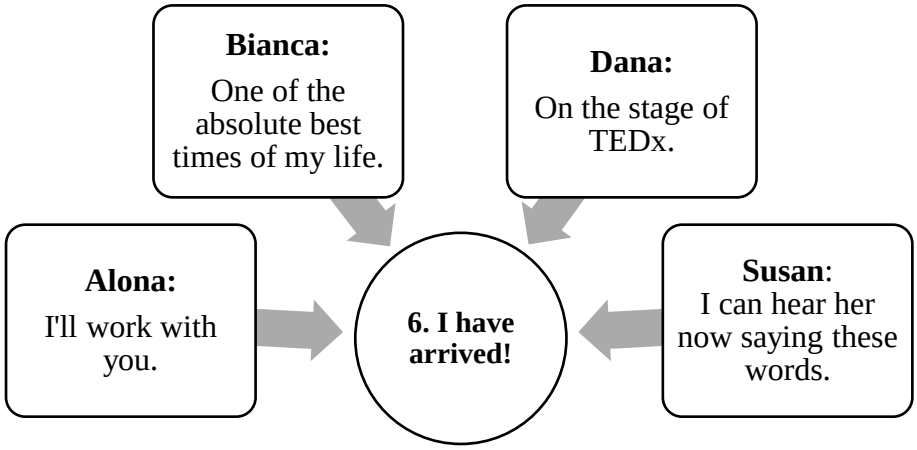

Figure 12. Emergent Theme 6

Alona: I'll work with you. Alona recalled a few high points that positively impacted her persistence in Computing Education. First, her uncle built her a computer while she was in middle school. She said, "So, one high point was actually getting my computer." Second, during the first year of her undergraduate program in Computer Science and Engineering, Alona received a 90 percent score on a second exam immediately after she failed the first exam due to lack of preparedness. She said, "Yeah, getting that grade pretty much pulled me out of the gutter, showed me, okay, you can do this." Her most significant high point occurred when she was a doctoral student:

> Another high point would be when my advisor asked me to work with him. That's where…I had no advisor pretty much for the most part. The guy I end up finishing with, he asked me to work with him. I felt like such a failure before that…He helped me to get my prelim[ary] and qual[ifying] stuff (i.e., exams) together…He was like "I really enjoyed working with you.", and I wasn't expecting it at all. I was expecting for him to help me, then I become a candidate, and then find some other advisor. And he was like "No, *I'll work with you*." So, that was good. And then finally defending, like defending, shaking those hands and walking out.

In essence, Alona was surprised when her new advisor wanted to work with her. Due to previous negative encounters, she had low expectations of her new advisor. Although she accessed her "inner strength" to stay in the program after ongoing tumultuous experiences, the support Alona received from her advisor helped her to become the first African American to graduate with a Ph.D. degree in her Computer Science and Engineering department.

Bianca: One of the absolute best times of my life. Bianca's high point was finally graduating with a Ph.D. degree after the death of her father and the negative stereotypes and biases she encountered from a white male professor while she pursued her Ph.D. degree. Although she was a "straight A student," Bianca faced many trials during her academic pursuits. Her father's death made it challenging to focus her attention on school, even with a strong support system (i.e., Black male professor and advisor). She described her graduation as the

highlight of her entire Computing Education journey: "It is especially joyful because I was not going to attend commencement. For a little while there I didn't think I was going to finish the Ph.D." Once she mustered the strength to complete her degree, Bianca doubted if her family would come to her graduation. She said:

> That was definitely a high point for me; going to commencement, being hooded… the entire weekend. It was from my family coming to the actual commencement ceremony, the pictures afterward, the dinner I had, the friends that came. It was all of that. It was wonderful to consider that I was not going to participate in commencement because I graduated in the summer. I was like, I've been through graduations, no big deal. It turned out being *one of the absolute best time of my life*.

In summary, Bianca's apprehensions subsided when she relinquished them to enjoy her high point experience. Although she had encountered several barriers, which could have changed her course of direction, she persevered to attain a Ph.D. in Computer Science.

Dana: On the stage of TEDx. Dana's high point in Computing Education happened while she was a faculty member. In 2011, she had an amazing opportunity to present before a crowd of onlookers at a TEDx event in the center of a metropolitan city in the Southeast. Dana marked this experience as a high point because she was honored to have such a prestigious opportunity to present her research to an international audience. As she prepared to present, she shared, "My heart was beating; it was racing before going onto stage. I had been made up by the make-up artist, and I was wearing a lot of make-up." With the heavy make-up, Dana was reminded of her "dancing days" (i.e., dance recitals during childhood), so she assumed "I needed to have it on to look good on the camera." During this experience, she was also "very pregnant" with her "second and final child." Dana described her experience as a "culmination of a lot of things:"

> It was recognition for the work being done. It was, wow! this is an international audience, so this is a high-quality production. They had a super paid producer and they volunteered...I mean, it was top quality. And I didn't have to figure [out] any details...

> they had it covered. I had to do practice, you know, beforehand on stage; eighteen minutes was the cutoff; mostly visual slides. It revolutionized how I give presentations because... it was timed... It was fusing me into the story. That was part of the value… And to have incorporated my students…they owned the experience with me...

Overall, Danny was enamored to have been selected by TEDx. Notably, she shared her platform with students, which revealed elements of her character. She continued to describe the setting and her feelings during the experience: "Stepping out of my comfort zone felt so vulnerable. And, getting such incredible [responses]... people laugh at the appropriate time, and [laughed at] my jokes. And afterward, that was really awesome. Like it made people think." Ultimately, Dana was thrilled to inform a broad audience about her research. Her goal was met, and she was fulfilled. She said, "I think they['ve] gotten something of value that made them look at technology and what we can do in a different light. And I had my daughter up there with me." Danny found joy in integrating her students and her family (i.e., unborn daughter) in her most notable academic achievement.

Susan: I can hear her now saying these words. Susan's high point occurred when she graduated from her Ph.D. program. In her story, Susan described her experience at a special ceremony, which was hosted prior to the commencement ceremony, to spotlight minority student graduates at a predominately white institution located in the "deep south." In particular, she was delighted to have her mom, new baby, husband and little sister in attendance at the ceremony. She described her experience as follows:

> I remember I had on this purple dress, which is my favorite color. They gave us these medallions, and my husband was there to escort me to receive the medallion and certificate of achievement. It really stood out to me because that was the moment it all came together. Like, oh my God! I'm a first-generation college student and I have a Ph.D. I think I was just 30 years old. By that point, I think I was just 30 when I graduated with my Ph.D. And, oh! This was really sweet. A lot of my family, of course, was unable to attend, but [Deep South University] broadcasted live the actual Ph.D. hooding ceremony. So, my family back home all got together at someone's house and watched it on the computer. So I thought it was so sweet after I finished when I called

> my grandmother and she said "Oh, my gosh! I saw you walk across the stage. I said: that's a bad girl!" Like, *I can hear her now saying these words.* I remember her saying… Oh, God, I'm about to cry [Susan cries]. Thanks! Thanks, Shetay! But she said: "When I die, I want them to put your invitation in the casket with me."

As she recalled her experience, Susan cried when she remembered her grandmother's response. Apparently, Susan as was unable to place the program in her grandmother's casket because she was cremated after a traumatic death. However, Susan fondly remembered, "She was always so very proud of me, and I was the closest to her in my family. That was just so amazing." Susan and I both shared a tender moment as she released the pain of her past but rejoiced in her final victory of attaining a Ph.D. degree.

Summary. Four of five participants (Alona, Bianca, Dana, and Susan) shared significant academic achievements that served as the high points of their entire Computing Education experiences. For Alona, Bianca, and Susan, their high points occurred when they overcame barriers (i.e., turning points) to graduate from their Ph.D. programs. Dana's high point happened later in her academic career when she presented at a TEDx event in a major city, which was a significant achievement and an acknowledgment of her contributions to a specialized field of research. Overall, the participants finally reached their goals of attaining Ph.D. degrees in their Computing disciplines despite all the odds they encountered on their journey.

Summary. In response to my second exploratory question, I conducted a thematic analysis (i.e., familiarized myself with data elements, created a codebook, inductively coded data elements using ATLAS.ti, reviewed and refined codes, identified high-level themes, and produced a report of emergent themes) of participants' low points, challenges, turning points, and high points to ascertain the emergent themes, along with supporting evidence (i.e., participants' quotations, researcher's reflexivity journal), of these experiences throughout their U.S. Computing Education trajectories (Table 11).

Table 11

Emergent Themes for Exploratory Question 2

Emergent Theme	Alona	Bianca	Dana	Jeanne	Susan
I am Ph.D. material! (i.e., low points and challenges)	N/A	You are not intelligent or creative enough.	Now you think you are a prima donna.	N/A	That was so demeaning.
I do belong! (i.e., turning points)	N/A	You're not good enough.	No imposter about it!	It wasn't how smart you are.	N/A
I have arrived! (i.e., high points)	I'll work with you.	One of the absolute best times of my life.	On the stage of TEDx.	N/A	I can hear her now saying these words.

Low points and challenges. Overall, I discovered their self-identified low points and challenges disproportionately occurred in graduate Computing Education, particularly in pursuit of Ph.D. degrees. For example, three of five participants encountered negative stereotypes and biases (Bianca, Dana, and Susan) from white male professors and advisors. Ironically, Bianca also had negative encounters in Black homogenous environments (i.e., award in elementary school, Black male ACM team at an HBCU).

Turning points. Alona's turning points that propelled her forward occurred when she determined she would not return home after failing her first exam (undergraduate), and she discovered she would be the first African American to graduate with a Ph.D. in her Computing Education department. Bianca's turning point occurred when she determined to obtain a Bachelor's degree in Computer Science after she was dissuaded from joining an all-male computer programming team at an HBCU. Both Dana and Jeanne had turning points in high school when they established (Dana) or began to establish (Jeanne) a sense of belonging. These examples provide evidence that the turning points for these Black women markedly changed their trajectories in Computing Education.

High points. Alona recovered from her setbacks (i.e., failing preliminary and qualifying exams) to become the first African American to graduate from her Computer Science and Engineering department. Additionally, Bianca, Dana, and Susan each resisted negative stereotypes imposed by white male professors to attain their Ph.D. degrees.

Overall, these women endeavored to disallow negative experiences (i.e., low points, challenges) to impede their progress. Regardless of external support from parents, professors, and community members, the participants displayed a level of determination and an inner strength that helped them to become resilient (i.e., ability to bounce back) in the face of insurmountable circumstances. These discoveries provide insight into potential influences on African American women's persistence in U.S. Computing Education.

Our Recommendations for U.S. Computing Education (Exploratory Question 3)

In response to exploratory question 3, I familiarized myself with participants' stated improvements to U.S. Computing Education through listening to interview audio files, reading transcribed interviews (loaded in ATLAS.ti 6.5), and reading notes in my researcher's journal. Second, I performed an Open Coding (i.e., developed codes while reading the data elements) process to ascertain emergent themes. During the final Counter-Life Story interview, I asked participants to provide their recommendations to improve U.S. Computing Education at all levels (see Appendix B: Counter-Life Story Interview Protocol, G. Reflection: question 2). As I employed ethics of caring and accountability (i.e., Afrocentric feminist epistemology), I minimally edited their verbatim answers (i.e., removed repetitions, question prompts, comments, and fillers: like, um, you know) to produce a coherent and seamless narrative account (Atkinson, 2002). Because participants provided unique responses, I summarized their answers rather than identified emergent themes in this section (Figure 13).

Alona	Bianca	Dana	Jeanne	Susan
• Change accessibility. • Change think[ing]. • Encourage women. • Watch the pronouns. • Educate teachers.	• Strides made.	• Targeted community. • Have a buddy. • See there's a path.	• Connect to broader experiences.	• Better Math.

Figure 13. Summary of Recommendations for U.S. Computing Education

Alona. Alona provided several recommendations to improve U.S. Computing Education. She immediately began to spout out her advice, without any hesitation. She also provided supporting examples based on her personal experience.

Change accessibility. Alona provided an example to illustrate the unaffordability of Computer Science camps for low-income students and the need to offer affordable options. She said, "A lot of times these computer camps are $2,000, and it prices out a lot of people who can't afford to go. So, they have the aptitude, but just not the money." Moreover, she suggested Computing should be as standard as mathematics in school because "Computer Science is the new math." Alona explained "…everyone learns math, you can't get out of high school without learning math, why not Computing? Because that's the next wave." Furthermore, she said, "Everybody uses math in high school and college to solve problems. It's going to be Computing in a second." Overall, Alona suggested Computing should be required similar to mathematics.

Change think[ing]. Alona also recommended "changing the way people think about science and Computer Science." She gave an example related to most people's immediate perception of the word "geek squad:"

> Say the word “geek squad.” You'll immediately have a picture of a white man with glasses, dark hair, and fixing a computer. For a Black woman who does not fit that image, that's not something they will typically gravitate towards. And I don't even know if it's anything education can do about it.

Alona did not think Computing Education could change this perception because it is influenced more by our society. Her central point was we should change the image of Computing to engage increased numbers of Black women and girls.

Encourage women. Alona also thought women should be encouraged to enroll in Computer Science classes as they would Home Economics classes. She provided an example in the literature which suggests male students need more attention than female students in mathematics and science. However, she asserted female students also needed equitable and equal spaces as male students.

