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New Source Code:
Spelman Women Transforming the Grid of Science and Technology

A Dissertation submitted in partial satisfaction of
the requirements for the degree of

Doctor of Philosophy

In

Anthropology

by

Holly Okonkwo

June 2015

Dissertation Committee:
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Committee Chairperson

University of California, Riverside

ACKNOWLEDGEMENT

DEDICATION

To my role model, best friend, and biggest champion.

BEATRICE "LADY BEA" OKONKWO

It is your love, spirit, conviction and compassion that worked through me to complete a

project of this magnitude. This is for you.

ABSTRACT OF THE DISSERTATION

New Source Code:
Spelman Women Transforming the Grid of Science and Technology

by

Holly Okonkwo

Doctor of Philosophy, Graduate Program in Anthropology
University of California, Riverside, June 2015
Dr. Yolanda T. Moses, Chairperson

From a seminary for newly freedwomen in the 19th century "Deep South" of the

United States to a "Model Institution for Excellence" in undergraduate science,

technology, engineering, and math education, the narrative of Spelman College is a

critical piece to understanding the overall history and socially constructed nature of

science and higher education in the U.S. Making a *place* for science at Spelman College,

disrupts and redefines the presumed and acceptable roles of African American women in

science and their social, political and economic engagements in U.S society as a whole.

Over the course of 16 months, I explore the narrative experiences of members of the

Spelman campus community and immerse myself in the environment to experience

becoming of member of a scientific community that asserts a place for women of African

descent in science and technology and perceives this positionality as positive, powerful and the locus of agency.

My intention is to offer this research as an in-depth ethnographic presentation of intentional science learning, knowledge production and practice as lived experiences at the multiple intersections of the constructs of race, gender, positionality and U.S science itself. In this research, I am motivated to move the contemporary discourse of diversifying science, technology, engineering and mathematics fields in the U.S. academy, beyond the chronicling of women of African descent as statistical rarities over time, as subjectivities and the deficit frameworks that theoretically encapsulate their narratives. The findings of this research demonstrate that Spelman students, staff and alumni are themselves, the cultural capital that validates Spelman's identity as a place, its institutional mission and are at the core of the institutional success of the college. It is a personal mission as much as it is an institutional mission, which is precisely what makes it powerful.

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CHAPTER 1

INTRODUCTION

"What does it mean for a young African-American woman to major in physics? It means she rejects some notion that women cannot do science. She is totally unimpressed by ideas that African-Americans are not good at math. How can you not love folk who smash myths that ultimately destroy us all? How can I not love these young sisters, who are so bright, who are off to be doctors, and lawyers, and business folk, and poets, and philosophers, but who also care about folks other than themselves."

Dr. Johnetta Betsch Cole (June 28, 1996)

The summertime at Spelman College was especially calm. Very few people were out and about on campus as the heat and humidity kept many indoors. Weather in the gulf region was tricky…afternoon thunderstorms with temperatures nearing the 100s posed many challenges for me as a southern California native. On a particularly warm and rainy day, I ventured to the Spelman Archives located in the Camille Hanks Crosby Center on the Spelman Campus. I would spend much of my time between observations and interviews and waiting for the afternoon storm clouds to pass by. The personal papers of former president Dr. Johnetta B. Cole were a central part of my research but I also enjoyed perusing yearbooks, newsletters and photos catalogued by Ms. Katherine, the college's archivist. As I surveyed the archived documents relating to Spelman women and science and mathematics programs, I was drawn to the short narratives and images of the women submitted by the women themselves. Ms. Katherine and I explored archived yearbooks, newsletters and the diaries of Spelman's founders, Sophia B. Packard and

Harriet B. Giles. Every now and then, she would share a few tidbits of the context, the significance or just the things she found interesting. Ms. Katherine was also getting more familiar with the materials as she was transitioning into being the lead archivist. She gleefully shared that she completed the archived files of former president, Dr. Johnetta Betsch Cole. Dr. Cole's personal papers would become a central part of my blueprint of the field. Her ideals of an engaged, rigorous and dynamic liberal arts institution were embedded in the college and audible in the narratives shared by members of the campus community, years after her presidency. However, the foundation for Spelman's new era began two decades prior to her arrival. In 1960, Dr. Shirley Mathis McBay and Dr. Etta Falconer, two African American women mathematicians, just the ninth and twelfth in the United States to earn doctorates in the field, committed to creating an environment that firmly believed African American women could become scientists, mathematicians and engineers.

Before entering the field, I knew Spelman College was special but throughout the research of this project, I connected with the narratives shared by Spelman women and those documented in the archives. It was not the college's more recent notoriety, distinction as just one of two historically black colleges for women, nor was it the names of notable alumni, celebrity donors and industry leaders that adorn the college's hallways and buildings. What makes the community at Spelman College special is a sense of community that begins with the historical, cultural and lived experiences of African American women. The story of the institution is told through the legacies of women who perceive their own backgrounds as the locus of their power, despite what others may

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believe. Today, what it means to be a scientist at Spelman – a Spelman Woman in science and technology, is a woman who dares to confront notions and expectations that say she could not.

I chose to begin this dissertation with a quote from Dr. Johnetta B. Cole, Spelman's first African American woman president, because these words represent the essence of the kind of dynamics I delve into in this research. During an interview with the Academy of Achievement, Dr. Cole discussed her passion for the students at Spelman College as rooted in a love for young women with high aspirations, despite challenges based on gender and racial expectations. (Cole, J., 1996) This work is about the lives of African American women as scientists and technologists, now, in the past, and in the making. Concurrently, this project explores the intersections of race, the complexities of both intra and interracial gender dynamics, gender and raced based social expectations and situated knowledge production within institutional science learning. My intention is to offer this research as an in-depth ethnographic presentation of intentional science learning, knowledge production and practice as lived experiences located at multiple intersections of axes of oppression. The term, axes of oppression, is used to frame the constructs of race and gender as acting upon the lives of the women in this study and as producing subjectivities rather than merely extensions of individual personhood or group identity. This dissertation provides qualitative documentation of the ways in which individuals navigate, negotiate and constitute meanings within the sociocultural landscape of science education. In this research, I am motivated to move the discussion of "women of color" and diversity in science and technology beyond just individual

narratives to highlight the articulation between the lived experiences of women as

knowledge producers and the ontological-epistemological differences between science by

women, and the link to their communities.

This research project stems from my experience as a young woman of African

descent with previous aspirations of being a biomedical engineer. I am also intimately

familiar with the obstacles, microaggressions and barriers that African American women

may encounter in their quests to become scientists in the U.S. The complexities presented

by the interactions among race, gender, socioeconomic class-based biases, expectations

and discrimination structurally skew science learning and practice environments, and

ultimately shape the sorts of roles allowable for the women in this project. This study

offers deeper insight into the experiences of women within and from a unique campus

community committed to correcting this skewed landscape. I approach this project

capitalizing on my own experiences in scientific and technological communities and my

background as a woman from African descent. There are moments in this research during

which I reflect on my experiences to unearth and survey the experiences of personal and

academic development of other women situated within Spelman's unique institutional

identity. Throughout this research, I am cognizant of the ways my experiences and

background not only shape and inform this work, but also allow for a more nuanced

exploration of the setting.

The term, *Source Code,* refers to a collection of instructions, comments and

principles written in a human-readable computing language or text. In computing, each

program has a specific source code designed to facilitate communication between the

programmer and machine. It structures the types of activities enacted and systemic

approach utilized by the machine. Through systemic processing, the source code is

translated and replicated in varying ways. *New source code*, as in the title of this text,

refers to the capacity of the programmer/human factor to transform this process and

rationale by altering the source code or collections of instructions and principles. I extend

the concept of *source code* to this research project in two ways. First, as a nod to the

women scientists and technologists in this project; second, as a way to punctuate a central

objective of this research to challenge the conceptualization of what it means to be a

scientist, and what it means to construct African American women as scientists. I will

show how people at Spelman do this by moving the experiences of African American

women from the margins of traditional definitions of scientists, to the center of the

enterprise of creating African American Women scientists, thus changing the *source*

code. Spelman College and the women in this study have in the past and continue to

rewrite the ways the so-called national scientific community thinks about the roles of

women from African descent in science and beyond.

Utilizing a sequential mixed-methods approach, this document traces the

discursive origins and implications of notions of what it means to be a scientist at

Spelman College, as a product of ideological discourse constituted both in text and

through the constitution of subjectivities in science at Spelman College. The narratives of

Spelman College and the women who participated in this study highlight the ways in

which they continually navigate and negotiate the cultural landscapes and political

economies of science and technology, as well as the gendered and racial expectations of

multiple social environments on campus and in their respective communities. Using a discursive manner, these narratives are presented in opposition to hegemonic ideals, notions and cultural norms of the discourse on science identity itself. Discourse is defined for this study as a system of thoughts (constituted in ideas), attitudes, behaviors, beliefs and practices that systematically construct subjects and its own reality. (Foucault, 1972) The construction of differences its self, the concept of diversity and the boundaries of science identity are explored as fluid, rather than fixed. The intentions of this project are to move beyond the chronicling and discussion of African American women scientists as statistical rarities over time, that dominated the early scholarship on African Americans in U.S science history, and begin to delve into the implications of race and gender stratification, political and economic barriers to access and the role of institutions in training of African American women scientists. (Manning, K., 1983; Pearson, W. & Betschel, H.K., 1989; Scrivens, O., 2007) I explore the narrative experiences of members of the Spelman campus community and I immerse myself in the environment, to experience becoming of member of a community that asserts a place for African American women in science and technology and perceives this positionality as positive, powerful and the locus of agency. In other words, women of African descent and Spelman College are placed at the center of conversations concerning institutional science learning in this ethnography. What will I learn as an anthropologist about what does it now mean to be a scientist?

Higher Education and Science in the US

In his speech addressed to the science and technology industry, education leaders, and federal government officials, President Obama announced the launch of the "Educate to Innovate" campaign. (Obama, 2009, Nov 23) In this address, President Obama references the lack of innovation and contemporary economic ailments as correlated to the "underachievement" of domestic students within public education. He then calls for federal reinvestment into public education, specifically in S&E (Science and Engineering) fields towards increasing the academic success and representation within U.S. public education and higher education institutions. This has become a national agenda for him, for the National Science Foundation (NSF) and for those agencies that frame educational access and inclusion as an issue challenging national security. Scientific knowledge production and scientists have been deemed markers of national economic success. (Chang, M.J., Eagan, M.K., Lin, M.H., & Hurtado, S., 2011) Therefore, the decline in the number of domestic undergraduate students completing programs in physical and life sciences as well engineering have been framed as threatening to United States economic competitiveness. (Chang, Eagan, Lin, & Hurtado, 2011)

Although the discourse of increasing the number of students majoring in STEM fields is framed as a recently emerging issue, this is not the first instance in which higher education has been directly correlated with increasing the economic and sociopolitical status of the United States on the global stage. In fact, the formal relationship between science and national economic development in the U.S. began in 1957 with the Russian

launch of Sputnik, which also coincides, with the establishment of NSF. (Mazuzan, G.T., 1996) Fear of Soviet domination of science and outer space, fueled the formalized engagement between scientific knowledge production and practice, federal economic and international agenda, and the role of higher education institutions in federally orchestrated economic growth and development during the 1950s. (Mazuzan, 1996)

In the years following World War II, higher education institutions were firmly rooted in the scientific enterprise in the U.S. (Leslie, S. W. 1983; Kitcher, 2008) Through the enactment of federal policies in support of the national agenda for economic growth and dominance, scientific research became a fruitful endeavor for U.S. colleges and universities. Scientists and scholars in social, physical and natural sciences campaigned for the notion of a formal science and invested in the process of formalizing and evaluating so-called sound science practices that would impact college and universities. In 1945, President of the Programs for Postwar Scientific Research and engineer, Vannevar Bush, proclaimed that the country's global economic competitiveness and national security depended on the ability of universities to effectively train U.S citizens in science[1]. (Bush, V., 1940) The proclamation further ignited the intentional construction of an objective, universal and systemic scientific approach and perspective by scientists already involved in the Programs for Postwar Scientific Research, which is well documented by historians and critical scholars of science. (Kuhn, S., 2012) However, even in the more critical discussions of modern science practice in the U.S. Post WWI to the present, the role of African American scientists has been understated and the

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[1] Vannevar Bush. Science: The Endless Frontier: A Report of the President on a Program for Postwar Scientific Research. Washington, D.C.: National Science Foundation, 1945, 1960

contributions of Historically Black Colleges and Universities (HBCU)[2] have largely

remained absent. (Scrivens, 2007) Studies that have examined the role of African

Americans in science are either limited to anecdotes of individual experiences or are a

chronology of a small number of African American scientists over time. (Jay, J.M., 1971;

Taylor, J.H, 1969; Manning, K.R., 1983; Scrivens, 2007)

The contemporary discourse concerning the lack of diversity (or

overrepresentation of white male scientists) in science and technology career fields and as

faculty members on college and university campuses, frames the agenda (in respect to

populations underrepresented) as a recent phenomenon rather than resultant of historical

and systemic exclusion of African American women and men from scientific

communities, access to institutional education and the perpetual marginalization and

underfunding of primary and secondary schools in predominately black neighborhoods

and HBCUs. (Manning, 1982, 1998; Pearson and Betschel, 1989; Jordan, D., 2006;

Scrivens, 2007) While not explicit, there is are a number of underlying assumptions

informing the discourse of diversifying STEM fields and the subsequent programs

developments to help to achieve those goals. The first assumption[3] is that people from

underrepresented populations lack previous exposure to science and therefore are less

interested in pursuing careers in STEM. The second assumption is that recently, there has

been a collective movement towards the advancement of African Americans within in

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[2] "Historically Black College and university" stems from The Higher Education Act of 1965. The act
defines an historically Black College or university as: "… historically Black college or university that was
established prior to 1964, whose principal mission was, and is, the education of Black Americans."
[3] Stated during the same preliminarily interview with Dr. Andrea Lawrence

these fields that was not present in the past.[4] The third assumption is that the limited

documentation of the contributions of African American women and men as scientists

throughout history is due to the low numbers of African Americans in science, in general.