Watch the pronouns. Alona also cautioned us to consider the pronouns we use in our everyday language. She described an encounter with a student who removed her from his dissertation committee. She apparently challenged his usage of pronouns as he described nurses and doctors in his profession. She said, “Every time he talked about the doctors, he said "he." Every time he talked about the nurses, he said "she." Alona summarized his behavior as an “unconscious association” or bias where males are assigned lead science roles and females are assigned to “helping sorts of occupations.” She believed we needed to change the image of Computing and the pronouns we use because “We certainly don’t fit the mold.” Alona drew from her personal experiences to describe this recommendation.

Educate teachers. Lastly, Alona suggested we should have teachers facilitate more computer usage in the classroom. Moreover, teachers should be further educated on how to use computers to alleviate their fears of using computers in the classroom. Alona perceived some seasoned teachers “(15, 20, 30, and 40 years of experience) are still incorporating "point and

shoot" methods because they have the mentality of "I've always done it this way," so they do not explore all of the possibilities available with the technology they are using in the classroom." Furthermore, based on her experience training teachers (i.e., Programming for CS Teachers Summer Camp), Alona witnessed them asking questions such as, "What if they ask me a question I don't know?" Her reply was, "Google it, that's what I did. Even if you're in class, and it [doesn't work], then tell them "You know what, that's a really good question. Let's find out." Therefore, she encouraged these teachers to introduce Computing as "an exploratory kind of thing" rather than having the attitude of "I'm not going to teach if I don't know all the answers." In conclusion, Alona recommended schools may hire a part-time Computer teacher or compensate teachers who are adept in Computing.

Bianca: Strides made. Bianca suggested strides (i.e., progress) had been made to improve Computing Education. She provided examples of current initiatives:

> Well, I think at this point, strides have really being made. Without all of the broadening participation grants, and all of the themes of diversity at different institutions and all of these middle school and even elementary school programs…With the Computer Science Education Week. It's a lot happening right now.

Bianca also mentioned the Computer Science Education Week (CSEdWeek) initiative, which is hosted annually by Code.org (i.e., a national nonprofit organization that provides free Computer Science resources) to promote interest in Computer Science among K-12 students. CSEdWeek commemorates the birth date of Admiral Grace Murray Hopper (December 9, 1906), who is considered as a woman pioneer in Computing. Bianca agreed that this effort, along with other efforts, should continue to be sustained by funding and support.

Dana. Dana intently thought of three primary recommendations to improve U.S. Computing Education. She also provided supporting examples to justify her responses.

Targeted community. Dana suggested a targeted community should be identified to communicate educational opportunities and best practices to African Americans. She recommended the "church" because historically the "Black Church" has served as a community hub for African Americans:

> Maybe it is through the church, right, if many African Americans are in the church? I think more often than not, we can presume, even if they're not currently actively practicing or believe, their [churches] are our bases. And so, they at least understand, they understand the language.

Dana suggested the church could serve as a "subterfuge" or a "sneak attack" to encourage more Blacks to participate in STEM and Computing (i.e., train technology skills in an urban design class, or Computing skills in a social media skills). As this idea matures, Dana assumes stakeholders will become aware of existing targeted communities. Moreover, she suggested leaders of this initiative follow a multi-level approach to engaging parents and students and to provide STEM and Computing related information, such as mathematics requirements, summer camps. Furthermore, she suggested other "sneak attacks" such as a "programming app for quickly assessing aptitude", if not currently available.

Have a buddy. Additionally, Dana suggested a buddy system for students at the graduate level to encourage peer-level support. She advises all doctoral students to have a buddy. In her educational journey, she often partnered with other students or groups to complete assignments and school work. Specifically, Dana recommended a buddy "because there's going to be some point in time when you're going to be weak, and it can't be just about you." She then shared to relay an experience when she served as a source of support for her buddy in the doctoral program.

> I remember standing in the hallway, as a doctoral student, with my buddy. She was crying about this terrible feedback she got. I'm like "Okay, get a grip on yourself because it's not about you. You're not going anywhere because I can't let you go anywhere. I

> need you here. So, get your cry, do what you have to do. I'll see you in class." And now she's a leader in the field, and she's employed the method that she got such terrible feedback on in her dissertation. She mastered it. Now, maybe because she was trying to prove something but she did it! She did it!

Furthermore, Dana suggested someone (e.g., professors) should "plant the seed" to help students recognize career pathways in Computing at the undergraduate level. Dana drew from her personal successes and experiences to provide a meaningful recommendation.

Jeanne: Connect to broader experiences. Jeanne's primary suggestion was related to the connection of Computing Education to broader experiences, such as students' future goals. She comically introduced the notion of our society being focused on "Kids-like fun" or "You've got to gamify everything" (i.e., when a computer game is connected to an activity). Jeanne agreed "the research does show, kids and adults are gaming like nothing before, however, she thought some efforts were "misdirected." She explained her personal experience to further describe this phenomenon.

> Games were fun, but I didn't see how any of that had to do with what I was doing in my life. So, I think we're misdirected. Yes, games can hold kids' attention for hours upon hours. But they don't necessarily see themselves in it. And you can throw as many Black characters as you want. You can make the experience as urbanized as you want. They still don't necessarily connect that to goals, dreams, etc. Right? So I think, again *connecting the Computer Education experience to the broader experiences* of self-discovery and all the things we do with kids in general, right? Learn about you. Learn about all your options in life… The more you are exposed to options, and then bringing that into Computing.

Jeanne also described the current state of existing informal learning Computing programs (i.e., afterschool, summer camps) that offer "Computing for Computing sake" activities (i.e., lack of practical application) and limited career exploration and real-life application. Jeanne described the crux of her recommendation as follows.

> Now I realize what I was trying to say. The problem with Computing Education is we don't know what they value and we don't know how to connect it to their value. If you find a way to connect Computing Education for the targeted audience's value, then build

it around there, it will be a sure win, in my opinion.

She further exclaimed, "Kids know who care," and "If you're putting in an effort to figure out who they are, what they value, what's important to them, and then [add] Computing Education [principles] to that, you won't be able to pull them apart." Jeanne's experience in Human Computer Interaction was evident in her response.

Susan: Better math. Susan's main suggestion was to improve mathematics. In her response, she reflected on her own personal struggles with mathematics throughout Computing Education. As an educator, she also provided keen insight on reasonable improvements for teaching mathematics education.

> I would say educators should enhance the rigor of math. More math opportunities and more innovation in math courses are needed to make it more interesting. They should teach in ways that speak to more than one child, and not just stand at the board writing down math problems. As an educator myself, I have found that is not the best way to teach all students. Even in my computer classes, I do not just teach one way. I have been teaching a multitude of ways, and I offer a multitude of assessments because not all students can take one particular test. Everyone does not like the same type of testing or even perform well on some types of exams. So, I have to give many different options.

Susan's detailed suggestions may help improve mathematics education at all levels. Although she did not explicitly mention it, Susan described the need to introduce various learning styles in the mathematics curriculum. Perhaps, Susan's struggles with mathematics were related to teachers' lack of accommodations for diverse learning styles. Furthermore, Susan agreed that Computer Logic should be offered to prepare kids for Computing careers. Additionally, she thought educators should encourage students to have an early "love or passion in mathematics." She suggested "Kindergarten" as a good timeframe to introduce children to mathematics and logical reasoning. Susan thought there should be "some type of special emphasis on math," similar to our emphases on children's daily activities with "sight words" and "reading." For example, children should be encouraged to practice "math every day." Overall,

Susan an early introduction of "fundamental knowledge" in "math reasoning" would improve mathematics education and promote comfortability with Computer classes, regardless of the Computing discipline.

Summary. Participants provided various improvements that connected to their personal interests and experiences as former students and current faculty and staff members in U.S. Computing Education departments (Table 12). For example, Alona was impressed by an administrator who expressed support of minorities and women during her first year of college. Personally, she expressed a desire to change the narrative about women and girls in STEM, which likely influenced her recommendations (i.e., pronoun use, the image of Computing). Bianca focused on sustaining current K-12 initiatives, which may have been influenced by her experiences (i.e., Pre-Calculus in the 9th grade) in K-12 Computing Education. Dana shared her recommendations for a buddy system, which she acknowledged was influenced by her personal experience with partnering (i.e., buddy system). During our interviews, we discovered partnering was a reoccurring theme in Dana's Computing Education journey. She also suggested the Black Church should serve as a targeted community to disperse information and host informal learning programs because it still represents a central hub for the Black community. Jeanne also seemed to glean from her experiences with game design and Computer Science Education outreach initiatives, which she currently facilitates in her postdoctoral researcher role. Moreover, Susan admittedly suggested improvements to mathematics education because of her personal challenges with mathematics, which she attributed to lack of diverse teaching styles in mathematics courses. In Chapter 5, I refer back to their suggestions as I reflect on my implications for practice.

Table 12

Summary of Responses for Exploratory Question 3

Theme	Alona	Bianca	Dana	Jeanne	Susan
Improvements to U.S. Computing Education	Change accessibility, Change think[ing], Encourage women, Watch pronouns, Educate teachers.	Strides made.	Targeted community, Have a buddy, See a path.	Connecting to broader experiences.	Better math.

Final Reflections: Co-Constructing Our Counter-Life Herstories

In this section, I provide a summary of my participants' (Figure 14) and my final reflections on co-constructing our Counter-Life Herstories. I provide verbatim responses from their final journal entry (i.e. Participants' Reflective Journal Writing 3) to give voice to their thoughts and feelings during the interview process.

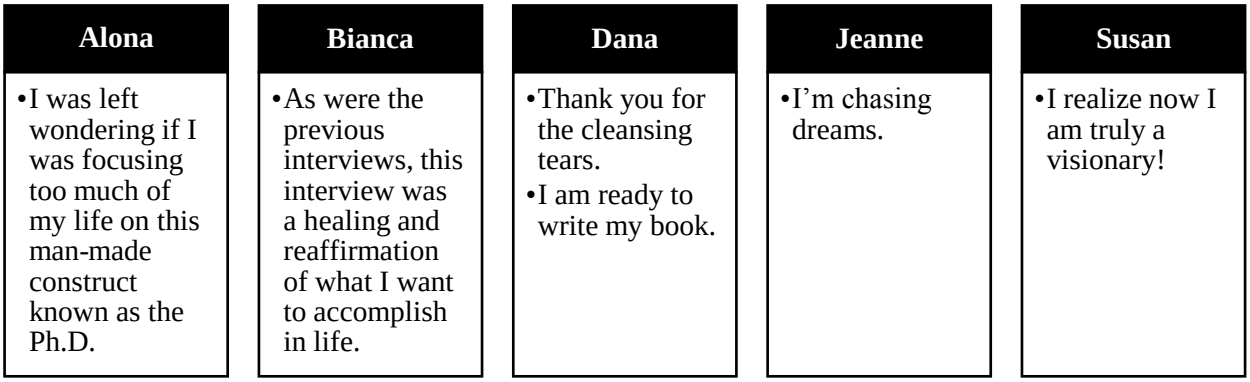

Figure 14. Summary of Our Shared Experiences

Alona: I was left wondering if I was focusing too much on the Ph.D. As Alona shared her final reflection, she provided insights into her overall journey and current placement as a tenure-track Professor in Computer Science and Engineering. She indirectly expressed her apprehensions about the tenure process and the next chapter in her life:

> Much of my journey centers on obtaining my Ph.D. I feel as though all of my toughest moments and challenges all stem from obtaining this mysterious Ph.D. This subjectively assigned piece of paper accompanied by several signatures and handshakes. After this session, I was left wondering if I was focusing too much of my life on this man-made construct known as the Ph.D. Then, it also made me reflect upon the tenure process

> which is very similar to the Ph.D. process in which (for some people) your entire life is dictated by the opinion of your peers. Furthermore, the same goes for the conference review process. As Christians we are taught to not worry about what the world may say or think about us, however, this is exactly what my job requires. It's an interesting juxtaposition of everyday life.

Alona also acknowledged her internal struggle with worry and valuing the opinions of others, which negates a Christian worldview perspective. Therefore, this interview process helped Alona to refocus on her core beliefs to regain strength for her continued journey ahead.

Bianca: This interview was a healing and reaffirmation. In Bianca's final reflection, she found our interviews to personally beneficial to her as a professor and mother, which also influenced her pseudonym selection. She wrote:

> As were the previous interviews, this interview was a healing and reaffirmation of what I want to accomplish in life. Not just in my Computing life, but in my personal life. This interview made me look into what I want to do as a mother. Not as a mother who is also a Computing professional, but just as a mother. It is so important to me that my children are loved and that they know they are loved. Through this interview, I realized my overall goal as a mother is to make sure my children can never describe their childhood as "dysfunctional."

Overall, Bianca related her Computing Education experiences to her role as a mother and her desire to produce productive members of society.

Additionally, Bianca expressed appreciation for my dissertation project and the unexpected impact on her life. Bianca, along with other participants, found value in the use of the life story interview protocol and the life history qualitative approach I followed. She said.

> I appreciate this project. While the goal of the project may be one thing, an unanticipated result has been my own personal self-reflections. While Shetay may have known this would happen, when I volunteered as a participant, I did not expect to come away feeling therapeutic. I think I should take the questions from the interviews and ask them again in say, five years. I think that if I make it a point to reflect on my past, present, and future on purpose, I will stay humble, driven, and focused on what matters in life, both personally and academically.

In essence, Bianca's final reflection further revealed how the interview process helped my participants to reflect on both the positive and negative aspects of their journeys to reaffirm their accomplishments and reconnect to their sources of strength.

Dana: Thank you for the cleansing tears. I am ready to write my book. Dana's final reflection recalled our third interview when we shared a similar low point experience, which occurred in undergraduate Computing Education. I immediately invoked an ethic of caring as she cried during our interview. In response, I shared my similar experience and also shed tears along with her. Dana wrote:

> Thank you for the cleansing tears. I had hoped that the more I relay the regret of missing the [University game] that the tears would lessen. Not so. Today, I am glad they have not gone away because they shared, helped unlock a similar experience of depression during undergrad. And we came out of the dark into the light. There was a light at the top of that deep well, and I made it out. I am thankful that my life narrative does not seem foreign but relatable. I have felt a bit apart at times and throughout my life. My husband has, too, and we connect on this point where we are unique, and different kind of Black geeks together. I like that. That is my base. I shall come back to this likely in tomorrow's final discussion. I am ready to write my book!

Dana's reflection further revealed the level of intimacy during our in-depth interviews. As she indicated, I also hope each woman will reveal their identities in the future to share their stories. Doing so will further liberate and bring "healing from their pasts", which will influence other women to reveal hidden truths about their educational experiences.

Jeanne: I'm chasing dreams…I can barely put into words. Jeanne revealed her acceptance and affirmation of her current state as a Postdoctoral Researcher. Although she seemed unfulfilled or devalued in comparison to her peers, she was finally reassured that she was on the right path. She wrote:

> Today was a lot challenging to reflect on for me at first. I have been a bit insecure about where I am now career wise and the goals I haven't reached yet. Many of the people that obtained their Ph.D. around the time I did are senior executives in their companies or tenure-track faculty coming up for tenure or doing other great things established adults

> with Ph.D.s do. Me? I'm a postdoc, and it's not fun – lack of opportunity or lack of skills that I'm not at their level – It's me doing me. I have always been a free spirited, tree-hugging type [of person]. The traditional path has never appealed to me for much of anything. I'm the one that always do things the hard way. So me being me is the idea, instead of taking the logical paths of a Ph.D. (academia, industry, or entrepreneur), I'm chasing dreams. Dreams I can barely put into words, that make little sense outside of my head that leave me financially, personally, and socially well behind my peers. But in my effort to describe the things I'm about today, I get excited every time at just the thought enough where I know I'm on the right path, just got to get there.

In essence, Jeanne's revealed the value of the Counter-Life Story Interview protocol and my life history qualitative approach. During our interviews, she noted patterns and acknowledged her successes along the way. I am honored to have been a part of her process.

Susan: I realize now I am truly a visionary! Susan shared how the interview process helped to uncover her true identity as a "visionary." She had not considered how she had persevered despite the insurmountable odds she faced. Although Susan had limited childhood memories, she exhibited a strong source of strength and determination. She wrote.

> I realize now I am truly a visionary! Realizing how I made a decision to "be successful" and had the courage to change my behavior and aim for greatness is something I should be proud of. However, it's difficult for me to say "I'm proud of something that I did." Thanks for helping me discover this about myself. I can now take the time to analyze those decisions and steps and determine how I can instill those values in my boys. I am blessed to have had the self-discipline to take major steps through life but more so I am thankful for that team who put together that college tour!

In her reflection, Susan revealed how my role as "researcher" also morphed into a role of "counselor" and "friend" during our interviews. I was so honored each participant shared so openly with me about their personal and educational experiences that impacted their overall persistence in Computing Education.

My final reflection. As I planned my knowledge validation process from a theoretical standpoint, I never imagined how fulfilling this process would be. Throughout my study of these women's lives, I wore many hats in addition to my primary role as the *researcher* and

instrument. At times, I served as a *counselor* when I asked probing questions about their educational journey and critical experiences that informed their persistence in Computing Education. Then, I served as *mentee* as I sought advice on becoming a faculty member and as they offered nuggets of wisdom to guide me on my path to obtaining a tenure-track Assistant Professor position. I was mentored in profound ways that I would have never imagined. For example, I was recommended to a Department Chair for a Post-Doctoral Researcher position, I was treated to lunch with a group of Black faculty members who were seeking information about the promotion and tenure process from a new Black Assistant Provost, I was invited to include my dissertation work in a book series, I was introduced to a Program Director at the National Science Foundation and other prominent scholars in Computing Education, and I was asked to join senior faculty in mentoring an undergraduate researcher to create a publication on the lack of African American faculty in Management Information Systems. Most impactful to me, I was invited into the family of African American women scholars. Our interviews were full of laughter, intimate storytelling, and even tears. We opened our hearts to each other, even if for a brief moment because we were hungry to share with someone who really cared to listen. I believe we shared some personal stories that we would not likely tell anyone else in our professional lives. I am happy my participants were safe in my presence and disarmed. I believe this is the value of conducting research on African American women from an African feminist epistemological perspective.

CHAPTER FIVE: CONCLUSIONS AND IMPLICATIONS

Introduction

During this study, my primary purpose was to explore the retrospective experiences (i.e., Counter-Life Herstories) of African American women faculty at all levels (elementary, secondary, middle school, high school, bachelor, master's, and Ph.D.) of U.S. Computing Education. Specifically, I co-constructed the Counter-Life Herstories of five African American women who now serve as Assistant Professors (Alona and Susan), Associate Professors (Bianca and Dana), and as a Postdoctoral Researcher (Jeanne) at postsecondary education institutions in the South, Southeast, and Mid-Atlantic regions of the United States.

Because Counterstories are useful to counter the majoritarian perspective about the experiences of marginalized groups (Bernal & Villalpando, 2002; Closson, 2010), they are powerful social justice tools to uncover hidden truths about experiences (Delgado & Stefancic, 2012). Moreover, herstories offer a historical narrative account from a feminist perspective (Mills, 1992). Herstory was coined in the early 1970s by the feminist movement as a counter to history. Feminists have purposely used this term to emphasize "the rewriting or respeaking of history" (Mills, 1992) from a woman's perspective. Critics of feminism argue historia (i.e., Ancient Greek origin: ἱστορία meaning "knowledge obtained by inquiry") is etymologically unrelated to the masculine term history (Conde Silvestre & Hernández Campoy, 2012). Herstories are a plural form of herstory. Therefore, I derived the term Counter-Life Herstories from the terms: herstories (Mills, 1992), life histories (Wisniewski & Hatch, 1995), and Counterstories (Bernal & Villalpando, 2002; Closson, 2010; Delgado & Stefancic, 2012;

Solórzano, Ceja, & Yosso, 2000) to reflect my use of the life history method to uncover the hidden truths about African American women's experiences in U.S. Computing Education. As an emerging African American woman scholar with a Bachelor's degree in Computer Science, I had a "unique angle of vision" (Collins, 2009, p. 39). Moreover, I followed a social justice agenda to situate the experiences of my participants in the social-political context of U.S. Computing Education, from an Afrocentric feminist epistemological perspective (Collins, 2009).

In this chapter, I make meaning of my key discoveries during this study. First, I discuss selected emergent themes that were most relevant to my interpretive frameworks (i.e., critical race theory, Black feminist thought), and my participants' recommendations. Second, I present implications and recommendations for future research. Last, I provide my final conclusion.

Discussion: Making Meaning of My Discoveries

I discovered six emergent themes (Table 13) that connected to my five participants' responses. These themes, with my interpretations, represented our counter-life herstories.

Table 13

Detailed Summary of Emergent Themes

Emergent Theme	Alona	Bianca	Dana	Jeanne	Susan
1. I am set apart!	I was always in the class that was set apart.	I was a brainiac.	I was ahead of everybody.	This is all I know.	N/A
2. I am holding my own!	N/A	I was going to be the poster child.	I'm just doing what they're doing.	Who don't belong here now?	N/A
3. I am making an impact!	Where are all the Black people?	N/A	N/A	Math is a universal language.	Oh, I'm making an impact!
4. I am Ph.D. material!	N/A	You are not…intelligent or creative enough.	Now you think you are a Pre-Madonna.	N/A	That was so demeaning.
5. I do belong!		You're not good enough.	No imposter about it.	It wasn't how smart you are.	
6. I have arrived!	I'll work with you.	One of the absolute best times of my life.	On the stage of TEDx.		I can hear her now saying these words.

Knowledge validation process. During this study, I employed an integrative conceptual framework (King, 2013) that incorporated Afrocentric feminist epistemology, critical race theory, and Black feminist thought to govern my knowledge validation process because they provided the appropriate lenses to understand African American women's experiences (Howard-Hamilton, 2003) throughout U.S. Computing Education (Figure 15).

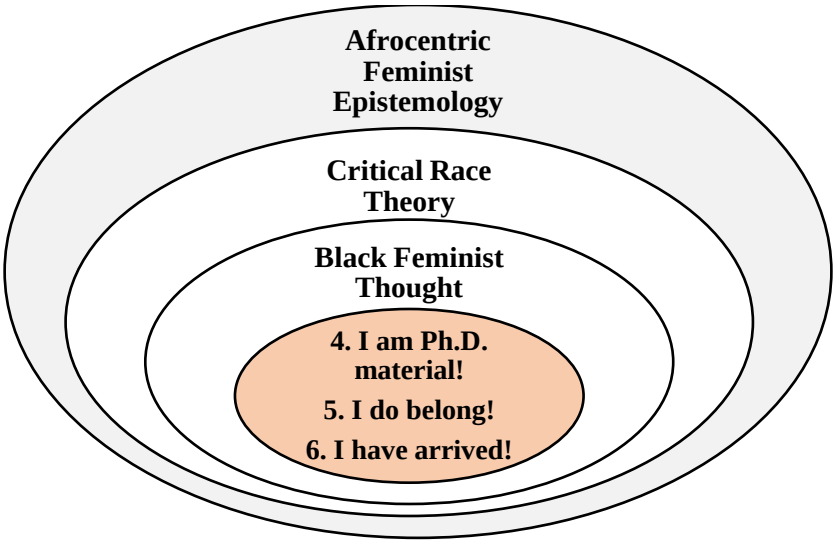

Figure 15. Situating Participants' Critical Experiences

Afrocentric feminist epistemology. I used Afrocentric feminist epistemology (Collins, 2009) to govern my knowledge validation process because it nullified the Eurocentric masculinist approach to accepting my participants' Counter-Life Herstories as concrete truths. Due to the nature of my interview protocols (i.e., timeline interviews, Counter-Life Story interviews), I engaged in dialogue with participants to co-construct their Counter-Life Herstories. I also invoked an ethic of caring by openly sharing my reflections and affirmations of their successes during our interviews, and an ethic of accountability as I maintained their confidentiality through their identification of pseudonyms and my intent of following a social justice agenda. Moreover, I performed a member-checking process of my participants' data elements (e.g., timelines).

Situating participants' experiences in U.S Computing Education. My participants' Counter-Life Herstories directly aligned with the notion of critical race theory's (CRT) experiential knowledge through Counterstories, which nullify majoritarian stories (Closson, 2010; Bernal & Villalpando, 2002). Some CRT scholars disapprove of white scholars generating knowledge about African Americans because they are disconnected from their experiences and unique histories (Delgado, 1995). Therefore, the fact that I conducted this study from an Afrocentric feminist epistemological perspective (i.e., emerging African American woman scholar) supports CRT scholars' notions about experiential knowledge creation. Next, I connected the following three critical themes, with their associated experiences, to my interpretive frameworks to further reveal hidden truths about my participants' experiences in U.S. Computing Education (Table 14): I am Ph.D. material!, I do belong!, and I have arrived!

Table 14

Connecting Critical Themes to Interpretive Frameworks

	Interpretive Frameworks		
Critical Race Theory	Endemic racism and Interest convergence	Commitment to social justice	
Black Feminist Thought	An oppressed group in the U.S.	A social justice agenda to advance BFT	Unique experiences, despite their commonality
Critical Themes: Experiences That Influenced Persistence			
4. I am Ph.D. material!	X	X	X
5. I do belong!	X		X
6. I have arrived!	X		X

*AAW – African American Women
** Bell, 1980, 1993; Closson, 2009; Crenshaw, 2011; Delgado & Stefancic, 2012; Ladson-Billings & Tate, 1995
*** Collins, 2009

I am Ph.D. material. Three of five participants' (Bianca, Dana, and Susan) low points and challenges were associated with negative stereotypes and biases they encountered in postsecondary Computing Education, which directly connected to tenets of critical race theory (i.e., racial realism) (Closson, 2010), Black feminist thought (Collins, 2009; Malcom & Malcom,

2011) and the phenomenon of stereotype threat (Steele & Aronson, 1995).

Critical race theory (racism), As the participants progressed along the Computing Education pathway, they each encountered heightened levels of racism, from white male professors, particularly while enrolled in graduate school programs. Despite their commonality, each participant's experience was notably unique (Collins, 2009). For example, Bianca encountered "a clear case of racism" when she requested a letter of recommendation from a white male professor to enter into a Ph.D. program at a predominately white institution located in the South. Although she was an "A" student, he responded, "You're not necessarily intelligent or creative enough to get a Ph.D. degree, but you are an excellent affirmative action candidate." This white male professor's response also demonstrated a form of interest convergence because his support of Bianca's admittance into the Ph.D. program (i.e., African American person's concern) was contingent on his interest to satisfy an affirmative action requirement (i.e., white person's concern) rather than his genuine support of her academic endeavors. During our interview, Bianca questioned his application of affirmative action because she believed "that is so not what affirmative action is for." She also followed a social justice agenda when she displayed concern for a Black male student (i.e., the only other Black person in the program) who was told "He was not Ph.D. material" from the same professor. As a result, Bianca augmented her teaching approach to ensure she never treated a student in a similar manner. Although Bianca never pursued any actions against this professor, she seemed still deeply wounded from her experience.