And finally the fourth assumption is that science and scientists are NOT produced at

HBCUs. The reality is that none of these statements are true. They are myths that

circulate widely.

Research examining the participation of African Americans in higher education

and science in the U.S, highlight that African American scientists have contributed both

individually and institutionally to the goals of science overall, despite structural

limitations. In the work, *Sisters in Science* (2006), Diann Jordan presents the barriers of

African American women scientists throughout the history of modern science practice in

the U.S. and credits HBCUs for making the strides that have fostered the increase in the

number of African American women completing degrees in STEM fields. Jordan states,

"If it were not for HBCUs, most of the early strides in increasing the number of African

Americans receiving degrees in science and engineering would simply not have

happened." (Jordan, 2006:8) Nearly a decade prior, Manning (1998) highlighted the

contributions of African American faculty members at HBCUs developing STEM

departments and mentoring students who would eventually complete doctorates at

predominately white institutions (PWIs) during the late 1950s and 1960s. These students

went on to contribute to the development of the scientific enterprise and economic

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[4] Stated during preliminarily interview with Dr. Andrea Lawrence, Department Chair of the Department of Computer Science and Spelman Alumna

agenda, at the time. For their contributions, Manning argues that the larger scientific community is indebted to HBCUs and their faculty. At Spelman College, Etta Falconer's documentation of the history of women in science and mathematics, her career as a mathematician and her very important work in the development of the science and mathematics departments, are all prime examples of the contributions of faculty members at HBCUs to the training of African American students who eventually complete doctoral degrees.

As of 2012, HBCUs make up less than one percent of colleges and universities in the U.S. with 105 institutions designated as or given the status as an HBCU[5]. Despite making up a statistically small population of institutions within the higher education community, HBCUs have consistently played a key role in the production of African Americans in STEM fields over time. Data collected by NSF (2013) attribute upwards of a thirty percent share of degrees awarded to African American students completing doctorates in STEM fields to HBCUs. This share increases to forty-five, fifty, and forty-two percent, when disaggregated into physical sciences and mathematics, agricultural sciences and biological sciences, respectively. (NSF, 2013) The exclusion of HBCUs in the historical narrative of science and the contemporary discourse concerning the agenda to increase the number of U.S students in STEM fields, including African American students, reflects the severity of the entrenched myths and erroneous notions, both nationally in the scientific community and locally at the U.S. higher education institutional level, that continue to relegate HBCUs as well as African American

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[5] National Science Foundation, 2013

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scientists to the margins of the sociocultural landscape of STEM communities, conversations and practices that engulf most institutions and funding agencies in the US.

In this research, I engage with the notions, biases, and implicit and explicit behaviors and practices that inform the structural barriers faced by Spelman College, as and institution in developing a competitive science program and making a place for African American women is U.S. science. I also investigate at a deeply ethnographic level the microaggressions (the enactment of stereotypes and biases during individual interactions) that often limit the persistence of women such as those in this study, in becoming members of scientific communities. For example, the pervasive notion (which turns out not to be completely true) that women, particularly African American women, are non-existent in computing and that those in the field of computing have experienced invisibility and isolation (that is true). The narratives shared by participants are placed in dialogue with the structural practices and ways of thinking about "what does a African American woman scientist look like and do?" Is it different from other groups of students that become scientists? And in what ways are they pushing back against the beliefs that relegate African American scientists, science learners and HBCUs to the margins of the larger social structure of science in the U.S.

My research directly challenges the contemporary discourse surrounding the inclusivity of the national agenda and goals of diversifying science and technology fields, including questions of where scientists are produced, who can do science and the sorts of scientific knowledge and practices that are perceived as allowable as defined by social and institutionally gendered, raced, and classed expectations. The findings presented in

this project demonstrate the integral role of Spelman College, one of just two Historically Black Colleges for women in the nation, in the production of scientists who contribute to the local, national and global community in a particular ways. They become scientists in an environment that provides an institutional vision and mission framework that grounds the students in an ideology of purpose and service that is in continual conversation with the sociocultural, historical and actual needs of African American women. This Spelman College ideology of purpose and service allows university officials and faculty to contend with negative historical and contemporary myths and assumptions that produce barriers for women in science and counter those negative ideologies by acquiring funding and sponsorship from members of the community and those invested in the academic development of Spelman women to support the college's institutional development. It is the commitment and intentionality of members of the campus community that the college has been able to do what most PWIs have not been able to do—graduate large numbers of African American students in STEM fields. Spelman College offers the unique opportunity to explore the dynamics of race, gender, institutional type and place within the larger sociocultural landscape of the contemporary scientific enterprise and higher education in the U.S. The narrative of Spelman College destabilizes the narratives of the history of science and higher education in the U.S and the role of HBCUs in this history and in developing scientists (a challenge faced by many institutions). Further, the Spelman story disrupts and redefines (this is where the agency comes from) the presumed and acceptable roles of African American women in science and their social, political and economic engagements.

Science Learning and the Topic of Diversity

Since the establishment of NSF, the engagement amid higher education, economic

development and the scientific enterprise has become more complex and intertwined.

Higher education institutions are more and more dependent on NSF, state and federal

funding for research and building development, STEM industries (healthcare and

information technology) are the top revenue sectors of the U.S. economy, and colleges

and universities have been charged with producing more laborers to enter STEM related

fields. (Obama, B., 2009) This engagement, or more accurately, entanglement informs

the discourses concerning higher education access, student learning and the purposes of

higher education, in general. Although this may not be the first instance in which STEM

education has become a federal priority, the claim of changing student demographics and

the resurgence of neoliberal ideology additionally shape these conversations. Within

STEM education studies, the increased racial and ethnic diversity of students within

American higher education colleges and universities is directly correlated to the decrease

in domestic students completing programs in physical and life sciences. (Chang, Eagan,

Lin, & Hurtado, 2011) In order to produce more U.S. domestic scientists, the changing

racial, ethnic and linguistic demographics of colleges and universities must also be

addressed. In 2007, the concept of developing a "science identity" emerged as way to

address the diverse so-called identities students bring with them as an attempt to facility

the institutional STEM learning. (Carlone & Johnson, 2007) I argue that the development

of the "science identity model" and the subsequent scientist typologies is a product of the

condition of a society motivated by ideals of accountability, quantified outcomes and the

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neoliberal perspectives of individualism. After all, in no other field is the concept of ascribing an identity correlated to academic learning or career viability.

Science identity is explicitly marked by students in sciences gaining and ultimately possessing four distinct goals; the first, the desire to become an authority within the respective field of study, second is colleague recognition, third is the desire to contribute to scientific knowledge, and lastly, to research cures for social health issues. (Eagan, K. & Skarkness, J., 2010) Science identity also includes three domains: 1) competence in scientific knowledge and practice, 2) self-recognition and recognition by others as a scientist and 3) performing the role of a scientist. (Carlone & Johnson, 2007; Eagan and Skarkness, 2010; Chang, Eagan, Lin, & Hurtado, 2011) A glaring limit to this framework is that the indicators and domains of science identity, all reside in the realm of the individual and are discursively framed in opposition to cultural, ethnic and linguistic identities/subjectivities.

Science identity also includes learning and performance, which students seeking entrance into science communities must appropriate, and the roles that so-called scholars of color must successfully navigate in order to become acceptable members of varying communities of science. For historically, excluded populations, these so-called identities vary from the standard science identity by aligning with what has been deemed to be cultural and/or social characteristics: the altruistic scientist (science for the greater good), the disrupted scientist (shaped by negative experiences) and the research scientist (ideal). (Carlone & Johnson, 2007) The aforementioned scientist types have been cited as the ways in which historically excluded students, in Carlone and Johnson's case, women

have *successfully* appropriated the science identity.[6] Although these identities models have allowed for the development of programming that have supported the persistence of some students from so-called underrepresented backgrounds such as alternative STEM communities; they do not challenge the exclusionary practices of the culturally embedded system itself. Instead the typology reaffirms underlying assumptions that diversity in student background, experiences and subjectivities are a limit to academic performance in STEM fields. The partitioning of science identity into three mutually exclusive categories overlooks the complexities of student behaviors and ideals as well as the implications of gender, class and race based expectations and negative biases that inform those same behaviors and ideals. Additionally, this typology undermines the ways institutional learning impacts student performance, personal and academic development and constructs student subjectivities.

The literature extending identity and sociocultural theoretical frameworks in science education has a tendency to attempt to determine the pathology of the lack of student diversity. (Carter, 2004) Trends in this research highlight cultural and social factors that are constructed as inhibiting the persistence of students in life and physical sciences.[7] Experiences of discrimination and racial stigmas towards students of color in communities are cited as social factors forcing students out of the science. (Carter, 2004; Chang, Eagan, Lin, & Hurtado, 2011) The authors assert that as the number of negative

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[6] Carlone, H. B., & Johnson, A. (2007). Understanding the science experiences of successful women of color: Science identity as an analytic lens. Journal of research in Science teaching, 44(8), 1187-1218
[7] Carter, L. (2004), Thinking differently about cultural diversity: Using postcolonial theory to (re)read science education. Sci. Ed., 88: 819–836. doi: 10.1002/sce.20000

racial experiences increase within communities of science, students are less likely to appropriate a science identity. Chang et al (2011) recommends that in order to increase the number of students of color in the sciences, the domains allowing for their identification with science should be increased. (Chang, Eagan, Lin & Hurtado, 2011) Therefore, student persistence is dependent on the ability to cope with microaggressions, and this ability may be further developed through the development of a science identity. This is accomplished by developing supportive peer networks, fostering inclusive environments through faculty pedagogy and faculty student relationships through structured research programming. (Chang, Eagan, Lin, & Hurtado) Microaggressions are indeed cited as a primary limit to the persistence by African American women scientist and are also cited by the women in this research. (Malcom, 1989; Sue, D., 2010) However, the domains of a science identity that are perceived as inclusive for women are also constructed and policed by the same biases, stereotypes and discriminatory practices in enacted during those negative interactions with science. I contend that the conceptualization of "scientist types" is more so the construction of "allowable scientist types" for women from historically excluded backgrounds. Additionally, the findings of this research expose the shortcomings this model that frames African American women as continually deficient, despite the persistence of those women in the study. Competence, recognition, and performance in science and technology are not limited by background or the "identities students bring with them" but rather by sociocultural biases and stereotypes ascribed to the racialized, classed and gendered bodies in which the participants of this research operate within.

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Identity

Despite its commonality in daily conversations, the term identity is a relatively recent concept in social science and public sphere. Identity as an analytical unit does not emerge until the post-war era and is linked to the explicit production of a national consciousness in the U.S. (Philip Gleason, 1983) It facilitates the conceptualization of an existential self and the parameters for examining the individual and a collective within the social world. Being largely informed by Sociology, education literature follows in this framing of identity as individually rooted yet culturally mitigated. (Erickson, 1998; Wenger, 1998; Brickhouse, N.W., 2001) Though briefly accounting for the effects of cultural and/or social ideals, the prevailing notion also frames science as an embodied experience for members of science communities. (Brickhouse, 2001, Keller, E.F., 1985) Wenger (1998) argues that learning is not an isolated event during which knowledge is acquired but is always happening as individuals engage in the world. This includes the process of deciding what type of person one wants to be in relation to the world and/or society. (Wenger, 1998) Learning science is a transformative process during which the identities that students bring to science are transformed. (Brickhouse, 2001) In his work on assimilation into the culture of science, Brown (2004) posits the use of a discursive identity analytical lens. (Brown, B.A., 2004) Brown argues that the act of communicating identity through discourse constitutes an identity created in multiple cultural spaces. (Brown, 2004) Discursive identity is characterized as a process in which science learners' transition through varying realms of discursive identities through co-constructed discursive norms. Together, the identity theories presented by Wenger (1998),

Brickhouse (2001), and Brown (2004) guide the contemporary discussions concerning science learning through an identity framework, as evidenced in the science identity model and literature discussed in the previous section.