While attending a predominately white institution located in the "deep south", Susan had several encounters with racism, such as a white male professor hitting her on the head with a stack of papers, daily microaggressions, and periodic appearances of the KKK on her school's

campus as recent as 2010. As a result, Susan's encounters supported the notion that African Americans experience the effects of microaggressions in educational settings based on the racial climate (Delgado & Stefancic, 2012; Solórzano, Ceja, & Yosso, 2000). Additionally, Susan was the only Black female student in the class and one of two Black students (1-Black male, 1-Black female) in the College of Business.

Black feminist thought (sexism). My participants' experiences also confirmed their double oppression (i.e., double bind) and status as an oppressed group due to gender and racial barriers (Collins, 2009; Malcom & Malcom, 2011; Ong, Wright, Espinosa, & Orfield, 2011). For instance, Dana experienced a form of double oppression when a white male professor told her, "Now you think you are a prima donna" when she no longer had to teach because she received a National Science Foundation (NSF) Graduate Fellowship at a predominately white institution located in the Southeast. Dana was the first person in the history of her department and in the College of Business to win a NSF Graduate Fellowship. She assumed her award was not given based on race or gender but because of her research accomplishments and abilities.

Stereotype threat. Stereotype threat (Steele & Aronson, 1995) is a psychological theory of viewing or treating someone based on a negative stereotype. When African American women experience stereotype threat, they often internalize the projected stereotypes and create self-fulfilling prophecies (Bush, 2013; Steele & Aronson, 1995), which may negatively impact their persistence in U.S. Computing Education (Perna et al., 2009). As previously described, Bianca's experience with a white male professor while pursuing a master's degree also connected with stereotype threat. Moreover, Dana encountered stereotype threat when a white male professor called her a prima donna.

Summary. In summary, three of the five participants indicated their low points and challenges involved forms of racism, sexism, or both. Bianca's negative graduate school experience had the most connections with critical race theory, Black feminist thought, and stereotype threat. Critical race theory helped to interpret their experiences with racism while Black feminist thought distinguished their unique experiences due to double oppression in U.S. Computing Education (Collins, 2009; Ong, Wright, Espinosa, & Orfield, 2011). I followed a social justice agenda to rouse their consciousness about exposures to racism (e.g., microaggressions) during their experiences. Collectively, the participants were victims of unconscious or conscious forms of racism at predominately white institutions with heightened college racial climates (Solórzano, Ceja, & Yosso, 2000). Their sustained wounds speak to the discriminatory effects of racial discrimination and stereotype threat, which inflicted emotional and lasting scars (Freeman, 1987; Steele & Aronson, 1995). Unfortunately, the white male professors (i.e., perpetrators) who imposed these negative stereotypes and biases did not acknowledge nor address how their marginalization of these women could have halted their Ph.D. degree attainment, including their earning potential and overall quality of life.

I do belong. Three of five participants' (Bianca, Dana, and Jeanne) turning points were related to their development of a sense of belonging in U.S. Computing Education, which directly connected to Black feminist thought (sexism) (Table 14), alienation, imposter syndrome, and determination.

Black feminist thought (sexism). Bianca's turning point experience was the result of sexism imposed by her Black male peers at an HBCU in the South. While enrolled in an undergraduate Computer Science program, she was dissuaded from joining a Black male computer programming team because "they didn't want any women on their team." In contrast

to literature about the supportive and nurturing environment at HBCUs, including in STEM departments (Borum & Walker, 2012; Jackson, 2013; Perna et al., 2009), Bianca was less than supported by her Black male peers in this environment. As a result, Bianca was reminded of her double oppression as an African American woman, even in a homogeneous environment (Collins, 2009).

Alienation. At predominately white institutions, African Americans, including African American women, are influenced by institutional factors, which may cause alienation and negatively impact their overall persistence (Palmer, Maramba, & Dancy, 2011). Regardless of ethnicity, these students may undergo a "weed out" process during their freshmen and sophomore years (Sondgeroth & Stough, 1992), which is often enforced by faculty and administrators. Jeanne was reminded by a college friend of how she survived the "weed out" process in an undergraduate Electrical Engineering program.

> In engineering, they have "weed out courses." So, they got weeded out, and they like tried everything in their power to make it work. And so, my friend was like, "Yeah, you're barely getting by because you made some bad decisions, but once you decided to change that path, you're surviving and *you're still here*!

In light of institutional factors (i.e., weed out courses), Jeanne persisted to attain a bachelor's degree in Electrical Engineering. Jeanne demonstrated a strong level of determination when she realized her "crew", which consisted of mostly social science majors, was either on academic probation or dismissed from school. During this time, Jeanne connected with a student chapter of the National Society of Black Engineers, which helped her overcome potential alienation. Regardless of her strong support system, Jeanne struggled with rejecting the imposter syndrome.

Imposter syndrome. Women in male-dominated environments may internalize an *imposter syndrome* complex (i.e., embrace the notion of not belonging), which may negatively impact their sense of belonging in STEM and Computing disciplines (Stout, Dasgupta,

Hunsinger, & McManus, 2011). Jeanne struggled with a sense of belonging in STEM and Computing Education from elementary school until her turning point experience in the junior year of college. Of all participants, she revealed the most evidence of embracing the imposter syndrome. At her "reject" middle school, Jeanne participated in the Math League and other STEM Education activities, which set her apart from most students. Although Jeanne referred to herself as "not the smartest kid," she successfully completed AP Calculus in high school. Jeanne revealed an awareness of her internal struggle with the imposter syndrome when she said, "I am…fighting back, trying to get back to where I needed to be." She also subconsciously referred to herself as an imposter as she compared herself to other "smart kids" at her school.

> There would be trip opportunities, scholarship opportunities, etc. that were slated for them but they didn't show up that day, or they didn't take the time to do it. And I just happened to be at the right place, at the right time and they are like, "Hey, you want this? You're here. You're a decent enough student; we'll just give it to you."

Moreover, Jeanne blatantly called herself an imposter: "I am an imposter who slid my way in here." Although her parents and peers provided positive reinforcement, Jeanne's internal struggle with acceptance (i.e., imposter syndrome) proved stronger than any external support. Early on, Jeanne was recognized as a high-achieving student, but she embraced an imposter syndrome, which is common among young gifted girls (Reis, 2004). As I considered the possible source of Jeanne's struggle with belonging in STEM and Computing Education, I resolved environmental factors (i.e., low-income schools, immigrant community, reject school) had influenced her marginalization and acceptance of the imposter syndrome (Reis, 2004).

Self-Determination. Self-determination may be classified as a theory, which was derived from empirical research that distinguished autonomy in human motivation (Deci & Ryan, 2011). Highly autonomous students reveal strong self-determination in educational settings (Reeve, 2002). For example, Bianca could have accepted the notion that she was an imposter, but she

determined to use it as fuel to successfully attain a Bachelor's of Science degree in Computer Science. She said, "There was no way you were going to tell me that I wasn't going to" and thus rejected the notion of being an imposter in U.S. Computing Education. Similarly, Dana had a turning point in a male-dominated environment, but at a prestigious Science and Technology magnet school when she became Class President. During the election process, she was overwhelmed by the level of stress, which affected her emotional and physical state (i.e., delayed menstrual cycle). She confided in her mother who told her to consider giving someone else a chance to win. Dana's immediate response to her mother was, "*'I can see, your point mom, but Naaah!'* Because I don't want to do that. Because I am a good leader and this is my position and I'm going to fight for it. And I did. And I won." Dana clearly rejected the notion of being an imposter when she said, "I am the leader of this group" and "there was no imposter about it." Jeanne finally embraced a sense of belonging in STEM and Computing Education when she realized her survival of the "weed out" process" in an undergraduate Electrical Engineering department was a significant achievement. Her mindset changed when she said, "Maybe I haven't just been sliding, maybe I am actually smarter than I think I am, and maybe I'm actually you know, worth my grain and salt, when I say like I actually know this stuff." To arrive at this point, Jeanne had to access a level of determination to resist an imposter mindset and embrace her belonging in STEM and Computing Education.

Summary. During their turning point experiences, each participant accessed their determination or "inner strength" (i.e., internal support or spirituality) to successfully change the course of their trajectories, which seemed stronger than external support from their schooling environment (Bianca), parents (Dana), and peers (Jeanne). Dana received external support from her mother, but she ultimately made her own decision to run for Class President and resisted the

notion of being an imposter ("No imposter about it!"). The participants exhibited varied levels of determination and confidence, which were pivotal to overcome potential barriers (i.e., negative stereotypes and biases imposed on them by white male professors) to their persistence in U.S. Computing Education.

I have arrived. Four of five participants' (Alona, Bianca, Dana, and Susan) high points were associated with their academic achievements in U.S. Computing Education. These experiences directly connected to tenets of critical race theory (counterspaces and racism), Black feminist thought (Table 14), and resilience theory.

Critical race theory (counterspaces and racism). African American women may create or seek counterspaces (i.e., sister circles) to shield themselves from endemic racism and its discriminatory effects (i.e., microaggressions) (Solórzano, Ceja, & Yosso, 2000). During this study, three participants (Alona, Bianca, and Susan) accessed counterspaces, and other support systems (i.e., teacher and family), to overcome racism in the forms of microaggressions, negative stereotypes, and biases. Alona received support from a white male professor who said "I'll work with you" after she encountered devastating setbacks (e.g., failed both preliminary and qualifying exams) during her doctoral program. As a result, Alona passed her qualifying exam and successfully became a Ph.D. Candidate in Computer Science. Bianca overcame barriers of racism when she was invited by a Black male professor to pursue her Ph.D. studies at a predominately white institution in the Southeast. She joined his lab because it represented an academic counterspace (i.e., a shelter from the negative racial climates), in response to the microaggressions she encountered at her previous institution (Howard-Hamilton, 2003; Solórzano, Ceja, & Yosso, 2000), to pursue her Ph.D. degree. Both Bianca's newfound support system (e.g., counterspace) and "inner strength" helped her to successfully attain a Ph.D. degree

in Computer Science. Moreover, Susan successfully attained a Ph.D. degree in Computer Information Systems despite her negative encounter with racism imposed by a white male professor (i.e., hit her on the head with a stack of papers) during her doctoral program. During our interview, Susan recounted feelings of joy on graduation day when she celebrated her accomplishment with her family. Although Susan did not express traditional forms of support (e.g., counterspaces, mentors, or role models), she indicated family support (i.e., husband and newborn child), and determination influenced her completion despite the oppression she encountered.

Black feminist thought. All four participants overcame some form of double oppression to successfully attain postsecondary degrees in U.S. Computing Education to achieve their high point experiences, particularly at the graduate level. Alona, Bianca, and Susan's high point experiences occurred after they faced some form of double oppression. As a result, they sought a counterspace or support system (i.e., teacher and family) to receive shelter from racialized campus settings or experiences. As African American women, they shared the commonality of race and gender but they each expressed unique experiences that contributed to their success. Overall, their experiences indicated determination and resilience regardless of the insurmountable odds they encountered along the U.S. Computing Education trajectory.

Resilience. African American women who persist in U.S. STEM and Computing Education programs demonstrate a high-level of determination and resilience due to internal perseverance, mathematics and science self-efficacy, and spirituality (e.g., faith and prayer) (Bush, 2013). Resilience is more than an innate quality that enables individuals to rebound from adversity or setbacks; it is a quality developed over time through life experiences (Benard, 1993). Oftentimes, individuals who have bounced back from adverse experiences are labeled as

"invincible," "hardy," or "invulnerable" (Werner & Smith, 1982). Moreover, they have accessed protective factors, which divert individuals from adverse conditions (Garmezy, 1993) to overcome risk factors that buffer, intercept, or prevent risk (Werner & Smith, 1982). Similar to Borum & Walker's study (2012), each participant in this study exhibited a strong level of resilience to "bounce back" from academic disappointments (Alona), as well as negative stereotypes and biases (Bianca, Dana, and Susan), to finally graduate with Ph.D. degrees in a Computing discipline and to receive recognition for faculty achievements (Dana). As Dana reflected on her high point experience, she recalled presenting her faculty research at a local TEDx event. Dana attributed her successful presentation delivery to the support of her students who assisted her with preparing for the event. Jeanne's high point occurred in college when she joined the National Society of Black Engineers and associated with a new "crew", which helped her to "bounce back" and embrace a sense of belonging. Although Jeanne's high point experience did not directly support this theme, she also demonstrated resilience in her attainment of a Ph.D. degree in Computer Science.

Summary. Bianca, Dana, and Susan each encountered negative stereotypes imposed by white male professors at predominately white institutions while pursuing a master's degree (Bianca) and Ph.D. degrees (Dana and Susan). Although they had strong external support systems, such as a Black male faculty advisor (Bianca), a white female advisor (Dana), and family support (Susan), their internal supports served as protective factors (i.e., determination, spirituality) to enable them to overcome the risk factors (i.e., negative stereotypes and biases) they encountered. To gain power over barriers such as double oppression, some participants openly shared their reliance on God and spirituality (Dana, Alona). During our interviews, each participant expressed Christian ideologies (Dillard, 2012). Although my participants'

experiences had the potential to halt their progress, they accessed an "inner strength", which influenced their resilience and ability to maneuver past these obstacles.

Improvements to U.S. Computing Education. In research question 3, I asked my participants to offer their advice for improving U.S. Computing Education. As African American women faculty and Ph.D. degree holders in a Computing discipline, they provided credible insight into critical emphases needed to broaden the participation of Black women and girls in Computing, based on their educational experiences (i.e., as students and faculty). In essence, I captured their responses verbatim to give voice to their concerns and recommendations for improving Computing Education. Overall, my participants provided unique responses, despite their shared commonality of race and gender, and insight into their social justice agendas to change the narrative for Black women and girls in K-12, undergraduate, and graduate Computing Education in the United States. Moreover, their responses aligned with the Black feminist thought interpretive framework.

Alona. Of the five participants, Alona provided the most recommendations to improve U.S. Computing Education for African girls and women based on her interest to broaden the participation of women in Computer Science. Since Alona was the youngest participant (birthdate: 1983), her Computing educational experiences were most recent in comparison to other participants. Moreover, she was the only participant to complete the AP Computer Science course (The College Board, 2014), which is one of the current benchmarks for high school students' prior experience in Computer Science. Alona completed her B.S., M.S., and Ph.D. degrees in Computer Science, and she currently teaches Computer Science and Computer Engineering courses at a predominately white institution (PWI), which further substantiated her credibility. In particular, she suggested improvements, with practical examples, related to

accessibility (e.g., change accessibility), culture and environment (e.g., change thinking, watch the pronouns), and teacher preparation (e.g., educate teachers).

Overall, Alona's recommendations supported themes in the literature related to barriers women encounter in U.S. Computing Education and current Computer Science Education initiatives. For example, women and girls generally are underprepared for undergraduate Computer Science programs because they lack prior experience and access to Computer Science courses (Heo & Myrick, 2009; Herling, 2011). Moreover, women have described the institutional culture and classroom environment of U.S. Computer Science and Engineering departments as "chilly" (Borum & Walker, 2012; Bush, 2013; Jackson, 2013; Ong, Wright, Espinosa, & Orfield, 2011) and predominately white male environments (Charleston, George, Jackson, Berhanu, and Amechi, 2014). Lastly, Alona's recommendation to improve teacher preparation related to current Computer Science Education initiatives such as the National Science Foundation's CS10K (Astrachan, Cuny, Stephenson, and Wilson, 2011), which initially sought to train 10,000 teachers in 10,000 U.S. high schools to effectively teach Computer Science by 2015, and Computer Science (CS) For All (The White House, 2016), which was launched by President Barack Obama in January 2016 to increase access to Computer Science for all students, regardless of race, ethnicity, or gender. Specifically, Obama proposed $4 billion for statewide and $100 million for school districts to improve access to CS in K-12 education by conducting CS training for teachers, providing high-quality curricula, and building collaborative public-private partnerships. In summary, Alona's recommendations provided strategies to support these initiatives to broaden the participation of women and girls in Computer Science Education.

Bianca. Similar to Alona, Bianca completed all three degrees (B.S., M.S., and Ph.D.) in Computer Science, and she teaches Computer Science and Computer Information Systems courses at a historically Black university (i.e., HBCU). Bianca expressed "strides" have been made to improve Computing Education. For example, she referenced broadening participation initiatives (e.g., broadening participation in Computing, broadening participation in Engineering), which have been funded by the National Science Foundation, and have spurred numerous research and intervention projects for women and historically underrepresented minorities (National Science Foundation, 2008). Additionally, she referred to the Computer Science Education Week (CSEdWeek) initiative hosted by Code.org (i.e., national nonprofit), which promotes K-12 Computer Science Education. Overall, Bianca's responses suggested the need to sustain current Computer Science Education initiatives (e.g., broadening participation, CSEdWeek) to broaden the participation of Black women and girls in Computing.

Dana. Dana's recommendations provided new insight to improve U.S. Computing Education for African American women and girls, based on her personal success strategies and community involvement. During our interviews, Dana acknowledged her natural inclination to partner with other students, regardless of race, gender, or ethnicity, to excel in high school and college. Dana's personal success strategies were reinforced by her postsecondary degree attainments in Systems Engineering (B.S.), and Computer Information Systems (Ph.D.), experience as an Information Systems faculty member, and involvement in her faith community. Specifically, Dana recommended a buddy system to provide emotional and academic support for women and girls, particularly at the graduate level, which was a major contributor to her success in Computing Education. Moreover, she recommended a targeted community, such as the Black Church, is identified to disseminate STEM and Computing related information, and to facilitate

STEM and Computing intervention programming. Since the Black Church has historically served as a community hub for African Americans (Witherspoon & Madyun, 2010), it offers a viable channel to broaden the participation of African American women and girls in U.S. Computing Education.

Jeanne. As a degree holder in Electrical Engineering (B.S.), Industrial Engineering (M.S.), Instructional Technology (M.Ed.), and Computer Science (C.S.), and a post-doctoral researcher, Jeanne had a breadth of experience in STEM and Computing Education, which informed her recommendations to improve U.S. Computing Education. For instance, Jeanne suggested the current gamification trend in Computing Education (Wiggins, 2016) may have an overemphasis on entertainment value instead of "connecting to broader experiences" to attract students to pursue Computing careers. Moreover, she emphasized the need for more career exploration and real-life application in existing Computing Education programs.

Susan. Susan's recommendation for "better math" related to her personal challenges with mathematics in U.S. Computing Education. Specifically, Susan's recommendation was informed by her degree attainments in Management Information Systems (B.S.), Management of Technology (M.S.), and Computer Information Systems (Ph.D.). In particular, she suggested mathematics should include more rigor and innovation to engage students with diverse learning styles. As a faculty member in Management Information Systems, Susan's experiences also influenced her pedagogy. Overall, Susan's recommendation supported current research on improving mathematics education (e.g., Weintrop et al., 2016).

Summary. My discoveries suggested a seamless connection between emergent themes, interpretive frameworks, and relevant literature. Overall, the experiences that impacted these five African American women faculty's persistence in U.S. Computing Education primarily

occurred in high school and beyond (Figure 16), and half of these experiences were negative in nature, particularly at the graduate level. My most salient discovery was negative stereotypes and biases were the most potent risk factors to impact my participants' persistence to attain a Ph.D. degree. However, they exhibited resilience to bounce back from these potentially debilitating setbacks. The positive reinforcements (i.e., I am set apart!) my participants experienced over time (i.e., elementary and middle school) served as protective factors, which equipped them to bounce back when they encountered risk factors, such as negative stereotypes and biases (i.e., I am Ph.D. material!), and finally achieve academic success (i.e., I have arrived!) in U.S. Computing Education.

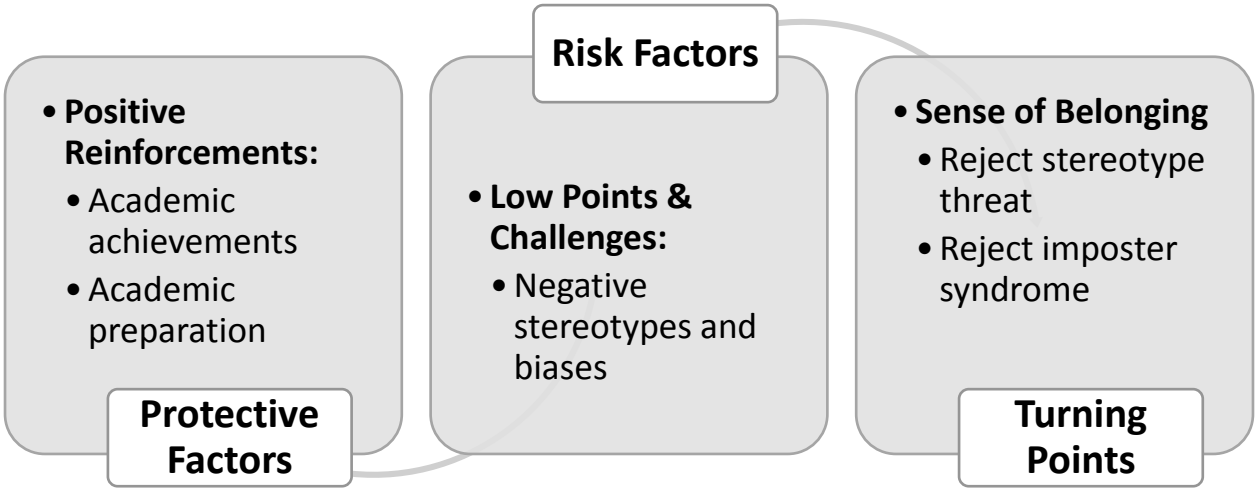

Figure 16. Most Salient Discoveries

Implications and Recommendations for Future Research

After co-constructing the Counter-Life Herstories of five African American women faculty (including a postdoctoral researcher) in U.S. Computing Education, I am compelled to give voice to their stories. Although I anonymized my participants' identities, their stories reflect the reality of their experiences as African American women in U.S. Computing Education. Due to the nature of qualitative research (i.e., justifiably small sample sizes), my participants' collective stories are not generalizable or transferable, and thus, do not reflect all African American women's experiences in U.S. Computing Education. However, my discoveries provided valuable insight into African American women's unique experiences, which informed the following implications to broaden their participation in U.S. Computing Education, and recommendations for future research.

Policy. Based on my discoveries, I offer the following local, state, and national policy recommendations to improve Computing Education pathways for African American women and girls.

Integrate Computer Science into CTE. Since the enactment of the Smith-Hughes Act of 1917, Career and Technical Education (CTE), formerly known as vocational education, has historically focused on preparing workers for low-skilled and low-wage jobs. Furthermore, it has historically been a "dumping ground" for low-income and minority students to pursue low-skilled jobs in the U.S. (Schwartz, 2014). During the U.S. industrial revolution, vocational education adopted its purpose "to prepare students for entry-level jobs in occupations requiring less than a baccalaureate degree" (p. 1), while academic programs focused on college preparation (Gordon, 2014; Levesque, Lauen, Teitelbaum, Alt, & Librera, 2000). Upon the enactment of the Carl D. Perkins Act of 1990, vocational education became more unified with academic education

and shifted its focus to preparing students for both entry-level jobs and postsecondary education (Fletcher, Lasonen, & Hernandez, 2014; Silverberg, Warner, Fong, & Goodwin, 2004; Stone, 2014). Moreover, CTE officially adopted its new name upon the authorization of the Carl D. Perkins Career and Technical Education Improvement Act of 2006, which further promoted the integration of academic, career, and technical skills for secondary and postsecondary education. Today, CTE has emerged to become a leading provider of rigorous pathways to STEM careers (e.g., STEM career cluster) through innovative models such as career academies, Project Lead the Way, and High Schools that Work (Schwartz, 2014). According to the Association for Career and Technical Education (2009), CTE programs play a significant role in improving the shortage of STEM workers (p. 1).

> CTE programs offer students a deeper understanding of STEM career pathways, build interest in STEM-related careers by making math and science content more relevant and tangible to students, and help grow the STEM workforce pipeline by encouraging more students from underrepresented populations to enter these career fields.

Therefore, CTE programs offer viable channels to integrate Computing Education standards, such as ACM's K-12 Computer Science Education standards (ACM, 2012), and curricula, such as the AP Computer Science Principles course, to prepare African American women and girls for the U.S. Computing workforce (ACM, 2014; NSF, 2015; Vincent & Velkoff, 2010). Specifically, state policymakers should assess current Computing Education pathways and high school graduation requirements to identify opportunities to broaden participation for historically underrepresented students, which includes African American women and girls. Current broadening participation in Computing initiatives, funded by the National Science Foundation, have suggested CTE is a viable channel to integrate Computer Science, but they encourage customized solutions for each state (Adrion, Fall, Ericson, & Guzdial, 2016). The Florida Career and Professional Education (CAPE) Act (Florida Department of Education, 2014) may serve as a

model for other states to establish legislation that promotes collaborative partnerships to construct Computing Education pathways. The CAPE Act is a statewide education-industry partnership between the Florida Department of Education (e.g., school districts, postsecondary institutions), the Department of Economic Opportunity (e.g., industries), and CareerSource Florida (e.g., workforce boards) to develop pathways to high-wage jobs. Specifically, the CAPE Act offers rigorous and relevant middle school and high school career-themed curricula to prepare students for critical high-wage and high-demand careers, such as Computing.

Update CTE career clusters. The National Association for State Directors of Career and Technical Education Consortium (2014), which was recently renamed to Advance CTE: State Leaders Connecting Learning to Work, has defined 16 career clusters that represent educational pathways from middle school to college or work. In the U.S., statewide departments of education are encouraged to adopt these standards to define educational pathways into various careers (e.g., www.achievetexas.org). The STEM career cluster is one of 16 career clusters that is more clearly defined, but Computing careers (or disciplines) span across multiple career clusters. For instance, Computing careers are represented in the Arts, A/V Technology, & Communications (AAVC), Information Technology (IT), and STEM career clusters. In this study, participants often discussed their experiences in STEM Education interchangeably with experiences in Computing Education, which indicated overlap or unclear Computing Education pathways (Association for Computing Machinery, 2014). Moreover, most participants did not attain the same undergraduate and graduate degrees, with the exception of Alona and Bianca who both attained B.S., M.S., and Ph.D. degrees in Computer Science. Jeanne attained a Ph.D. in Computer Science and a bachelor's degree in Electrical Engineering. Dana attained a bachelor's degree in Systems Engineering and a Ph.D. in Computer Information Systems while

Susan attained a bachelor's degree in Management Information Systems and a Ph.D. in Computer Information Systems. Dana and Jeanne's educational pathways clearly indicated overlaps in STEM and Computing Education. While Alona's and Bianca's educational pathways seemed straightforward. However, the career cluster framework does not clearly indicate entry points into Computer Science or Computer Information Systems. Therefore, I recommend Advance CTE leaders initiate an effort to modify the 16 career clusters to more clearly reflect entry points into Computing disciplines, which will engage students in career exploration and career counseling related to Computing disciplines, and their broader contexts, starting in the eighth grade. Specifically, Advance CTE could establish a new Computing career cluster, which combines the AAVC and IT career clusters, and adds Computer Science as a new sub-cluster, to enforce clarity and align with other Computing Education initiatives.