The conceptualization of identity as rooted in the individual underestimates the role institutions and structure play in the process of identity formation and is fairly inapplicable in this study. While the conceptualization of science as embodied may be accurate in critiques of scientific knowledge production and practice for some, it is rooted in a particular experience in science and society and the conceptualization of individual agency. Identities, rather identity domains, are not neutral, particularly within an environment in which institutional learning is entangled with political and economic federal agendas. This project addresses the concept of identity as both complex historically and culturally constructed and as a product of historical and social artifact. Throughout the fieldwork for this research, members of the Spelman campus community were perplexed by the concept of a scientific identity. The idea that one needed to identify, as a scientist to do science was obscure to them as shown below.

> "There is a distinct difference between who you are and what you do. Why do you have to identify as a scientist to do science? Seems odd"- Dr. Andrea Lawrence, Chair of Computer Science and Engineering

Identity for this study proves to be far more an historical and social artifact of the hegemonic sociocultural landscape of science and U.S society than a salient characteristic or extension of human individuality. Science identity and identity frameworks in education purport to provide the parameters for understanding the ways in which all students learn and practice science, which inherently problematizes the lives of those

with varying experiences. The limits of the science identity model begin with the adaptation of identity frameworks that do not consider the implications of discriminatory and oppressive racialized, classed and gendered systems that have in the past and continue to skew lived experiences and produce subjectivities.

Anthropologists have studied identity formation in schools (primarily kindergarten to high school) and the social structure of formal education institutions as developmental spaces of rites of passage. In this context, students possess a level of limality as they navigate through the cultural systems of colleges and universities. (van Gennep, 1960; Turner, V., 1960) In addition, educational institutions operate as reaffirming agents in the transmission of hegemonic ideologies. Student success within science programs at colleges and universities in the U.S is dependent upon their capacity to align with the cultural expectations of the field but primarily the institution. (Singleton, J., 1974) Therefore, understanding identity formation in schools demands the analytical lens be equally placed on both the student experience and the institution. If science identity is to be explored, it must be conceptualized as subject to varying mechanisms both within and outside of institutions. (Yon, D., 2000) In his study of urban Canadian high schools, Yon highlights the complexities of identity production within institutions and argues that they are not only spaces that work to reaffirm dominant culture, but are also filled with varying cultural productions including local, national and global discourses. (Yon, 2000) Identity formation is navigated through a seascape of competing discourses and practices including "popular culture, and ethnic tributary, cultural and subcultural concurrents." (Hemmings, A., 2006) In conclusion, the environment, in which

contemporary scientists are produced in the United States, is far too complex to be framed only as an extension of individual values and personalities. In addition, the landscapes in which the institutions of science and science education operate are equally complicated, layered and nuanced.

Recent anthropological studies of the socialization of incoming scientists have focused on identity production via knowledge transmitting processes. (Bucholtz, M., Skapoull, E., Barnwell, B., & Janie Lee, J., 2011) Scientific knowledge and practice along with becoming a scientist are inextricably linked, with each reaffirming the other. The practice of doing science is an additionally self-identifying and socially reaffirming process. (Lowe, C., 2004) In addition to formal scientific knowledge transmission, students negotiate science both within and outside of the classrooms and through both micro and macro levels of discourse regarding the respective fields of science. (Bucholtz, Skapoull, Barnwell, & Janie Lee, 2011)

This study adds to anthropological theories of education in the U.S. by offering a nuanced discussion of institutional learning and the production of identity domains and the ways in which individuals navigate and negotiate these domains in and out of colleges and universities. The term identity domain is used to focus on the formative process in reference to the institution and social expectations. If identity is understood as a social artifact, then we must question how it is produced, who is involved in its production and how is it preserved? This framing allows for a pragmatic examination of the social and political engagements and implications of identity.

The Intersections of Race, Gender and Class

The examination of identity as a social construction and artifact calls for the consideration of the implications of race, gender, ethnicity and class as group identities and axes of stratification. Shared experiences across these domains frame identity as constructed social categories rather than as an extension of individual personality. (Durkheim, E., 1968, 1961; Weber, M., 1946, 1968, 1957; Bourdieu, P., 1977) However, group identity is also subject to essentialism and stereotypical characteristics that tend to marginalize those marked as other. This tendency is avoided in this project. I examine the axes of race, gender, place and class in reference to the social and political implications of these identity domains on the lived experiences of the women in this study and Spelman College as an institution.

Bias in science itself inevitably lead to biased conceptualizations in science practices, which are additionally coded throughout the practice of science. (Keller, E.F., 1996; Keller, E.F. & Longino, H.E, 1996) Constructivist critiques of science have adequately challenged meanings and the conceptualization of bodies in scientific knowledge production, but have dismantled opportunities to effectively talk about science practice from varying positionalities. (Haraway, D., 1988) For example, the way African American women are conceptualized in science informs the ways women engage, practice and dictates the sort of science accessible to them. Knowledge production is situated within the experience of the individual and is in conversation with the social expectations and biases that impact those same experiences. Knowledge as situated within the experience of the individual deconstructs meanings,

conceptualizations of racialized and gendered bodies and subjectivities in science while creating a space for the creation of new meanings. Fostering a more inclusive science-learning environment begins with learning from the experiences of women in science in that environment. (Harding, S., 2008) The perspectives (standpoint) of women in historically excluded environments better equipped them to understand the intricacies of hegemonic processes. (Smith, D.E., 1987)

Early studies examining the institutional experiences of women in science focused on women as a collective, overlooking the implications of race, ethnicity, and class. (Tidball, E., 1970; Kistiakowsky, V., 1976; Tidball, Smith, D.G., Tidball, C.S., & Wolf-Wendel, L., 1999) For example, the assumption was that Women's colleges and programs developed to support the academic development of women serve all women, which was found to be untrue. (Scrivens, 2009) Women's Colleges were found to be more conducive for U.S white women and HBCU for African American women. In addition, the extensive gap in the literature concerning the participation of African American women in science is also evident in the continual oversight of Spelman College by the Women's College Coalition in the discourse on institutional approaches for increasing access for women in science. (Leggon & Pearson, 1998; Jay, 1971; Wolf-Wendel; 1997)

The intersections of race and gender as axes of oppression do not act on the lives of black women in a simple combination but produce a unique experience altogether. Gender is skewed through the lens of race and visa versa. Intersectionality theory critiques the tendency to homogenize the experiences of women. (Crenshaw, K., 1998)

Crenshaw argues that the experiences of black women are invisible due to the categorization in discriminatory practices that address gender and race separately. (Crenshaw, 1998)

I approach this research with the concept of knowledge as built on the lived experience rather than the objectification of an *Other*. (Collins, 2000) The narrative experiences shared in this study are not necessarily explored comparatively, but were gathered and analyzed to explore how the concept of science identity travels through these various spaces and experiences. (Collins, 2000)

Decolonizing Science in the United States

The use of postcolonial theory in exploring the experiences of a U.S institution and amongst a primarily U.S born population may initially seem misplaced. Postcolonialism elicits notions of imperial conquests and colonial occupation in far off lands, however, I contend the institutional agenda of Spelman College to train women of African descent to become scientists, engineers and mathematicians in a place in which African Americans and their communities and institutions have been systematically oppressed, exploited and marginalized, crosscuts similar contested boundaries of *who can do science, where science happens* and *where scientists come from* that are similar to the ways practicing science is an postcolonial space shapes accessibility to science communities outside of that space.[8] Postcolonial theory may be defined and interpreted in

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[8]Reference to Indonesian scientists in Lowe, C. (2004), Making the Monkey: How the Togean Macaque Went from "New Form" to "Endemic Species" in Indonesians' Conservation Biology. Cultural Anthropology, 19: 491–516.

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different ways depending on its social and political project, I argue that the training of women of African descent to become scientists at a college historically established to train freedwomen (former slaves and the daughters of former slaves) is indeed a social and political project. Postcoloniality is not a state of being, beyond our past, but is a liminal or hybrid state. (Bhabha, H.K., 1997) The negotiation of cultural identity involves the continual interface and exchange of cultural performances that in turn produce a mutual and mutable recognition (or representation) of cultural difference. The institutional identity of Spelman College, the local identity of the City of Atlanta and the meanings and practices of science within the particular place, the "Deep South", are resultant of historical and political interactions that impact human activity and lived experiences in that space. These interactions produce the identity of a place that is distinguishable from the larger environment—which also reaffirms its identity as well. The state of limality not only refers to a space between group identities, but also between historical periods, politics, theory and practice. In this project, I explore the institutional experiences and campus culture at Spelman College in conversation with political, historical and economic engagements that inform behaviors and beliefs within the campus space, as well as the ways the Spelman narrative speaks back to the so-called larger sociocultural landscape of science in the US.

For the purposes of this project, I highlight postcolonial theories composing the projects primary theoretical lens. I begin with framing the discourse of science and diversity in higher education as a policed cognitive system. In a policed cognitive system the discourse is structured as a powered entity controlling and constituting boundaries

and borders shaping the mode and means of representation. (Gandhi, L., 1998; Seth, S., Gandhi, L., & Dutton, M., 1998) Postcolonial theory allows for the development of a dialogue in which knowledge of the other and self are both contested. The self-reifying process of categorizing the other becomes highlighted as well. Hence, the positioning of racial, ethnic and gendered identities outside the sphere of science identity in the U.S. established science narrative is simultaneously a process of neutralizing or reifying what it means to be a scientist in the U.S. that does not inherently stem from the perspective of Spelman College and African American women. (Gandhi, 1998; Chakrabarty, D., 1992)

Postcolonial theory further denaturalizes ideas of cultural differences in science studies challenging the bounded conceptual spaces and subjectivities produced by the positionality of the places of science practice and types of scientific knowledge that are produced. (Lowe, 2004) The experience and practice of science outside of so-called science places, is relegated to the margins of the sociocultural landscape of science as well as the subjectivities produced in and by these spaces. Postcolonial frameworks problematize the borders and boundaries constructed in the discourse of science identity and culturally diverse students in the United States. (Carter, 2004) Scholarship on cultural diversity and science education traditionally displays the tendencies to either focus on the experiences and processes of learning science by culturally and linguistically diverse students or to highlight elements of science that are culturally positioned. (Carter, 2004)

With the use of a postcolonial critical lens, naturalized notions of difference and dualism become conceptualized as constructs available for exploration. Science identity is no longer discussed in opposition to other identities and/or subjectivities and the

constitution of historical and social contingencies of the borders becomes the object of inquiry. (McKinley, 2001) This framework conceptualizes place as "between and betwixt" and uniquely positioned to deconstruct binary discourses of science identity. Interlinking and underlying mechanisms of contemporary science practice in the U.S., hegemonic national identity and histories of social relations particularly constitute contemporary discussions of science identity. The elasticity of postcolonial theory allows for the interrogation of the wide range of complexities that constitute contemporary discourse of science identity. By providing unique methodological insights, that have been used to explore complexities in varying fields and disciplines, postcolonial theory offers the opportunity to ask new questions in a new temporal space in science education studies of identity.

Research Design

The research in this dissertation is guided by the following objectives:

- Deconstruct U.S. naturalized notions of science practice to expose how power operates through the production of meaning. (Foucault, 1980)
    - Trace discursive origins and implications of these notions as products of ideological discourses constituting both text and subjectivities of science practice. (Adreotti, 2011)
    - Explore the translations of cultural meaning (such as innovation and success), identities and subjectivities. (Callon, 1986)

From these objectives the following research questions emerge:

1. Under what conditions are women from marginalized ethnic, racial and gendered histories deemed successful candidates for becoming scientists in the U.S.?

2. What does it mean to be a U.S. scientist and how have emergent science identities redefined science itself?

3. What are the ways, Spelman College as an institution, fosters a learning environment that supports the academic and personal development for the women on its campus and beyond?