Practice. Based on my discoveries, I offer the following recommendations for practitioners, such as K-12 teachers, to broaden the participation of African American women and girls in U.S. Computing Education.

K-12 Computer Science teacher preparation. Although current initiatives, such as CS10K (National Science Foundation) and Computer Science (CS) For All (The White House, 2016), which includes a new culturally relevant AP Computer Science Principles course, are focused on adequately preparing K-12 teachers to teach Computer Science to all students (including students of color), I recommend these efforts include specialized training on the unique needs of each ethnic minority group, such as African American girls. To foster inclusion and equity among African American girls, CS teachers should be encouraged to incorporate culturally relevant pedagogy in their CS classes, which includes inviting African American women role models (e.g., university professors, industry leaders in Computing) as guest speakers

to rouse the critical consciousness of their students. Moreover, K-12 CS teachers should be equipped with tangible information about Computing Education pathways (i.e., Computing career clusters) to positively influence their students to pursue Computing careers. Additionally, I recommend school districts offer CS teachers a new professional development course on the intersections of Computer Science Education, critical race theory, and Black feminist thought to gain a deeper understanding of African American girls' double oppression and support systems needed to broaden their participation in U.S. Computing Education.

University professors and faculty. Similar to my recommendations for K-12 CS teachers, I recommend a new professional development course is developed and offered to university professors (undergraduate and graduate) to teach them how to incorporate culturally relevant pedagogy in their Computing-related courses. Moreover, this course should include the intersections of Computing, critical race theory, and Black feminist thought. The goal of this course is to influence university professors, particularly white males, to gain a deeper understanding of African American women's double oppression and the support systems they need to enter and persist in U.S. Computing Education. As a result, program administrators and students should observe a shift in the "chilly" environment of white male-dominated classrooms within U.S. Computing Education departments. Additionally, Computing Education professors should offer a variety of examples and hands-on activities to engage diverse learning styles, especially in Computer Logic and highly quantitative topics. I also recommend faculty members in graduate Computing Education programs, particularly white male faculty members, to actively participate in initiatives to recruit and retain African American women and seek opportunities to create supportive and nurturing classroom environments. Faculty members should confront and seek to resolve their unconscious biases and stereotypes. Moreover, they should promote

equitable and supportive learning environments for African American women and other women of color.

K-12, undergraduate and graduate program administrators. In this study, participants faced extreme cases of stereotypes and biases imposed by white faculty members while pursuing graduate degrees in Computer Information Systems and Computer Science in the College of Business and the College of Engineering respectively. Although these women proved to be resilient, despite the barriers they faced, I recommend superintendents, program chairs, department chairs, college deans, and campus presidents actively explore their institutional climates to ensure they foster supportive and equitable environments for African American women and girls, and people of color in general, particularly in STEM and Computing Education programs at predominately white institutions. In light of my previous recommendations, these administrators should strongly enforce the participation of teachers and faculty members to participate in these targeted professional development courses by connecting their performance to annual evaluations. Additionally, I recommend for program administrators to ensure equitable access to U.S. Computing Education for African American women and groups through targeted interventions.

Targeted interventions for African American women and girls. To ensure African American women and girls have equitable access to Computing Education, including rigorous mathematics, science, and Computer Science Education, I recommend practitioners create targeted interventions at the K-12, undergraduate, and graduate education levels. The U.S. Congress Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline (2011) offered recommendations for P-20 STEM Education in its report: *Expanding Underrepresented Minority Participation: America's Science and*

Technology Talent at the Crossroads, which spurred an increase in broadening participation initiatives for women, underrepresented minorities and persons with disabilities, but targeted interventions are needed to meet the unique needs of specific ethnic minority people groups, such as African American women and girls. Specifically, I recommend the following interventions to target African American women and girls.

Counterspaces for African American women and girls. I suggest program administrators develop counterspace (i.e., to shelter themselves from negative racial climates) models in K-20 Computing Education that incorporate culturally relevant practices and provide equitable access to rigorous mathematics and science curricula in informal learning (i.e., out-of-school time; afterschool, summer camp programming) environments for African American women and girls. This counterspace model may borrow from effective STEM intervention models such as summer bridge programs, Meyerhoff programs, and minority engineering programs to establish a targeted model for African American women and girls. To ensure its effectiveness and to engage larger concentrations of African American women and girls, program administrators may establish university, school, and community partnerships with targeted community organizations such as predominately Black churches, nonprofits, and school districts. These efforts may seek funding from sources such as the National Science Foundation's broadening participation in Computing initiatives, the White House's Computer Science For All, and the White House Office of Faith-Based and Neighborhood Partnerships. Moreover, I recommend that the National Science Foundation should consider developing targeted broaden participation programs for Black women and girls (e.g., Broadening Participation of Black Women and Girls in STEM and Computing), and other historically underrepresented groups.

Targeted interventions for African American women at HBCUS. During this study, Bianca encountered feminism from Black males during her undergraduate Computer Science program at an HBCU. Since HBCUs are noted for their supportive and nurturing environments in the literature, Bianca's experience raises a question about the nature of Black women's experiences in Computing degree programs at HBCUs. Therefore, I recommend for program administrators at HBCUs to assess their institutional climates and the factors that support impede African American women's persistence in Computing Education. Furthermore, they should make concerted efforts to hire more African American women faculty in Computing Education programs with Ph.D. degrees.

Recommendations for future research. Upon conducting this study, I realized the following recommendation for future research. This list represents my most salient considerations in light of my discoveries and future interests.

African American women's graduate experiences. My study provided a glimpse of five African American women's experiences at various points (e.g., elementary school, middle school, high school, bachelor's, master's, and Ph.D.) along the U.S. Computing Education trajectory. Moreover, it highlighted the critical incidents that influenced their persistence, both negatively and positively. Although I think in-depth qualitative studies at each point would be beneficial, I think the first subsequent study should focus on their experiences in graduate school because of my participant's experiences in this study. Specifically, I recommend a longitudinal study of African American women's experiences is conducted as they transition from master's to doctoral degree programs. Moreover, I suggest a case study design is used to follow a cohort of first-year African American women doctoral students until graduation (i.e., four to five years).

Exploration of distinct pathways to degree attainment. I think an exploratory study should be conducted on various pathways to postsecondary degree attainment in Computing Education to provide guidance on distinct career pathways. For example, I propose a sequential mixed methods study, which uses a national secondary data set, such as the National Longitudinal Survey of Youth (NLSY) (U.S. Department of Labor, Bureau of Labor Statistics), to examine the curricular pathways (i.e., high school course-taking, postsecondary degree attainment) of African American women, followed by focus group and/or individual interviews with identified participants (i.e., African American women with bachelor's degrees in Computing disciplines) to ascertain the factors that influenced decision-making processes. To best reflect the age of participants in this study, I recommend the NLSY79 dataset is selected.

Influence of environmental factors on persistence. Additionally, I recommend a quantitative, qualitative, or mixed methods approach to investigate the influence of environmental factors on African American women's persistence in Computing Education at all levels. As a quantitative study (e.g., multiple regression) in K-12 Computing Education, I recommend a national secondary dataset, such as the High School Longitudinal Study of 2009 (U.S. Department of Education, National Center for Education Statistics) is used to investigate the influence of environmental factors such as socio-economic status, percentage of free and reduced lunch on African American students' rigorous Computing Education course-taking (e.g., AP Computer Science, Computer Logic). Additionally, I recommend a qualitative study is conducted to follow-up with identified participants to understand their perceptions about the environmental factors that influenced their persistence in U.S. Computing Education. This study may also be replicated to investigate factors that influence students who do not persist in U.S. Computing Education.

Investigate the low number of Black Ph.D. faculty at HBCUs. Because HBCUs produce a high number of Black STEM graduates, including master's degree and Ph.D. degree recipients, researchers should seek to understand the factors that have influenced the low number of Black faculty at HBCUs. Initially, I recommend a qualitative study is conducted at an HBCU to explore potential factors that have influenced low numbers of Black Ph.D. faculty. Based on the results of this qualitative study, I recommend a follow-on survey is created to elicit responses from program administrators and faculty at HBCUs throughout the United States. Additionally, I recommend a factor analysis is conducted to identify factors that may be explored in subsequent studies.

Investigate the role of the Black Church in U.S. CE. The Black Church has notably influenced the lives of Black people in the United States and the African diaspora (Dillard, 2000; Dillard, 2012; Dillard & Okpalaoka, 2011). Moreover, the Black Church has historically served as a community hub for African Americans (Witherspoon & Madyun, 2010). Therefore, I recommend further research is conducted on its role in broadening the participation of African American s in U.S. Computing Education.

Expand and replicate the Counter-Life Herstories approach. First, I propose the current study is replicated to include more African American women's Counter-Life Herstories to reach a greater level of saturation. Specifically, I would like to interview an additional 20 to 30 participants, with at least five participants per Computing discipline (e.g., Computer Science, Computer Information Systems), to strengthen my implications within and across these disciplines. In addition, I would like to replicate this approach to explore the Counter-Life Herstories of other women of color, such as Latinas Pacific Islander, and Native American. Based on the Computer Science degree enrollment and attainment rates, I recommend this

approach is first replicated with Latina faculty members. I also suggest scholars outside of Computing Education use the Counter-Life Herstories approach in their respective disciplines.

Conclusion

As I illuminated the *Counter-Life Herstories* of five African American women faculty, I gave voice to their experiences in U.S. Computing Education. As I traced their experiences from elementary school to their current faculty positions as Assistant Professors, Associate Professors, and Postdoctoral Researcher, I discovered trends and key scenes in their journeys that impacted their persistence in U.S. Computing Education. Unequivocally, their persistence in U.S. Computing Education was not solely based on early positive reinforcements or academic preparation, but their resilience and ability to bounce back from insurmountable barriers, such as negative stereotypes and biases. Most notably, the African American women indicated their participation in this study was life altering (Chapter 4, Final Reflections). As a result, my ultimate goal was met to reveal their hidden truths, rouse their consciousness, and empower them to continue on their journeys (Collins, 2009).

Although sample sizes are justifiably small in qualitative research, my small sample size (n=5) presented a limitation in this study. As a result, my discoveries related to the experiences that impacted my five participants' persistence in U.S. Computing Education are not generalizable or transferable to reflect all African American women's experiences in U.S. Computing Education. However, my discoveries adds to the existing knowledge base about African American women's unique early educational experiences (i.e., elementary school, middle school, and high school) and postsecondary education experiences (i.e., bachelor's, master's, and Ph.D.) in U.S. Computing Education, particularly at the graduate level (i.e., master's and Ph.D.). Additionally, my study adds to the growing body of scholarly works

conducted from an Afrocentric feminist epistemological perspective (i.e., from the perspective of an African American woman scholar).

Among the five participants who persisted to attain a Ph.D. degree in a Computing discipline, three participants had distinguishable characteristics, which represented my most profound discoveries in this study. These three African American women (Alona, Bianca, and Dana) received strong academic support and positive reinforcements (i.e., protective factors) from their parents, teachers, and administrators early in elementary school ("I am set apart!"). As a result, they were equipped to access their resilience (i.e., ability to bounce back) when they faced negative stereotypes and biases (i.e., risk factors) that had the potential to halt their academic achievements. Much of the literature about African American women's early educational experiences indicates they are not well-prepared in mathematics and science, and they lack positive reinforcements, which produces self-confidence. In this study, these women were not only well-prepared, but they were confident in their abilities, which was sustained throughout their educational experiences from elementary school to graduate school. Because they had a strong sense of belonging, they actively sought support systems and networks to mitigate their risks they faced. Even in the absence of strong academic preparation and positive reinforcement (Jeanne and Susan), they accessed their resilience to complete Computing Education. To broaden the participation of Black girls and women in Computing Education, I think it is critical to operationalizing these discoveries to showcase successful models and intervention strategies.

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APPENDICES

Appendix A: Timeline Interview Protocol

Description
I will use this protocol to conduct the initial timeline interview (one-on-one and in-person) with African American women who have attained Bachelor's, Master's (optional), and Ph.D. degrees in Computer Science or a related Computing discipline (i.e.,Computer Engineering, Information Technology, Information Sciences) at a convenient location of their choice. The instructions and interview questions are adapted from Adriansen (2012). Although the participant and I will construct the timeline by hand, this interview will still be audiotaped and transcribed for reference purposes. If needed, this protocol may be modified to be conducted online, in a virtual environment. My goal for this interview is to build rapport and trust with each participant before conducting the three subsequent Counter-Life Story interviews.