Over the course of 16 months, I conducted ethnographic fieldwork consisting of participant observation; qualitative semi-structured interviews, surveys and free listing at Spelman College located in Atlanta, Georgia, USA. I gained approval from the Institutional Review Boards at the University of California, Riverside and Spelman College, prior to conducting the fieldwork for this research. As a Historically Black women's liberal arts college, the Spelman College campus community provides a distinctive opportunity to examine the dynamics among gender, race, place/positionality and the political economies of science and technology. Through its explicit efforts to increase the number of young African and African American women scientists, over the last thirty years Spelman College is regarded as the top undergraduate institution, who graduate African American women who go on to complete the highest number of doctorates in Science and Engineering fields in the entire United States.[9] (NSF Report,

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[9] Tuskegee University located in Alabama Top producer of both African American men and women

2013) The college is also distinguished as the number one ranked Historically Black College and University (HBCU) in the country. (*U.S. News & World Report, 2012*) In 1995, Spelman College became one of six institutions designated by the National Science Foundation (NSF) and the National Aeronautics and Space Administration (NASA) as a "Model Institution for Excellence"[10] in undergraduate science and math education. With a rich history and intentional effort to develop a campus climate and culture that truly believed that women from African descent could not only learn science but become scientists and technologists, Spelman College is the ideal site for this research.

My research focuses on the fields of computer science and engineering for a few distinctive reasons. To begin, the disciplines of computer science and engineering are a relatively new addition to the academic landscape. In its beginnings, computer science was conceived to be gender neutral as it was innovative and assumed to not carry the exclusionary baggage of the more established STEM disciplines. Additionally, using computers as a skill or competence to be developed aligned with perceptions of the type of education suitable for women. (Noble, J., 1957; Guy-Sheftall, B., Steward, J., 1981) However, over the past 30 years the participation of women has exceptionally declined within computer science and related fields to less than 20% with African American women representing approximately about 1% of the total.[11] (Zweben, S., 2012) The social reconstruction of computing, software engineering and programming, *(or "bro-*

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[10] NSF Designation and program for successful minority serving institutions. In 1995, Spelman became the first HBCU to win the grant

[11] In its formative year during the early 1970s, women occupied approximately 50% of computing jobs.

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gramming"[12], as a male-dominated field also aligns with its increase in profitability and social status in the U.S. The field is currently inundated with pervasive notions of who are technological innovators that work to exclude anyone who does not fit the young, white, suburban, male Silicon Valley model. Unfortunately, Silicon Valley operates as the nexus of technological innovation despite the lofty notion of science being a placeless and global endeavor (thanks to the internet and social networking). However, computer science…in the south, at an HBCU, amongst African American women, does not *compute* (no pun intended) for some outside of Spelman College. The research conducted in this project provides a nuanced conversation concerning the conceptualization of contemporary scientific knowledge production as universal, global and placeless on the one hand, and the realities of science knowledge production at Spelman College. I ask how do the narratives of Spelman College, its students, faculty and alumni fit within the narrative of the current ideals of science and technology?

Next, the role of knowledge producer and user in the field of computing and engineering are conceptually consolidated. Within the field, scientific knowledge is often produced by the end-user (the programmer, computer scientist and/or engineer). This makes the practice of computer science equally as political as the production of knowledge and technology. Finally, research conducted in the field is explicitly linked to market mechanisms and the immediate practical use value of the knowledge produced. It is perceived that scientific knowledge production within the field occurs in conjunction

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[12]Brogramming, portmanteau of "bro/brother" and "programming" is a reference to the saturation of Suburban white males in their mid-20s. Also referred to as Silicon Valley "tech-types"

and in *real-time* rather than *delayed*. Scientific work in this field is continually engaged

with social, local and federal expectations and trends. This engagement shapes research

topics and agendas as well as the individuals charged with conducting this work.

Participant Observation

Participant observation is the primary method of collecting data during the fieldwork of

this project. Participant observation proved to be the appropriate method in exploring the

student experience of the college and helped in gaining an in-depth understanding of the

campus community, and to formulate sensible questions for later stages of this research.

(Bernard, 1994) My level of participant observation was a balance between full

participation, when possible, and direct observation. During the first three months of my

fieldwork, I lived with a family friend who lived within five miles of the campus. At the

end of the Spring 2013 term, I obtained housing at the Johnetta B. Cole Living and

Learning Center II on campus. I also resided in The Suites, housing community during

the fall semester of 2014. I met students, faculty, and program administrators, took part in

community activities, and established rapport. Then I kept a systemic record of day-to-

day interactions, observations and informal conversations. (Bernard, 1994) The

ethnography of the institution provided a more in-depth understanding of how the

ideological value of the STEM disciplines has been interpreted at the institutional level. I

observed the ethos of the institution, its history, values and myths (the things they tell

themselves about who they are) while focusing on student, staff and faculty narratives

and how the institutional actors operate within the realm. The narrative experiences

shared by the participants in this research were enlightening and provide exceptionally

rich contextual data.

Free Listing

I used free listing to determine the relevant categories and language used in the ascription

of "what it means to be a scientist and/or technologist" to themselves and others. (Weller

and Romney, 1988) The goal was to identify salient terms and ideas within the campus

community. The campus community is defined as students, administrators, faculty, staff

and researchers currently and previously affiliated with the college. I collected free lists

from 10-15 3rd year students, 6 faculty members and the department chair in the computer

science and engineering department. The analysis of the free list data focus on two

measures of an item's salience. The first being the frequency with which each term is

mentioned by an informant, and the second being the salience index as computed by

ANTHROPAC. (Borgatti, 1996) These measures estimate the salience of cultural and

local notions of science and scientific practice and also help define the boundaries of the

domain.

Interviews

 The initial phase of interviewing I conducted semi-structured interviews with principal

investigators of NSF funded research projects, program directors, the department chair

and Spelman alumnae. Many of these categories overlapped such, as the department

chair, Dr. Andrea Lawrence, is also a Spelman alumna and a program director. In this

case, multiple interviews were conducted to collect reflective of their multiple roles.

These in-depth, open-ended interviews provided a broad understanding of the relevant

topics and terminology, and to discover the right questions to ask. Participants were
encouraged to use their own terms. I conducted in-depth interviews with 8 campus
personnel including the fulltime faculty members and chair of the department of
computer science and engineering, director of institutional research and the College
Provost. These interviews examined institutional ideals, insight into their backgrounds
and individual teaching and leadership philosophies. These interviews were transcribed
and coded. A cultural consensus analysis was used to test whether informants share a
single cultural model of success in the science and engineering fields and institutional
and individual values and science learning and teaching philosophies. Interviews were
conducted face to face; however, a few were conducted on the telephone for the
convenience of the interviewee. All appropriate IRB guidelines were followed throughout
the gathering, analyzing and presentation of the data.

Survey

Using the Diversity and learning environments survey and the Science Identity Survey
(both developed by HERI) [13] instruments as a framework, I developed a survey
instrument to examine student perceptions of science learning at Spelman, career
aspirations and what it means to be a scientist in conversation with the domains identified
in the development of both surveys. The department's administrative assistant and Dr.
Lawrence facilitated the dissemination of the survey o all computer science majors. Of
the 60 students in the department, 14 completed the survey and 3 partially responded. The

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[13]HERI, the Higher Education Research Institute is located at the University of California, Los Angeles.
The Diversity and Learning Environments Survey was administered at the University of California at
Riverside in 2011 through the Office of the Vice Chancellor, Yolanda T. Moses. As her student researcher,
I assisted with the data analysis at UC Riverside.

data collected through the survey responses revealed the ways in which the students at Spelman did not exactly fit the science identity model and their perceptions of science learning.

Student Interviews

Per the suggestion of the Department Chair, Dr. Andrea Lawrence, I conducted a group session with a group of students in their 3rd year in the computer science program at Spelman. Focus group participants were selected based on an opportunity sampling and met on two separate occasions. Prior to the session, participants signed a consent form and were given an overview of the study. Dr. Lawrence requested that I provide a short assignment to prompt students to begin to think about the research topic. The group interviews offered insight into student dynamics and collective ideals concerning science, their learning experiences at Spelman and interests outside of the college.

In-depth semi structured interviews were conducted with two computer science majors at Spelman. The first student, Zazie, was an avid contributor to this project through sharing her insights during the group sessions and survey. Towards the end of my fieldwork, I asked if she would be interested in participating in an interview to which she agreed. Zazie also refereed the second student interviewee, Jazette. Both students were graduating seniors and members of the Spelbots, the competitive robotics team at the college. Both interviews were conducted over the phone and were approximately 1 hour in length. During the interviews, students shared experiences in science communities including summer internships and outreach programs, their learning and research experiences as Spelbots and their independently developed senior research

projects. Students also shared stories from their childhood, family and social expectations and career aspiration. From my perspective, the narratives provided by these young women are not only interesting but also galvanizing. The clarity and nuance of their narratives highlight the ways a more inclusive learning environment can foster the development of African American women in science who are knowledgeable, dynamic and socially engaged.

Document Analysis and Archival Research

The exploratory components of this research are punctuated with an in-depth examination of both primary and secondary sources amassed from the archival holdings at Spelman College as well as journal and newspaper articles and NSF statistical reports and documents. The Spelman archives contain an extensive collection of institutional records, yearbooks and archived newsletters dating back to the founding of the college. The personal papers of former president, Dr. Johnetta B. Cole, are a central component of the archival research conducted in this study.

The document analysis component of the project is subdivided into two parts, pre- and post-ethnographic exploration. The preliminary portion consists of reviewing documents as artifacts mobilizing networks. (Latour, 1998) I interrogate national trends in the discourse of "science identity" such as the 2009 *Educate to Innovate* campaign (the federal program sparking the contemporary discourse), the "Science Identity" Survey (2012), NSF *Best Practices* (2000), and related NSF program solicitations. Through this process, I trace notions and meaning through local sites and explore how individual

narratives in the field "speak back" to the ideals, values and cultural meanings of the discourse.

The document analysis conducted post-ethnographic *research explores documents* as producers of the very persons and societies that use them. (Brenneis, 2006; Foucault, 1991) While in the field, I compiled material and documented artifacts of the field including institutional data, mission statements and histories, program curriculum and agendas. I also explore the departmental and administrative files in the Spelman College archives as well as the artifacts informally archived by individuals within their spaces. Through this process, I explore local meanings of science as well as institutional and individual narratives through the material produced and archived as well as what is not.

Organization of the Dissertation

This theoretically and methodologically innovative project intends to push the boundaries of the debates concerning increasing diversity within the academy, race and gender studies in science through an in-depth ethnographic case study of a local situation and a community that has largely remained absent in the literature (African American women in science, HBCUs, Women's and Liberal Arts Colleges). The following text, critically engages situated ethnography in conversation with complex historical engagements and the broader sociocultural environment. What do the narratives of Spelman College and members of the campus community tell us about the structural dynamics of science education, relations of power and the constitution of new meanings within the cultural landscape of science and technology in the U.S?

The following chapter, Chapter two introduces Spelman College and the campus community as the setting of this research. This chapter includes a review of the history and context of Spelman College and it's social, cultural and historical engagements with the City of Atlanta and the area surrounding the Atlanta University Center. Place, is presented as a dimension of science. The development and establishment of the Science Center is discussed as making a place for science that brings people together, builds student and faculty capacity and marks the college as a place in which scientists and scientific knowledge is produced.

Chapter three directly challenges the discourse concerning science learning and the topic of diversity in higher education. This chapter destabilizes the paradigms informing the science identity discourse, conversations on access and persistence of students from underrepresented backgrounds in science and the scientific enterprise as a whole. I examine the production model of institutional learning and the labor of scientific work. The domains of the model are placed in conversation with the narrative experiences of the students and faculty at Spelman to reveal the ways the conceptualization of women of African descent in the literature overlooks the nuances of the intersections of race, gender and scientific practice.

The institutional structure, ideology and organizational culture of Spelman College are examined in Chapter four. The data collected through semi-structured interviews with campus officials, faculty members and administrators is analyzed to explore institutional philosophy, pedagogy and ideologies of key personnel on campus.

This chapter also examines the "Spelman Model of Encouragement" and cultural values of the institution.

Chapter five explores the intersections of gender and race and institutional science learning. I also examine the ways the women in this study navigate and negotiate racial and gender based expectations and personal and academic development. This chapter includes a discussion on gender dynamics between the women at Spelman College and men from the adjacent all-male HBCU, Morehouse College. The meanings and conceptualizations that emerge through these varying engagements are analyzed through the narrative experiences of Spelman women.

Chapter six explores the negotiation between choosing to pursue a career in science and the subtle ways in which African American women as signaled that they may not belong in scientific and technological communities. I end the chapter with a presentation of the innovative research being conducted by students at Spelman College and the ways science learning and practice are in continual conversation with the legacies of Spelman women in the past and now.

Chapter seven concludes this text with a discussion of the insights and implications of this research. By understanding the dialectic occurring between STEM departments at local institutional sites and how the framework of "what is a scientist?" is constructed, produced and reproduced juxtaposed to historically excluded subjectivities, may produce a better nuanced understanding of the elements that present barriers to the success of future U.S. domestic scientists. This chapter offers avenues for further

research and strategy development for engaging institutions in culturally responsive ways that foster a more inclusive learning environment for all students.

CHAPTER 2

"PUTTING SCIENCE IN ITS PLACE"

Social studies of science animate the conceptualized inert spaces of scientific knowledge production and technoscience practice. Through ethnography, sterilized labs and facilities become field sites and scientists, assistants, and technologist are explored as cultural communities. Just as any other community, there are normative behaviors and expectations informed by shared values and worldviews. By emphasizing the cultural, political, economic and historical dimensions of scientific and technological knowledge production and practice, science studies scholars have challenged the existence of objectivity, universalism and value-neutrality, which anchor modern science in the United States. Less frequently explored, *place* as a dimension of scientific knowledge production, also informs the sorts of knowledge produced, valued and activities engaged within communities of practice. Understanding place is far less in reference to location such as "here or there" but more so refers to the temporal, political and spatial embeddedness of human activity within the site. (Appadurai, A., 1996; Hannerz, U., 1987; Rosaldo, R., 1988, 1989) Place is what makes ethnography worthwhile for the anthropological project.

This project explores scientific knowledge production, practice and learning as situated within a particular place (Spelman College) while simultaneously affirming that very same place. However, the ethnographic research conducted at Spelman College should not be understood as reflective of an unproblematic or "naturally" distinctive cultural community or as in the sense of culture mapped onto space. In this research, the

tendency to conflate culture and place is intentionally avoided. Hence, exploring

scientific knowledge production and learning at Spelman is not equated to "Spelman

Culture" or "the cultural practices of African American women." Instead, the experiences

and identity of Spelman College as an institution and those of the women in this study are

explored as situated between hierarchically interconnected spaces. (Gupta, Ferguson,

1992) Spatially, these spaces include surrounding institutions, the college's location in

the region, and this region in reference to the national landscape of science and

technology community. Virtually, these spaces consist of national education policy,

hegemonic educational ideals, gendered and racialized expectations and local history and

social communities. The ideologies, values, and narratives of shared by members of the

campus community are explored in conversation with a landscape of powered

interactions and relationships. Spelman College and all places of scientific knowledge

production, learning and practice are explored as locally embedded, historically

informed, and culturally relative.

Science Learning for Girls and Women in the Public Sphere

The education of women and girls in societies governed by male supremacy

entangles schooling and careers in science with social policies and practices. (Harding,

S., 2008) The conditions which distort the career trajectory and experiences for women as

scientists and faculty members (such as those at Spelman College) align with the

conditions that make science learning environments difficult for young women and girls.

(Greene, M., 1978; Shultz, T.P, 1993) Male dominance in the public sphere affords men a

larger share of social resources and labor, at the expense of others within the social

network. (Rosaldo, M., Lamphere, L., & Bamberger, J., 1974; Chickerling, 1981; Tinker, 1990) These expenditures are afforded through the prioritization of the education of young boys before young girls and the demand for social labor (domestic work, childcare and financial contributions from paid work), if familial resources are limited. (Rosaldo, Lamphere & Bamberger, 1974; Chickerling, 1981; Tinker, 1990) Due to this entanglement, the underrepresentation of women is science and technology fields and careers should not be surprising. Regardless of the institution type, location or prestige, the landscape of science education and practice is skewed by its embeddedness within a social system that privileges the perspectives and experiences of men. (Longino, H., 1990; Keller, 1996; Harding, S., 1998, 2008)

Similarly to the conceptualization of place as emergent through hierarchical interactions, the science environment for women (at large) may be understood as situated within these same interactions. Therefore, the science learning experiences of the women at Spelman College must be explored in conversation with the historical hierarchical interactions, which inform social practices and ideals within the local community as well as those that transgress the larger national landscape.

This conceptualization of the dimension of place as not geographical but rather as an unbound system of hegemonic ideals overlaying and informing human activity is central to meeting the objectives of this project. While I conducted the fieldwork of this project at Spelman College, I was committed to exploring the experiences of African/black women as scientists and technologist, in training and this institution, within the larger landscape of the science and technology.

Setting the Stage

  I boarded the first leg my flight, on an early Thursday morning. However, due to flight delays, travel time and the three- hour time difference, it was well into the night when I landed in Atlanta, Georgia. Along with being the only airport in the state, the Hartsfield Airport is also one of the largest airports in the nation. Exhausted and hungry, I debarked the plane and grabbed my over packed carryon luggage. As I reached the end of the bridge between the plane and the arrival gate, I stopped, looked around the terminal and the phrase "Chocolate City" immediately came to mind.[14] Prior to entering the field, I spoke with friends and colleagues who either lived or visited Atlanta, to gain insight from their experiences in the area. In conjunction with my preliminary research, I was well aware of the city's high numbers of African Americans and African immigrants and rich African American history. That being said, I was still struck by the high increased visibility of black and brown faces and the diversity in accents, dialects and languages. Despite being an African American women from an immigrant background, I had become accustomed to not only being a minority in predominately white spaces but also to not expecting to see many black and brown faces in public spaces. Alas, I find this insight to be a bit shameful however; I share this experience as it reflects the pervasiveness of the biases and perspectives that dominate the larger sociocultural landscape. As the primary travel hub of the southeastern United States, the Hartsfield-

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[14] The term "Chocolate City" is used in reference the concentration of African Americans in the City of Atlanta as well as the prevalence of black/African American culture and history.

Jackson Airport reflected the diversity and fast-pace climate of the city. From the flight crew, airport staff and retail workers to the patrons and passengers, the diversity of the region was reflected in those that I interacted with in this space. In that moment, it was clear…I landed in "Chocolate City"

As the capital and most populous city, Atlanta is the cultural and economic center of the metropolitan area of the State of Georgia. The City of Atlanta is the county seat of Fulton County and extends eastward into DeKalb County and is divided into 242 officially designated neighborhoods. The city is socially and geographically organized around three adjacent high-rise districts: Peachtree-Downtown, Midtown, and Buck head (commonly referred to as the Beverly hills of Atlanta).[15] Government agencies, tourist attractions and sports venues are located in Downtown. The city's cultural attractions, art institutions, law firms and modern architecture distinguish the second largest business district, Midtown (see Figure 1). Located eight miles north of Downtown, Buckhead is marked by a blend of urban design amidst a dense forest landscape. Together, these districts center the Atlanta metropolitan area.

Figure 1. Aerial view of Atlanta's three high-rise districts

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[15] A reference to Beverly Hills, California, which connotes "high class", fashion-oriented and wealth.

I quickly learned that although many of individuals referenced Atlanta as their residence, most actually resided in nearby cities. Like many metropolitan areas, housing in the city's core was expensive. In addition, not all of the 242 neighborhoods were desirable areas to live. The city was not the most desirable area to inhabit. Despite not residing within city limits, many referred to Atlanta as their home due to the city being conceptualized as the cultural capital, progressive and globally engaged. Being from "Atlanta" meant more than a place of residence.

My level of immersion ranged on a spectrum of observer to full participant observer, depending on the environment. During the initial stages of my fieldwork, I lived with the daughter of a friend of my mother. I accompanied her to social events, recreational activities and throughout her daily activities. For the most part, I navigated my way through the city. While Atlanta transportation authority and government website touts the city's superior transportation system in the past, my experiences on the MARTA (Metropolitan Atlanta Railway Transportation Authority) did not reflect that. The MARTA train and bus system was notorious for not running on schedule, which I discovered after long wait times.[16] Obtaining a rental vehicle was necessary to effectively conduct the research for this project. As a public transit patron, the city seems large and extensive. Outside of rush hour traffic, I could travel between the two furthest districts, from Downtown to Buckhead within 15 minutes. However, access to a personal vehicle not only made traveling easier but also helped to better understand the geographic and social landscapes.

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[16] Prior to beginning this fieldwork, I was warned that the public transit had a tendency of running behind schedule. From my experience, this was indeed correct.

The City of Atlanta

> "Atlanta and Georgia are different. People forget that Georgia is still the
> South. Some people are going to be nice to you and others will not. It's
> not you; it's just how things are. Just be careful"
> - A friend from UCR who recently moved to Atlanta, GA.

Since the late 1960s, African Americans have represented more than 60 percent of

Atlanta residents. While African Americans may make up a large portion of the city's

population, I was also informed that this diversity was limited to just the city of Atlanta.

Throughout my fieldwork, residents and visitors to the region continually expressed this

distinction between the city of Atlanta and the state of Georgia, despite the city being

encompassed by the state.

> "Atlanta is like a big city but still has a southern feel to it. My family lives in
>
> savannah [Georgia]. It's beautiful but it's too slow"
>
> - Spelman Senior.

Through my observations, I found that this distinction is more so attributed to

differing social climates and history rather than to the higher percentage of African

Americans residing in the city. State population demographic reports show that while

there is a higher concentration of self-identified Black/African Americans in the city of

Atlanta, there is also a relatively high representation in the surrounding areas and

counties. The percentage of African American residents decreased as the distance from

Atlanta, increased.

In 1837, the City of Atlanta was established at the intersection of two railroads.

As the nexus of multiple railroads, the city became a hub for the transportation of military

goods to the then confederate south during the civil war. Since its beginnings, the city has

served as a site for the transmission of people, goods and ideals. With much of the city's

infrastructure destroyed during the civil war, the transportation system supported the

quick rebuild, which led to the city's designation as the capital of the state of Georgia.

Due to its superior transportation network and emerging business hub, the population

grew exponentially during the following decades.

With the city largely being established by railroad workers, merchants and those

in search of jobs and other financial opportunities, initially Atlanta did not house the

same sorts of racial tension and discriminatory practices that were prevalent in the

segregated south. Prior to the Atlanta Race Riots of 1906, black and white owned

businesses were integrated in the downtown business district. However, competition

between working-class white and black residents for jobs and housing gave rise to racial

tension between the groups. Allegations of sexual assaults against white women by black

men by local newspapers ignited the race riots, which resulted in the killing of 25 African

Americans, and 70 injured victims. These events of the race riots would forever alter the

social climate of the city. Due to increased fear, black businesses began to move from the

previously integrated business district to the safer areas surrounding the elite black

colleges and universities, now known as the Atlanta University Consortium (AUC)

located west of downtown Atlanta. Although, the race riots increased racial segregation,

discrimination and tension they also spurred the development of the African American

cultural identity that is the bedrock of Chocolate City.

The concentration of African American businesses, churches and colleges and university laid the foundation for the emergence of an intellectual and civically engaged middle- and upper class African American community. Located east of downtown and Auburn Street, the neighborhood was coined "Sweet Auburn" by civic leader, John Wesley Dobbs. As the neighborhood's unofficial mayor, Dobbs referred to Sweet Auburn as the "richest negro street in the world." Officially named Sweet Auburn Historic District, the area became the central site of African American culture and achievement in Atlanta. The district includes the first African American owned office building, Rucker Building, Atlanta Life Insurance company) owned by Alonzo Herndon (former slave and Atlanta's first African American millionaire) and the first and longest running African American newspaper in the United States, Atlanta Daily. Also located in the district is the birth home of Dr. Martin Luther King Jr.[17] Though segregation, violence, Jim Crow laws and racism dictated the housing patterns and forced the concentration of African Americans in Atlanta, this mile and a half long street became the nexus of African American heritage, activism and intellectual and economic development in the early 20th century (see Figure 2).

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[17] The birth home of civil rights activist Dr. Martin Luther King Jr. is a national monument and popular tourist site in Atlanta.

Figure 2. An artistic rendition of the 20th Century Atlanta.
Reprinted with permission from AUC archive.

The brief historical overview discussed above is central to understanding the conceptualization of Atlanta as a more than simply the geographical location of Spelman College. Atlanta's identity as a place is produced through outcomes of historical events and hierarchical interactions. These events and interactions not only mark the city as a particular place but also inform the behaviors, ideals and experiences of those who operate within the place. The cultural and social identities and practices of both institutions and individuals are embedded within this historical context and frame the site of this research. What it means to be an African American from/in Atlanta, a Spelman woman and scientist at Spelman is inextricably linked to the identity of Atlanta as a place, which is produced, engaged and reaffirmed through this rich heritage.

Atlanta University Center

Just three miles west of the Historic Sweet Auburn District, stand the largest consortia of private black colleges and universities in the world. In 1929, the Atlanta University Center and consortium was established to systemically improve services and

cost savings. The consortium began with six institutions, Morehouse College, Morris Brown, Spelman College, Clark College, Atlanta University, and the interdenominational Theological Center. After a series of changes in governing structure, campus mergers and administration transitions, the AUC now includes, Morehouse, Spelman, Clark-Atlanta University and Morehouse School of Medicine (see Figure 3). Although the formal affiliation did not begin until 1929, the idea to develop a collective approach to bettering the human condition began decade's prior.