Materials to Bring
1 – Large sheet of butcher or flipchart paper
5 – Colored pens or markers
5 – Colored Sticky notes (3"x5" inches)
1 – Audio recorder
2 – Reflective journals
1 – Notepad
1 – Camera or
4 – Bottled waters and refreshments

Introduction
1. I will briefly introduce myself and thank the participant for their willingness to participant in the study.
2. I will share details about the study (purpose, structure, schedule.), ask the participant to read and sign the Informed Consent form, and then ask the participant for permission to audiotape the interview.
3. After starting the audio recorder, I will begin to build rapport with the participant by introducing myself and sharing my prior experiences in Computing.
4. I will share the purpose of the timeline interview and ask if the participant if she has any questions: "The purpose of the timeline interview is to capture your critical incidents (entry, persistence, transitions, and exit), and ancillary events, during your Computing Education journey. I have allotted 60 minutes for our first session. This timeline will serve as a guide for us during our following interviews. In between interviews, I will hold on to the timeline for reference purposes as I transcribe the audiotape of our session. I have allotted 60 minutes for our session today. Do you have any questions before we begin?"

Instructions
1. I will draw a horizontal line in the middle of the paper.
   "This horizontal line represents a timeline of your critical incidents during your Computing Education journey, from childhood to now. Particularly, I am interested in questions such as: when did you first become interested in Computing? what were the critical incidents during your

elementary, middle school, high school, undergraduate, and graduate school experiences? etc? To guide our interview, we will order the events from left to right."

2. I will ask the participant to write their *name* and *birth date* at the beginning of the timeline and the *current year* at the end of the timeline.

3. Next, I will guide the participant to capture the critical incidents, and surrounding events, during their Computing Education journey on sticky notes (sticky notes are used to allow the participant to reorder events as needed).
   "Now, I want you to think about the critical incidents during your Computing Education journey? When they come to mind, I want you to write them down on a sticky note. We will them place them above the line on the timeline. As your story unfolds, I want you to write any surrounding events on a sticky note, and then we will place them below the line on the timeline. During this process, we will do our best to use different colored sticky notes for critical incidents and surrounding events. Please understand your critical incidents and surrounding events may happen simultaneously or sequentially. This is also a working timeline, so we may reorder events as needed, at any point."

4. Probing questions
   For the remainder of the interview, I will use probing questions to elicit the more information about the participant's critical incidents and events. Some examples of the probing questions are as follows.
   a. When did you first become interested in Computing?
   b. When did you first gain access to computers?
   c. What were the critical incidents during your elementary, middle school, high school, undergraduate, and graduate school experiences?
   d. When did you first enter into college?
   e. When did you start grad school?
   f. Did you work in industry or academia?
   g. What are the supporting events which contributed to these critical incidents?

Conclusion

1. I will summarize the timeline and ask if there is anything else they would like to add.
2. I will take a picture of the timeline to email it to the participant and to have for my records.
3. I will then give the participant their reflective journal and ask them to capture their thoughts about our initial meeting and the timeline interview. I will also ask them to journal at least once a week until we meet again.

Appendix B: Counter-Life Story Interview Protocol

This protocol will be used to conduct a two-part, Counter-Life Story interview with African American women, who have attained Ph.D. degrees in Computer Science or a related Computing discipline (i.e., Computer Engineering, Information Technology, Information Sciences), to capture their Counter-Life Herstories. During these interviews, we may refer back to the participant's timeline, which was constructed during the initial timeline interview. The interview format and structure were adapted from Dan P. McAdams (2008).

Introduction
This is an interview about the story of your life in Computing Education. As a social scientist, I am interested in hearing your story, including parts of the past as you remember them and the future as you imagine it. The story is selective; it does not include everything that has ever happened to you. Instead, I will ask you to focus on a few key critical incidents in your life – a few key scenes, characters, and ideas. There are no right or wrong answers to my questions. Instead, your task is simply to tell me about some of the most important things which have happened in your life and how you imagine your life developing in the future, as it relates to Computing Education and the Computing industry.

A. Life Chapters
Please begin by thinking about your experiences in Computing Education, from childhood until now, as if it were a book or novel. Imagine the book has a table of contents containing the titles of the main chapters in the story. To begin here, please describe briefly what the main chapters in the book might be. Please give each chapter a title, tell me a little bit about what each chapter is about, and say a word or two about how we get from one chapter to the next. As a storyteller here, what you want to do is to give me an overall plot summary of your story, going chapter by chapter. You may use your timeline as a guide if you would like. Please feel free to reorder events as you remember them if needed.

B. Key Scenes in Your Life Story in Computing Education
Now you have described the overall plot outline of your experiences in Computing Education, I would like for you to focus in on a few key scenes (critical incidents) which stand out in the story. Consider a key scene to be a moment in your Computing Education experiences which stands out for a particular reason – perhaps because it was especially good or bad, vivid, important, or memorable. Below are some prompts for you to consider as "key scenes."

1. **High point**. Please describe a scene, episode, or moment in your Computing Education experiences which stands out as an especially positive experience. This might be the high point scene of your entire life, or else an especially happy, joyous, exciting, or wonderful moment in the story. Please describe this high point scene in detail. What happened, when and where, who was involved, and what were you thinking and feeling?

2. **Low point**. The second scene is the opposite of the first. Thinking back over your Computing Education experiences, please identify a scene which stands out as a low point. Even though this event is unpleasant, I would appreciate your providing as much detail as possible. What happened in the event, where and when, who was involved, and what were you thinking and feeling?

3. **Turning point**. In looking back over your professional life, it may be possible to identify certain key moments which stand out as turning points -- episodes which marked an important change in you or your life story. Please identify a particular episode which you now see as a turning point in your Computing Education experiences. If you cannot identify a key turning point which stands out clearly, please describe some event in your teaching life wherein you went through a significant

change of some kind.

4. **Childhood memories**. Describe any childhood memories (positive or negative) you recall about schooling. Think of specific events (field trips, summer camps), locations (schools), and people (students, teachers). What makes them memorable for you? Now, we're going to talk about the future.

5. **Adult memories**. Moving ahead to your adult years, please identify one scene which you have not already described in this section (in other words, do not repeat your high point, low point, or turning point scene) which stands out as especially vivid or meaningful. This would be an especially memorable, vivid, or significant scene, positive or negative, from your adult years. Please describe this scene in detail, tell what happened, when and where, who was involved, and what you were thinking and feeling. Also, what does this memory say about you or your life?

6. **Wisdom event**. Please describe an event in your life in which you displayed wisdom. The episode might be one in which you acted or interacted in an especially wise way or provided wise counselor suggestions, made a wise decision, or otherwise behaved in a wise manner. What happened, where and when, who was involved, and what were you thinking and feeling? Also, what does this memory say about you and your life?

C. Future Script

1. **The next chapter**. Your life story includes key chapters and scenes from your past, as you have described them, and it also includes how you see or imagine your future. Please describe what you see (or would like to see) as the next chapter in your career.

2. **Dreams, hopes, and plans for the future**. Please describe your plans, dreams, or hopes for the future. What do you hope to accomplish in the future in your life story?

3. **Life project**. Do you have a project in life? A life project is something which you have been working on and plan to work on in the future chapters of your life story. The project might involve your family or your job life, or it might be a hobby, avocation, or pastime. How does this project have the potential to impact you as a Computing educator or professional?

D. Challenges

This next section considers the various challenges, struggles, and problems you have encountered in your professional life.

1. **Challenges in Computing Education**. Looking back over your Computing Education journey, please identify and describe what you now consider being the greatest single challenge you have faced. What is or was the challenge or problem? How did the challenge or problem develop? Have you experienced racism or sexism? What is the significance of this challenge or problem in your Computing Education life story?

2. **Failure, regret**. Everybody experiences failure and regrets in life, even for the happiest and luckiest lives. Looking back over your teaching career, identify and describe the greatest failure or regret you have experienced? How have you coped with this failure or regret? What effect has this failure or regret had on you and your Computing Education life story?

E. Personal Ideology

Now, I would like to ask a few questions about your fundamental beliefs and values and about Computing Education and education in general. Please give some thought to each of these questions or prompts.

1. **Religious/ethical values**. Consider for a moment the religious or spiritual aspects of your life. Please describe in a nutshell your religious beliefs and values, if indeed these are important to you. Whether you are religious or not, please describe your overall ethical or moral approach to living.

2. **Political/social values**. How do you approach political or social issues? Do you have a particular political point of view? Are there particular social issues or causes about which you feel strong about? Please explain.

3. **The value of education**. What is the most significant value of Computing Education? What is its purpose? Please explain.

4. **Other**. What else would help to understand your most fundamental beliefs and values about life and the world? What else would help me understand your overall philosophy of life?

F. Life Theme

Looking back over your entire life story in Computing Education with all its chapters, scenes, and challenges, and extending back into the past and ahead into the future, do you discern a central theme, message, or idea which runs throughout the story? What is the major theme in your life story? Please explain.

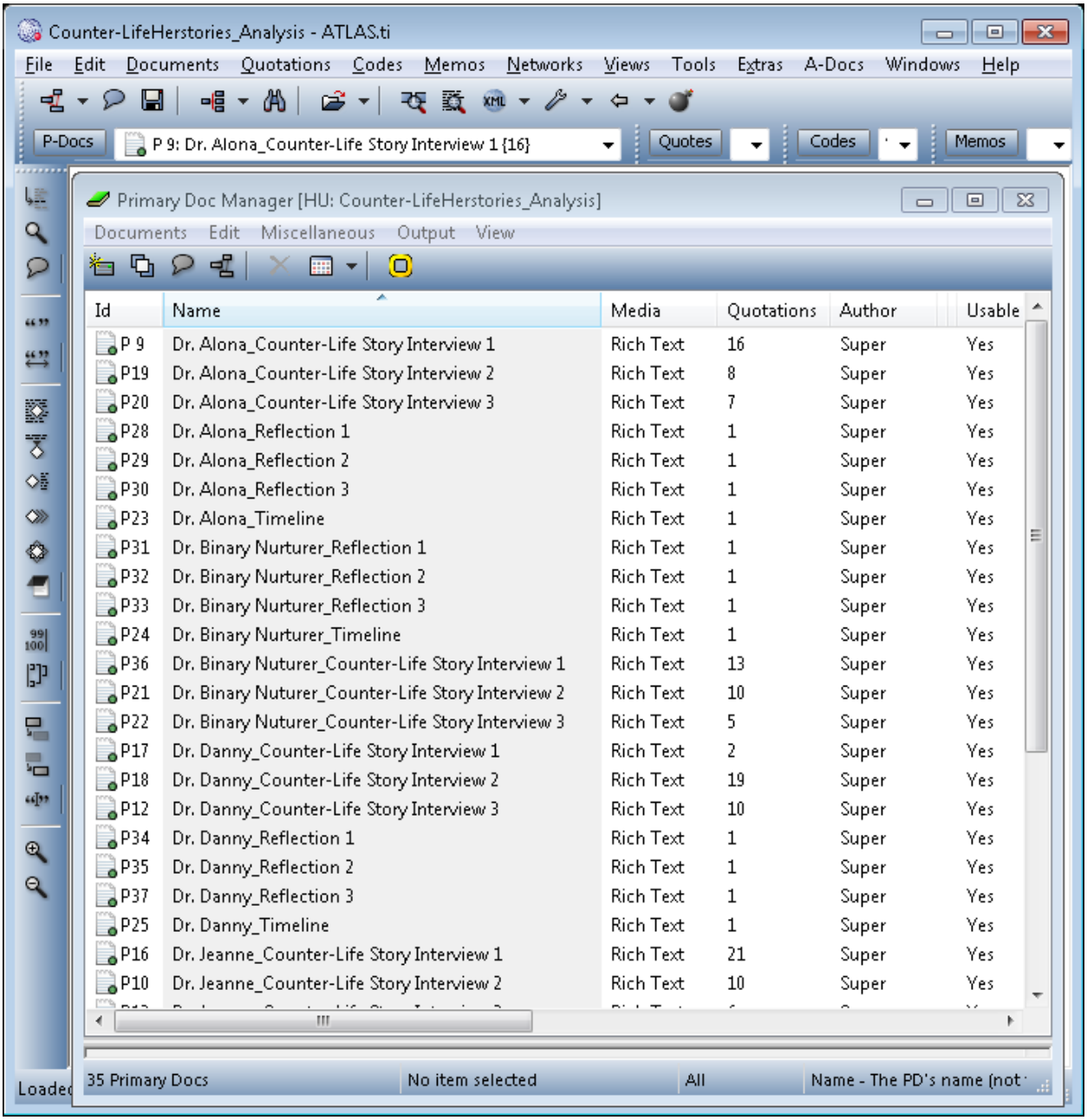
G. Reflection

1. What advice would you give to African American women and girls who desire to pursue postsecondary Computing degrees, at any level?

2. What could be done to improve Computing Education, at all levels?

3. Thank you for this interview. I have one more question for you. Many stories you have shared are about the experiences, which may stand out from the day-to-day. I'm wondering if you might reflect for one last moment about what this interview, here today, has been like for you. What were your thoughts and feelings during the interview? How do you think this interview has affected you? Do you have any other comments about the interview process?