In 1897, members of the Spelman campus community participated in the 2nd "Annual Conference for the Study of Negro Problems" hosted by Atlanta University. During this meeting, Spelman president, Horace M. Bumstead, urged for the development of a "systematic and thorough investigation of the conditions of living among the Negro population."[18] Bumstead's message was well received but the audience and the topic of a systemic approach to examining the experiences of African American spread throughout academia. News regarding the development of a collective approach across institutions and disciplines attracted the attention of many scholars including the prominent, W.E.B DuBois. Within that same year, DuBois visited Atlanta University and from that point on, directed the annual conference over 13 years.

At the center of metropolitan Atlanta and in close proximity to the nexus of African American cultural identity in Atlanta, the partnership of these elite institutions play a vital role in the advancement of African American peoples and perspectives. Since its beginnings, the AUC has been committed to the holistic development of African

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[18] AU Archival documents, accessed May 2014

American students who of socially and intellectually engaged with the local community. The AUC boasts an extensive list of notable alumna including social activists, writers, scholars and national leaders. Dr. Martin Luther King Jr., playwright, Spike Lee and President of the Children's Defense Fund, Marian Wright Eldemen.[19]

As of 2014, the AUC serves nearly 10,000 students across four individually prestigious institutions. As a central participant of the AUC, Spelman College has been able to remain connected to the local community while also extending the focus on advancing the perspectives of African American women in Atlanta. The partnership amongst the member institutions provides a rich learning environment and socially engaged intellectual community for students at the institutions and the local campus communities.

Figure 3. Map of Atlanta University Center

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[19] AUC Alumni record, accessed May 2014

Spelman College: History and Context

> "If you graduated from Spelman, you were expected to 'do' something –
> to achieve something, to 'be' something,"
>
>   - Dr. Barbara I. Whitaker[20]

Within the AUC, Spelman is nestled between Morehouse Medical School on the north end and Clark Atlanta University on the south. Founded in 1881, Spelman College is now regarded as a global leader of institutions serving women from African descent and preparing them for leadership roles and service in a global community. (Spelman mission statement) The liberal arts college, located in Atlanta's Old Fourth Ward neighborhood adjacent to Sweet Auburn, is just one of two Historically black women's colleges in the United States. Bennett College, Spelman's sister college, (not to be confused as one of the Seven Sisters[21]) was established in 1873 in Greensboro, North Carolina. Originally, Bennett was founded as a normal school for newly freed men and women but transformed into a college specifically for Black women in 1926. Both colleges overlapped in the agenda to train African American women but differ in foundation. Albion W. Tourgée, an American soldier and civil rights activist, founded Bennett College.[22] Racial equity and activism are the roots of the college's inception, which was represented in the curriculum and leadership. In 1888, Bennett elected its first

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[20] C'52, the first Black female assistant superintendent for Atlanta Public Schools.

[21] "Seven Sisters" refers to seven historically women's liberal arts colleges founded between 1837 and 1889 in the Northeast region of the US: Barnard, Smith, Mount Holyoke, Vassar, Bryn Mawr, Wellesley, and Radcliffe. "Sister" refers to the proximity and affiliation to the then, all male IVY league institutions in the area. Though founded within the same period 1881, Spelman was not included.

[22] 8 Albion W. Tourgée is also noted as the plaintiff litigator in the Plessy v. Ferguson case that found schools to be separate but not equal.

African American president, Reverend Charles Grandison. However, Willa Beatrice Player, the first African American woman was not elected until in 1965.

The roots of Spelman College begin in the basement of the Atlanta Friendship Baptist Church. Two of the instructors at the time, Sophia B. Packard and Harriet E. Giles, visited a Baptist church in Cleveland, Ohio. During this trip, Packard and Giles, met with two notable members of the church's congregation, John Rockefeller and his wife, Laura Spelman. Following this meeting, the two northern-born teachers returned to Atlanta with the funds to open a college for freedwomen in the area. Spelman College was founded on April 11, 1881. The legacies of Sophia B. Packard and Harriet E. Giles still persist today. Institutional documents, profiles and mission statements attribute the institutional values of service and social entrepreneurship to the two northern born white women. (Cole papers; Spelman History in Brief) The archived diaries of Packard and Giles detail the mission to train freewomen and girls to become teachers in their communities. (Read, F., 1961; Guy-Sheftall, B. & Stewart, J., 1989) The curriculum focused on developing reading and writing skills as well as moral character that aligned with Eurocentric expectations of femininity and womanhood. At the time, Liberal arts education ran counter to sensibilities about the type of education and jobs suitable for former slave women and girls. (Read, 1961) Education for African Americans, in general focused on developing applicable skills and an adequate literacy level. However, the curricular focus on domestic training, morality and dress code and behavior regulations directly aligned with the sensibilities of the time.

"Yes, I'm a Spelman Woman, but do I have to wear a white dress every damn day?" –Spelman Alumna

Alongside the foundational principles of increasing education access for African American women, social entrepreneurship and the funding from the Rockefellers came the expectations and standards for women prominent in the New England region. (Read, 1961, Scrivens, 2007, Guy-Sheftall & Stewart, 1989) For the freedwomen at Spelman College, these expectations were mandated and policed by the administration. (Read, 1961) From 1881 to 1956, the advisory board routinely elected members and friends of the Rockefeller family for the position of college president. Spelman College was noted for its strict leadership which demanded that students to adhere "Victorian-era" standards of femininity, behavior and aesthetics. (Read, 1961; Giles & Packard Diaries) Spelman administration, as an extension of the advisory board, believed students needed to develop proper work habits and feminine behaviors. While Giles and Packard touted the importance of educational and personal development for freedwomen, under the guides of Christian missionary agenda and Eurocentric gender ideals for women, these values were conceptualized as domestic training for African American women. African American women were perceived to needing to develop academic skills as well as developmental training in "being a woman". (Guy-Sheftall, 1971) Until the 1930s, students at Spelman were required to begin their day at 4:30am. At this time, they were required to wash and iron their clothing, clean living quarters prior to attending classes. The institutional curriculum primarily focused on teacher training, expanding to nursing and missionary training; all conceptualized as suitable occupations for African American

women. Students were also required to spend months teaching at secondary schools across the state.

Leadership

Throughout the years, the values of service learning, social entrepreneurship, and the centrality of African American women seamless integrated into the varying reiterations of Spelman's institutional identity. However, ridding the institution of the practices that restricted the holistic development of Africa American women, as self-defined, proved to be a difficult challenge. The formative decades of Spelman College chronicle a string of markedly restrictive and white northern college presidents. Under heavy criticism and pressure from social justice movements and uprising in Atlanta, Spelman College's advisory board, arguably begrudgingly, elected its first African American president, Albert E. Manley in 1953. Up until the election of President Manley, African Americans, in general, were not perceived as capable of being college president. After 107 years of the college's founding, surmounting criticism from the campus community and student protests, Spelman finally elected its first African American women president, anthropologist Johnetta B. Cole in 1987.

It took just short of a century to pass before an African American woman was perceived as capable enough of leading either Bennett or Spelman College. For both colleges' transforming into notable institutions for women of African descent required intentionality and persistence in challenging notions of the capacity of black women. The significance of leadership, as defined as decision making, on both campuses stem from historically specific notions of the roles of African American women in society and their

communities. (Read, 1971; Guy-Sheftall, 1989; Scrivens, 2007) Stereotypes and

sentiments concerning African American women during the time, constructed their roles

to be supportive rather than as authoritative, even in respect to their own educational and

personal development. Reflecting on her election as the first African American woman

president of Spelman, Dr. Cole (1996) makes a point to clarify that she must not be

mistaken for the first to be qualified to lead the college.

> "I pose that question to myself, why, in the 107 years of the history of this
> historically Black college for women, there had not been an African-American
> woman president. I asked myself that question and came up with the answer that
> there were actually many women, many African-American women, who could
> have done it. Our society had made the mistake of not giving them the chance.
> And so, what that does is to give you a sense of enormous responsibility. Because
> what you're really doing is carrying out this job, not just for yourself, but for all of
> those sisters who were denied the opportunity to do so when they were really
> quite prepared"

The barriers limiting the full participation of African American women as high ranking

faculty and administrators along with the perpetuation of Eurocentric standards through

the regulation of student behavior and aesthetic, demonstrates the pervasiveness of the

gender expectations, bias which permeated the larger society then. The implications of

racial and gender expectations and biases continue to skew the learning environments for

African American women outside of both colleges.

As of 2014, Spelman and Bennett colleges is the top producing institutions for

African American women who complete doctorate degrees in STEM fields producing

more than two-thirds of the total population. (NSF, 2014) While predominantly white

women's colleges are noted for producing high numbers of women in STEM, in general,

this is not the case when disaggregated by race. (Wolf-Wendel, 1998) Prior to Wolf-

Wendel's work, the assumption was that women's colleges were successful in training *all* women in STEM however this was found to be a myth. (Wolf-Wendel, 1998) HBCUs (including coeducational institutions) were the top undergraduate institutions for African American women and Hispanic-serving institutions (HSIs) for Latina women in STEM. Additionally, not one of the top 10 women's colleges in STEM was located in the South. These facts beg the question of the ways dimensions of place and racial stratification in science work shape educational environments at women's colleges? It is not a coincidence that women's colleges in the northeast have been extraordinarily successful in training primarily white women in STEM.

The dimensions of race and positionality (place) of science shape the social structures of science as it is embedded within the social landscape. The stereotypes and the notions questioning capacity that marginalize black men and women in science extend to institutions, particularly colleges for black women. (Betschel, 1989) Societal attitudes about race and educational philosophies (concerning the purpose of schooling and what should be taught/learned and to whom) have erected systematic barriers to funding, equipment and curriculum development for HBCUs. (Betschel, 1989; Scott, J.L., & Fox, M., 1995; Fox, 1999) Curriculum focused on developing reading and writing skills for the purposes of industrial jobs aligned with perceptions of suitable training and work for African American men and women. However, initiatives to develop substantive curriculum and infrastructure for STEM fields did not receive federal support comparable to other liberal arts colleges nor did it fit within the conceptual framework of where science happens and who can do science work.

Despite federal investment in STEM departments on college campuses across the nation, including liberal arts colleges, departments on HBCU campuses remained underfunded and poorly equipped. (Long & Fox, 1995; Pearson, 1989; Scrivens, 2007) The post WWII era marked a significant increase in federal funding for STEM higher education and fueled the development of an economic structure based on science and technology. With an emerging economic structure based on the promise of wealth, authority and prestige accumulation through scientific and technological industries, the politics of who may be considered members of the so-called normative structure of science increased in complexity. Attitudes about race and gender directly impacted institutions of color through development of educational policies that posed barriers for the sustainability and development of HBCUs, including Spelman College, and STEM departments on these institutions. (Betschel, 1989; Fox, 1999; Scrivens, 2007) In an interview with Time Magazine (2014) Spelman President, Dr. Beverly Tatum discusses the implications of the college being labeled as an HBCU.

> "Just as we as individuals tend to be stereotyped, lumped together as a group, in the same way the institutions that are serving African Americans are lumped together and are stereotyped as a group. We have to work very hard to penetrate that bias. You don't regularly read articles about predominately white institutions are in trouble. You know what I mean? You don't. So why is that when an HBCU closes its doors because of a loss of enrollment or loss of accreditation we read articles in which all of us get mentioned? That is, I think, just consistent with the stereotypes that have permeated our culture about people of color and the institutions of color"

Dr. Tatum challenges the tendency to discuss HBCUs as a monolith. Despite Spelman College's $357million endowment (compared to the 38million of the average HBCU) and the distinction as an NSF model institution of excellence, Spelman College is

often included in conversation concerning the accreditation, legitimacy and relevancy of HBCU's.[23] Being marked as an HBCU means more than the historical context of its founding and the specific demographic served. The same deficit frameworks often used to discuss the role and capabilities of African American women in science is reflected in the language utilized in discussing African American institutions. (Pearson, 1989) In her personal papers, then president, Dr. Cole, shares the importance of "connecting the story then to the story now" due to the unlikelihood of Spelman College winning the NSF Institutional grant.

> "Back then, it meant training in nursing and to become teachers. Now, it is to become scientists and technologists."

Framing Spelman college as a place capable of training women to effectively enter STEM careers and graduate programs required the development of an approach that reflected the historical and cultural institutional identity, challenged bias yet translated to the expectations of a women's HBCU. The approach, or Spelman STEM narrative includes values of science learning through increased engagement and framing science as a tool and reflects the principles of service learning and civic engagement prized by its founders.

This narrative informs science learning pedagogy, teaching, institutional approaches and the way science is practices within the bounding of Spelman as a place. In addition, it shapes the sorts of scientists produced within the space. This is an

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[23] During a 2014 interview with Time magazine, Dr. Tatum states that Spelman College has been included in conversations concerning the accreditation and funding for HBCUs, despite an endowment comparable to other prominent liberals arts colleges.

important aspect overlooked in the discourse of identity and diversifying STEM fields on college and university campuses. Just as science and technology practice are constructed by political, cultural and social factors of the social context of science, these forces shape the institutional context. Scientific knowledge production and practice is embedded within the social context and is predisposed to the hierarchical interactions, power struggles and interests that permeate this context. (Bourdieu, 1974; Bloor, D., 1976; Latour and Woolgar, 1979) In addition, this context produces scientific knowledge, subjectivities and localities that reflect the hierarchical structure privileged within this social context while reaffirming it. (Bloor, 1976; Harding, S., 2008, Keller, 1996; Collins, 1998) The discourse of science identity does not consider the ways institutional context is shaped by the larger social context and as an extension, the types of scientists produced and the allowed to develop from an institution's identity as a place. Critiques of institutional education frame K-12 schools and the general landscape of science as a microcosm of society. (Bourdieu, 1974; Gordon, 1986) Inline with this framing, the so-called larger scientific community as a U.S institution, is also a microcosm of reproducing the racial, gender and class stratification that form the social and historical fabric of the nation. (Stanfield, D., 1981; Cole, J. & Cole, S., 1973; Pearson, 1988) Racial and gender based stereotypes and discriminatory practices contribute to the marking of Spelman College as a distinct place at the periphery of the larger scientific community despite its comparability to other elite liberal arts colleges. (Cole, 1998; Guy-Sheftall & Stewart, 1989; Scrivens, 2007)

HBCU: Money Matters

After a few weeks into my fieldwork, I was offered housing on campus.[24] Living

in student housing on campus, offered an invaluable opportunity to be immersed in the

campus community. Campus housing was limited during the Spring 2013 semester

during which I arrive. I was fortunate enough to get housing in the Johnetta B. Cole

Living and learning center centrally located on campus. In addition to student housing,

the center had a hall designated for campus visitors and new faculty members. I resided

in the first suite of three in the hall.

It was late in the evening when I completely moved into my living quarters for the

duration of my fieldwork. That evening, I settled in, made a list of the supplies I would

need for the upcoming weeks and searched for local grocery stores and shopping centers

in the area. The following morning, I ventured to the local shopping center located just a

couple miles off campus. As I approached the gate between Spelman and the adjacent

college, Clark Atlanta University, I was stopped by the Spelman security guard.

"Hello, young lady. Where might you be heading?"

I responded that I was heading to the supermarket and asked to verify if he may verify

that I was heading in the right direction. He pointed me to a shorter route through the

walkway connecting Clark Atlanta and Spelman. I graciously thanked him, as this route

would shorten by trip by nearly half a mile. As I continue on my trek, I faintly hear the

gentleman's voice but continue walking. He calls out louder,

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[24] During the initial period of the fieldwork for this project, I resided with a family friend in the New
Fourth Ward neighborhood. Five miles from campus

"Miss…Miss!"

I turn around and remove my headphones…

"When you walk out that gate, make sure you take those ear buds out.
Be aware of your surroundings."

A bit concerned, I asked,

"Is it okay for me to walk to the store?
It's not too far; it's a safe area, right?

The security guard responds,

"It's okay; there are just young troublemakers.
They won't bother you if you are alert.
I will look out for your return. Be good and safe"

I thanked him again for his advice, and then proceeded…without my headphones.

As I cautiously approached the gates, I noticed that the Clark Atlanta campus did not look

like that of Spelman. Immediately as I stepped off the Spelman campus, I noticed a

change in campus climate and clear difference in the maintenance and landscaping. The

pathway between the campuses continued down the middle of Clark Atlanta and

transitioned to John Wesley Dobbs. The pathway leading into Spelman College was well

maintained however; there were cracks and weeds sprouting through the road through

Clark Atlanta (see Figure 4). The physical damage to the roads and sidewalks were

accompanied by over grown foliage and chipped paint on a few of the buildings. These

features were also apparent on other neighboring campuses of Morehouse College[25] and

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[25] Morehouse College, a Historically Black liberal college for men, is considered to be Spelman's "Brother" college. It is located directly adjacent to Spelman.

Morris Brown[26]. This is not an assessment of institutions' management, expenditures or

aesthetic values but rather, speaks to disparities in funding and resources amongst

HBCU's, the degradation of the local environment and the effort imparted in the

preservation and maintenance of the Spelman landscape (see Figure 5).

Figure 4. Main entryway to Spelman
College Campus

Figure 5. Path leading to Sister's
Chapel. The center of the Spelman
College Campus. Floral is
maintained year round, despite
seasonal changes.

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[26] Morris Brown is a private coeducational Historically Black liberal arts college located approximately two
miles south of Spelman. In 2012, the college, once a center of the civil rights movement, lost accreditation
and faced bankruptcy in 2014. At the time of this research, (2012-2014) many of the campus buildings
were closed.

These visible differences in the campuses' appearances highlight the funding and resource disparities amongst historically black colleges and universities and the challenges many of these institutions, the degradation of the city's downtown area and the intentionality and energy investing in the preservation of Spelman College within this environment.

Making a Place for Science

> "If Spelman was to take her rightful place among the best of the small liberal arts colleges in our country, then we would have to extend our reach all over this great nation of ours."
> -Dr. Johnetta B. Cole, Spelman President, 1989

At the beginning of her tenure in January 1989, Dr. Johnetta Betsch Cole committed to making Spelman one of the top liberal arts colleges in the nation. Dr. Cole envisioned a Spelman College that would be benchmarked "against colleges such as Wellesley, Oberlin, Williams and Amherst. In regards to student performance and faculty, Spelman College was on par with its liberal arts counterparts; however, the college lacked the financial resources and facilities. To accomplish this goal, the college administration, under the direction of Dr. Cole, decided to embark on an unprecedented fundraising campaign, known as "The Initiatives of the 90's" (Cole, 1989) The three-year, 81 million dollar campaign was separated into three components: an endowment initiative; a science initiative to raise support for a new science complex; and a constituency initiative to involve all of the college's constituents prior to the launch of this campaign, the most successful fundraising campaign raised 11.4 million nearly a decade prior. The initiatives for the 90's campaign were more than ambitious; it was

considered nearly impossible, even by supporters. (Shultz, 1997; Cole, 1993, 1996)

Skeptics of the feasibility of such a campaign were valid as there were a few glaring deficiencies including a professional fundraising program, efficient network system and annual giving program. In addition, Spelman alumna base was small in comparison to the more prominent liberal arts colleges at the time. However, these deficiencies were the catalyst in Spelman administration developing an innovative campaign that would transform the institution and welcome a new era in African American philanthropy.

By the end of the campaign, the Initiatives of the 90s's would surpass the 81 million dollar goal, amassing a record high 113.3 million. This is the largest amount raised by an HBCU as well as a liberal arts college with less than 8000 students. (Shultz, 2007) The campaign was distinguished by a multipronged approach based on the college unique constituency rather than the traditional approach based on identified prospective donors. An individualized campaign was developed based on the constituency groups: trustees, alumnae, corporations, individuals, federal government, students, faculty/staff, and parents. The college community succeeded in building partnerships with private companies based on the promise of developing dynamic and innovative students and the college rather than based on need. In 1997, Billie Sue Shultz, the Vice President of Institutional advancement shared the following insight in

"People give big money to quality, and small money to need."

The partnerships developed with companies such as Boeing and biotech company, Amgen along with high profile celebrity donations (20mill from Bill and Camille Cosby[27] and 1mill from Oprah Winfrey[28]) helped to increase the visibility of the campaign. However, the contributions and partnerships developed with Spelman students and alumnae were central to the success of the campaign and long-term development of the college. The connection between the institution and its alumnae were organically solidified as the campaign progressed. In addition, current students organized to develop a student campaign to contribute to the initiatives. Spelman science major and graduate of the class of 1996, Johnita Mizelle, ambitiously took the responsibility of developing and managing the student campaign, which sought to raise 75,000. When asked why students sought to actively participate in the campaign, Mizelle stated:

> "It was the feeling of empowering other sisters to give of themselves for future Spelman sisters that was most important to me."

The increased visibility and social prestige of Spelman College during the tenure of President Cole are result of the integration of the cultural value of sisterhood and service as an aspect of the institution's identity and the social and economic needs of companies and government agencies in the national community. Affirming a place for science at Spelman required the reconceptualization of who can do science by agencies such as NSF and private companies employing scientists.

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[27] Prominent African American comedian and social commentator, Bill Cosby and wife, education philanthropist, Dr. Camille Cosby, made a 20 million dollar gift to Spelman in 1987 for the building of the Camille Olivia Hanks Cosby Academic Center

[28] Television mogul, Oprah Winfrey made a 1 million dollar gift to Spelman during the "Initiatives for the 90s" She is also noted as Morehouse College's highest donor with 12million in scholarships and gifts.

Documents from the archived files of Johnetta B. Cole, demonstrate the level of energy

and effort exerted in framing Spelman as a conceivable place for scientific knowledge

production and scientist producer. In a memorandum addressed to President Cole, Dr.

Etta Falconer, Associate Provost for Science programs and Policy at Spelman, references

the denial of the proposed science building at Atlanta University by NSF. The 1993

memorandum was sent in regards to develop a strategy for submitting the proposal for the

newly developed NSF Model Institution of Excellence Program (NSF, MIE 1999).[29]

During this exchange, the two discussed their history with Dr. Luther Williams, as a

scientist and former president of AU. Now a Program Director at the NSF, Williams,

Cole and Falconer had remained in contact to gain funding for the college's science

initiatives. This would not be the first attempt by a college in the AUC, which is why

Cole and Falconer were meticulous in their approach with Williams as well as

Bridgewater, the MIE administrator. Despite both agreeing that Spelman's "chances of

winning were slim", Cole and Falconer continued in their efforts to frame the college as

"poised to make a substantial contribution" to the fields of science, engineering and

mathematics (not yet including technology (STEM) as defined by NSF. As the

visionaries of the college's science initiatives, Cole and Falconer were charged with not

only competing for the funding of the vision but also fighting for the conceptualization of

science by the larger community as feasible within Spelman's identity as a *place*.

In a handwritten document from former Johnetta Cole's archived personal papers,

the president wrote a rough outline of how to make the connection between Spelman

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[29] Archived Personal Papers of Dr. Johnetta B. Cole

College and the NSF MIE agenda. On two sheets of copy paper titled "The Spelman

Vision", she writes:

> "From Packard and Giles in 1881 until now. Focus must be on Ed and students-
> African America female* Mission hasn't changed. For their times- female* to
> become teachers, nurses, social workers. For our times- female* to become full
> participants in a highly scientific and technological world. Our science program
> must touch every student not just the majors. Something else hasn't changed:
> Spelman in 1881 had a distinction. The first institution of its kind. Today-
> continues to make a mark. In short- we plan to soon be with great company
> among Americas top small liberal arts colleges. Today cant do that without a
> first rate program in science, engineering and math." (Cole, 1989)

These documents demonstrate Dr. Cole's approach in connecting Spelman's history to

the core recent mission of training African American women for careers in SEM fields.

Dr. Cole addresses the presumptions about the types of careers better suitable for African

American women such teachers, nurses and social workers and frames these

presumptions as apart of history. Moving forward, the institutional mission has adapted to

the contemporary era and so should those who find it difficult to conceive a "top rate"

program at Spelman.

Dr. Falconer is also vested in affirming a place for science practice and learning

within the Spelman identity. In a 1989 publication, Dr. Falconer discusses the story of

Spelman success in the sciences as beginning at its founding. She chronicles the history

of Spelman women who became scientists and physician beginning with Georgia Dwelle

Rooks, the first graduate to attend medical school in 1904. Dr. Falconer, also the chair of

the mathematics department, frames the increased visibility of the institutions success in

producing SEM[30] graduates as a continuation of the institutions history in the fields. Therefore, African American women in SEM fields should not be framed as foreign to the Spelman learning environment nor is it a recent adaptation to the institutional identity. In fact, a key reason for the under participation of Spelman students in the sciences prior to the development of the science initiatives is the science building being described as "dark and uninviting". (Falconer, E.Z., 1989) hence, investment in the science infrastructure should be funded to reinvigorate student participation in SEM fields.

The uncertainties of whether the college could raise the necessary funding and distinctions as a science producer were quieted as the college would not only surpassed its fundraising goals but also earn the 5 year NSF distinction as a Model Institution of Excellence. The vision of Spelman College taking its seat a top liberal arts college was becoming a reality.