Appendix C: ATLAS.ti 6.2.28 Hermeneutic Unit



Appendix D: Codebook

Code-Filter: All

HU: Counter-LifeHerstories_Analysis
File: [U:\Counterlifeherstories\Counter-LifeHerstories_Analysis.hpr6]
Edited by: Super
Date/Time: 2016-02-19 14:05:23

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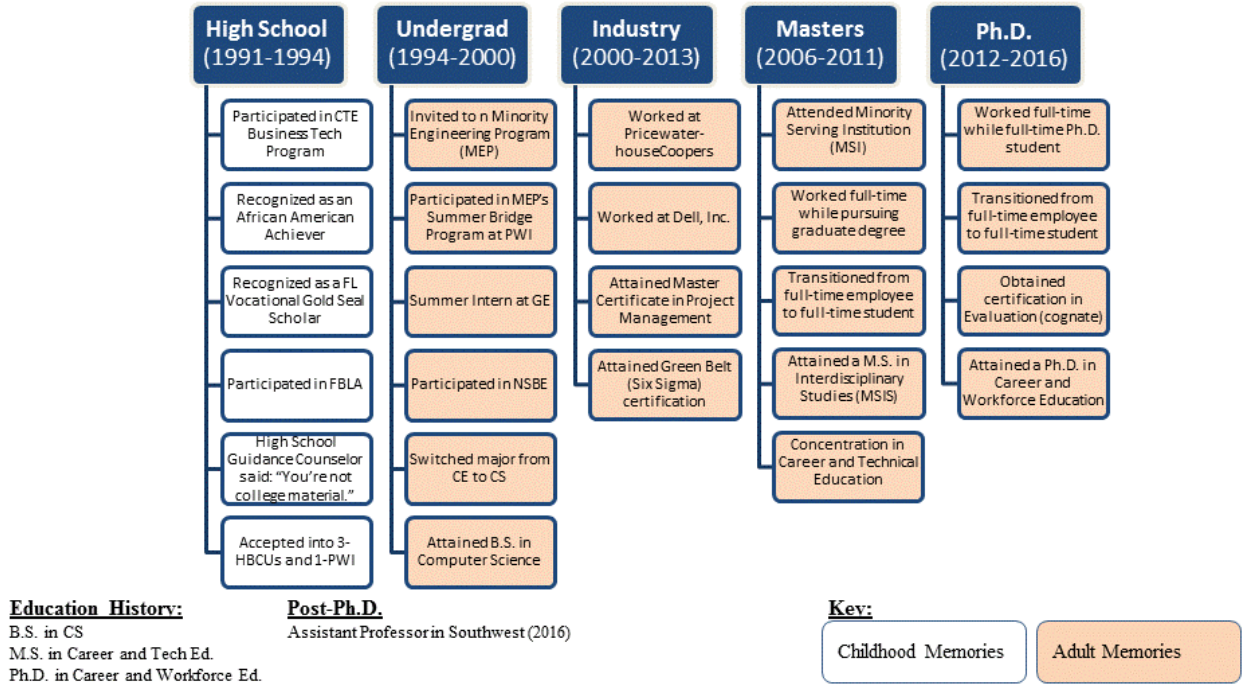
0. Career and Technical Education
1. Elementary School
2. Middle School
3. High School
3.1 Not Best Student / Not the Smartest Kid
4. Undergraduate
5. Industry
6. Master's
7. Ph.D.
8. Academia
9. Barriers
9. Barriers: Inadequate Academic Preparation
9. Barriers: Lack of Role Models
9. Barriers: Self-Doubt/Lack of Confidence
9. Barriers: Stubbornness
10. Barriers: Lack of Academic Preparation of Diverse Faculty
10. Supports
10. Supports: Administrator
10. Supports: Awards and Recognition
10. Supports: Community
10. Supports: Confidence
10. Supports: Mentorship/Advisor
10. Supports: Parental
10. Supports: Safe Space
10. Supports: Teacher
A. Life Chapters
B.3.3 Sense of Belonging –[imposter syndrome]
B1. High Point
B1.1 Acquiring a Computer
B1.2 Academic Achievement
B1.3 Sense of Belonging and Acceptance
B1.4 Career Achievement
B2. Low Point
B2.1 Academic Disappointments
B2.2 Lack of Acceptance/Outsider Within
B2.3 Belittlement by Professor
B3. Turning Point
B3.1 Academic Achievement
B3.2 Academic Disappointments

B3.3 Sense of Belonging –[imposter syndrome]
B3.4 Loss of a Loved One
B3.5 Desire to Make an Impact
B4. Childhood Memories
B4.1 External Support: Positive Reinforcement
B4.10 Lack of Support: Community
B4.11 Family Relocated
B4.12 Academic Achievement
B4.12 Hands-on
B4.2 All white Spaces
B4.5. Connection to STEM: Logical Thinker
B4.6. Math is a Universal Language
B4.7 About Face
B4.8 Out of School / Extracurricular Activities
B4.9 Awards and Recognition
B4.9 Mischievous
B5. Adult Memories
B5.1 Institutional Support of Women and Minorities at PWI
B5.2 Coursework
B5.3 Awards and Recognition: Making an Impact
B5.4. Identify Development: Part of Me Embracing Who I am
B5.5 Mishaps
B5.6 Life Events
B6. Wisdom Event
Barrier: All white Spaces/No Diversity
Barriers: Lazidazical
Barriers: Racism/Sexism
Barriers: Self-Doubt/Lack of Confidence
C1. The Next Chapter
C1.1 Entrepreneurial: Consulting, Software Apps, Nonprofits, For-Profits, Intellectual Property
C1.2 Tenure and Increase Funding
C2. Dreams/Hopes/Future Plans
C3. Life Project
Career Achievement
D1. Challenges
D1.2: Mathematics/Quantitative
D1.3 Academic Disappointments
D1.4 Lack of Diversity
D2. Failures/Regrets
D2.1 Not Listening to Sound Advice
D2.2 Academic: Not Learning a Subject
D2.3 Discontinued an Activity
D2.4 No Regrets
D2.6 Missed Friend's Life Event
Alona
Bianca
Bianca: I think I.
Dana
Jeanne
Susan
E1. Religious/Ethical Values

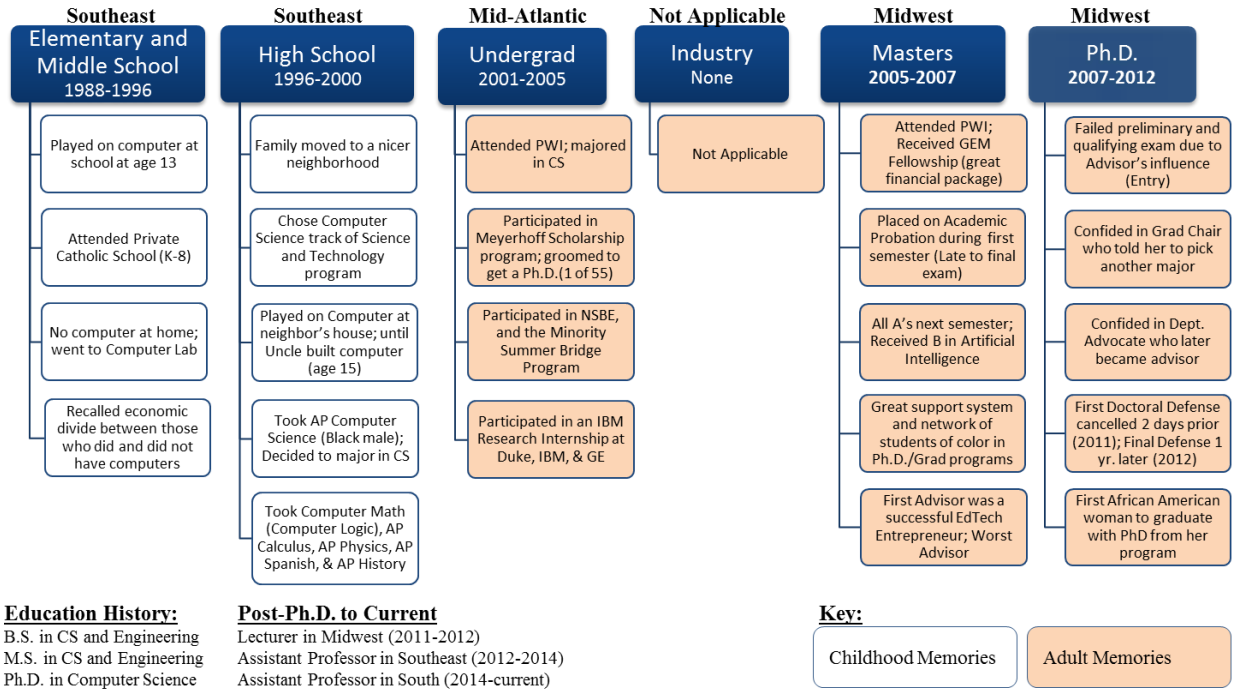
E2. Political/Social Values
E3. Value of Computing Ed
E4. Other
F. Life Theme
F1. "Everything's fine, I'm in charge"
F1. In Charge
F2. “I'm a Connector”
F2: Connector” “I'm a Connector” | Cultivate Others
F3. "Art and Technology"
F3: Arts and Technology
F4. “I’m a Technologist That Knows People”
F4. I'm a Technologist that Knows People
F5. Your Past Doesn't Have to Predict Your Future
F6. Success, Despite Adversity; Triumph Despite Tragedy
G1. Advice for AA Girls and Women (W3)
G2. Improvements for Computing Ed
G2.1. Targeted Community - Black Churches
G2.2 Buddy System (e.g., Graduate Education, For Girls)
G2.3 Connect Computing to Broader Experiences (e.g., Self-Discovery)
G2.4 Improve Mathematics Education
G2.5. Improve Accessibility to Computer Science Education
G2.6 Transform the Image of Computer Science: "Watch the Pronoun"
G3. Interview Process
Reflection 1
Reflection 2
Reflection 3
Why Chose STEM/Computing?

Appendix E: Timeline Examples

Shetay's timeline (birthdate: 1976).



Alona's timeline (birthdate: 1983).



Appendix F: IRB Training Certificate

Certificate of Completion

Shetay Ashford

Has Successfully Completed the Course in

USF IRB Student Researcher Workshop

On

Tuesday, September 9, 2014

USF
UNIVERSITY OF
SOUTH FLORIDA

8/28/2015 6:22:27 AM

Appendix G: IRB Approval Letter

USF
UNIVERSITY OF SOUTH FLORIDA

RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 00001669
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799
(813) 974-5638 • FAX(813)974-7091

10/22/2015

Shetay Ashford
USF Department of Leadership, Counseling, Adult, Career & Higher Education
4202 E. Fowler Avenue, EDU 105
Tampa, FL 33620

RE: **Expedited Approval for Initial Review**
IRB#: Pro00019122
Title: Our Counter-Life Herstories: African American Women Ph.D.'s Experiences in U.S. Computing Education

Study Approval Period: 10/21/2015 to 10/21/2016

Dear Ms. Ashford:

On 10/21/2015, the Institutional Review Board (IRB) reviewed and **APPROVED** the above application and all documents contained within, including those outlined below.

Approved Item(s):
Protocol Document(s):
Ashford_Study Protocol_Pro00019122

Consent/Assent Document(s)*:
Consent Form-Pro00019122.pdf

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent document(s) are only valid during the approval period indicated at the top of the form(s).

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review

research through the expedited review procedure authorized by 45CFR46.110 and 21 CFR 56.110. The research proposed in this study is categorized under the following expedited review category:

(6) Collection of data from voice, video, digital, or image recordings made for research purposes.

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval via an amendment. Additionally, all unanticipated problems must be reported to the USF IRB within five (5) calendar days.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

John Schinka, Ph.D., Chairperson
USF Institutional Review Board

Appendix H: Recruitment Flyer

eIRB# Pro00019122

OUR COUNTER-LIFE HERSTORIES™:

African American Women Ph.D.s' Experiences in U.S. Computing Education

RESEARCH PURPOSE

To counter the master narrative about African American Women Ph.D.s' Experiences in U.S. Computing Education.

PARTICIPANT CRITERIA:
African American women with Ph.D.s in a Computing discipline (e.g. Computer Science, Computer Engineering, Information Systems).

COMPENSATION:
Upon completion of four (4) interviews, you will be entered into a drawing to win one of three $50 Amazon gift cards. The drawing will take place up to 30 days after the last interviewee has completed all four interviews.

CONFIDENTIALITY:
Your identity will remain confidential during and after the study. The researcher will use pseudonyms to anonymize any information that would reveal your identity.

LOCATION & TIME
Based on your availability, the researcher will conduct four (4) individual interviews online or in-person that last up to 60 minutes each. You will also write three (3) entries in a personal reflection journal for up to 30 minutes in between each interview.

USF UNIVERSITY OF SOUTH FLORIDA

This dissertation study is being conducted by Shetay Ashford, Ph.D. Candidate at the University of South Florida. You may contact her at (813) 419-0845 or shetaya@mail.usf.edu.

FOR MORE INFORMATION: http://counterlifeherstories.org

Version 3, 01.25.16

ABOUT THE AUTHOR

Shetay Nicole Ashford is a Ph.D. Candidate in Curriculum and Instruction, with a concentration in Career and Workforce Education at the University of South Florida. She has a Master of Science in Interdisciplinary Studies, specializing in Career and Technical Education from Texas State University, and a Bachelor of Science in Computer Science from the University of South Florida. Shetay also holds graduate certificates in Project Management and Evaluation, and she has 13 years of experience as a Global Training Program Manager, Technical Trainer, and Consultant for Fortune 500 companies in the Information Technology, management consulting, pharmaceuticals, and life sciences industries. Shetay was the Project Manager and Research Associate in the final year of a three-year, longitudinal, mixed methods study entitled "Effects of STEM/ICT Aspirants' High School Experiences on STEM and ICT Course-Taking", which was funded by the National Science Foundation's Innovative Technology Experiences for Students and Teachers project. She is also the founder of the Technology 4 Life Institute. Shetay's research agenda focuses on broadening the participation of women and people of color in the STEM and Computing workforces. In fall 2016, Shetay will begin a new career as an Assistant Professor in the Department of Occupational Workforce, and Leadership Studies at Texas State University.