Albro-Falconer-Manley Science Center

Spelman College, as a whole, is a pristinely well-kept campus. Cherry blossom trees border the red brick pathways. There are benches along the paths to stop and enjoy the environment. Despite a few buildings closed for renovation or under construction, the campus climate is serene and welcoming. Amongst the cherry blossom trees stands the impressive Science center complex. Completed in 2001, the 154k square foot complex was named the Albro-Falconer-Manley Science Center, in honor of African American women who had influential careers at Spelman, Dr. Helen T. Albro and Dr. Etta Z.

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[30] Here, **"SME"** refers to Science, Mathematics and Engineering, prior to the addition of Technology

Falconer, and the college's 8th president, Dr. Audrey Forbes Manley. The 34 million dollar complex is centrally located towards the rear end of the campus and boasts an array of equipment and facilities for an interactive STEM environment and is one of the top science facilities in the nation (see Figure 6). The facility supports faculty research and student training and houses the Office of Research Resources, the Office of Sponsored Programs, Internal Evaluation Services, the Institutional Review Board, and the Office of Institutional Research Assessment and Planning.

Figure 6. View of the Science Center from across the central lawn area**.**

Commonly referred to as the Science Center, the building is a focal point of the campus due to its size and location. The road leading from the main entrance of the campus ends in a turnabout in front of the building. The building is easily accessible for special guests of the center and campus officials as they were allowed to drive to the designated parking/drop-off area. Just as the conceptualization and approach to fundraising and the development of partnerships was meticulously organized, so was the

design and construction of the complex. The archival files of the Office of the President[31] include letters to building developers and a selection of innovative science programs and facilities at other institutions.

Building developers met with Spelman faculty members to outline the anticipated number of faculty, staff, professionals, students, teaching assistants and other staff as well as to develop innovative ways to equip the facility to support innovative programming. Innovative science projects developed on other campus were referenced and analysis to determine the ideal features of the science center for long-term success of the institution. These programs include: "Mathematics and science for non-majors at Allegheny College in Pennsylvania, "Project CALC-Calculus as Laboratory" at Duke university in North Carolina and "Calculus Reform Using Technology" at Knox College located in Illinois. Member of the development team visited key sites of interest which included: Kalamazoo college the Dow science center at Kalamazoo for biology and chemistry, the Student/Faculty research building at Lake forest College and the Instructional Technology center at the University of Delaware to review the movable multimedia stations in the center.

Upon entering the building, the Spelman College Wall of Honor, immediately caught my attention (see Figure 7). On the wall are plaques of varying sizes, with the names of entities and individuals who have contributed to the building of the complex including Amgen Inc., The Robert Woodruff Foundation and AT&T Foundation. The

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[31] Personal papers of Dr. Johnetta B. Cole, Spelman Archives

wide array of names and notable companies at the entryway of the building increased the

visual impact of the complex.

Figure 7. Wall of Honor

The entryway of the science center leads to the atrium. The space operates as both a

lobby and central gathering area of the complex. The history of women in mathematics

and notable scientist from Spelman are shown in display cases along the center wall.

Photographs, timelines and artifacts are depicted in museum like display cases (see

Figure 8). This imagery documents an extensive history of Spelman women in science

and mathematics along with the contributions of all women (see Figures 9, 10, & 11).

Figure 8. Photos and artifacts

Figure 9. Depiction of Dr. Etta Falconer
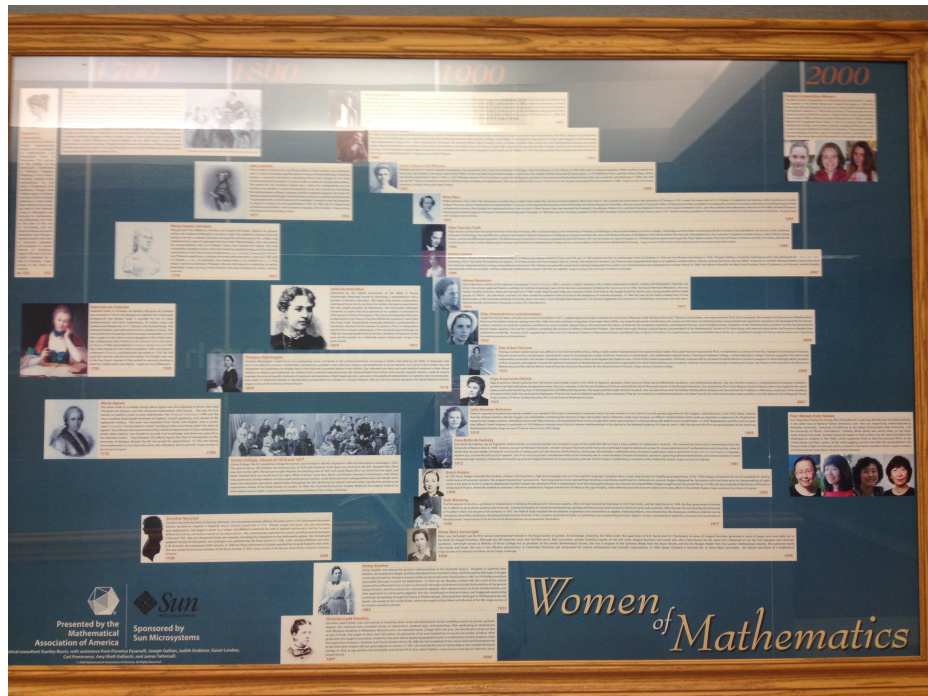
Figure 10. Timeline of Women in Mathematics
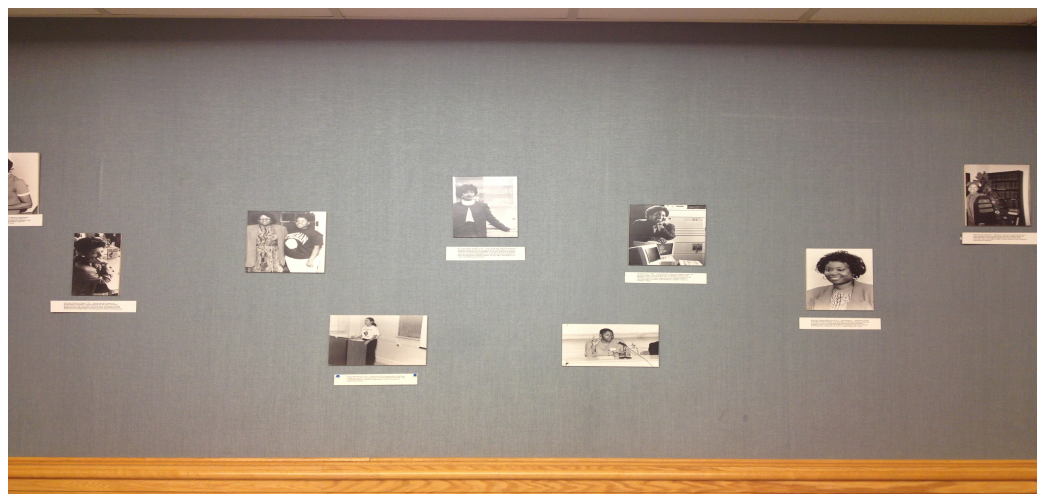
Figure 11. Photos and descriptions of Spelman women in Science and Mathematics

After taking a closer look at the photos, I recognized a few names from my preliminary

observations—Dr. Andrea Lawrence, Chair of the Computer Science department, (see

Figure 12). Dr. Falconer and Professor Iretta Kearse (see Figure 13). The legacy depicted

on the walls of the atrium is inclusive of members of the Spelman faculty and extends to
students at the college.
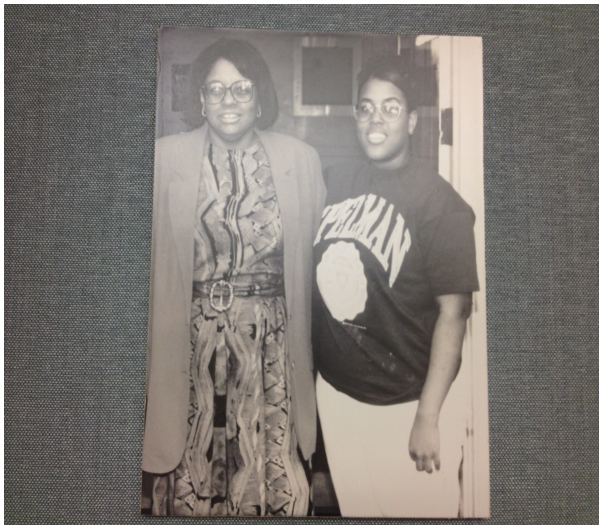
Figure 12. Photo in display of current (2014)
Dr. Andrea Lawrence, Chair of the
Department of Computer science and
Engineering with a Spelman student
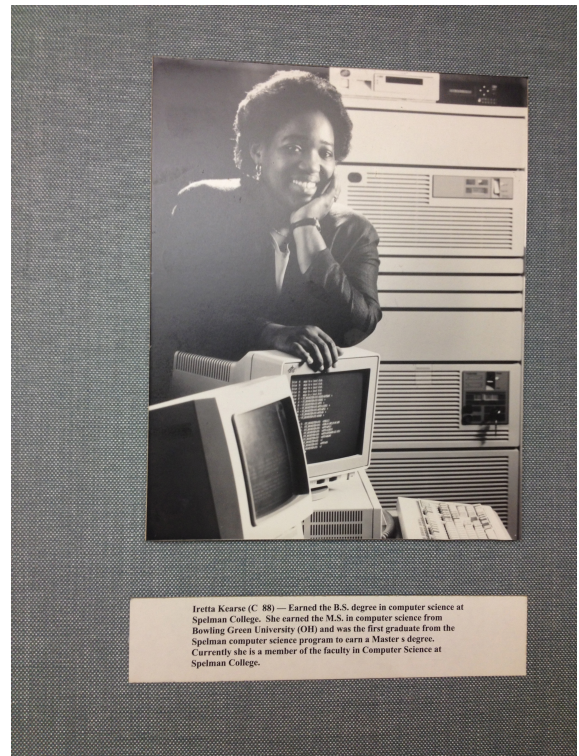
Figure 13. Photo and description in
display of current (2014) faculty
member Prof. Iretta Kearse.

Generally, the features of the science center were in line with those expected at a
competitive college science-learning environment. However, the science center at
Spelman differed in the artist displays that lined the halls and stairwells of the facility
(see Figure 14, 15 & 16). These artistic displays were produced by students in the photo
arts lab located in the basement of the center.

Figure 14. Photo A of student artwork

Figure 15. Photo B of student
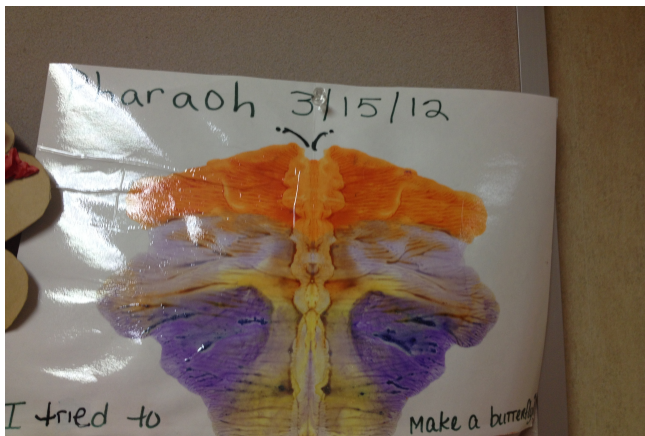
Figure 16. Photo of student artwork

The arts lab was relocated to the science center due to the space required for the department's air compression equipment. While the combination of the arts and STEM departments was not intentional, it allowed the opportunity for the organic development of an arts and STEM interactive learning experience.

The Science Center not only a place for science learning and research but also a place that bridges disciplines and students across the campus. This interactive is an unintentional consequence that supports the goals of developing a "science program that touched all students" (Cole, 1989) and a science building that is warm and inviting, rather than "dark and uninviting". (Falconer, 1989) The Science Center, as a physical place, represents the history, institutional ideology and educational pedagogy valued by the Spelman campus community.

As an institution for African American women the challenge of developing and maintaining a place for the advancement of these women, not only punctuates the severity of such exclusionary and stereotypical ideals but also the tenacity of the students and faculty member who demanded change during the institutions transformative periods. The contemporary Spelman institutional identity, "the Spelman Way"[32], is multiply informed by the historical and hierarchical interactions that produced the need to establish the institution form a particular foundational structure as well as the restrictive practices enacted by leadership during the college's early years.

This framing of place as emergent through interactions, positions science education at Spelman in conversation with local context and larger sociocultural landscape. It is also continually engaging with the historical events, hierarchies, expectations and biases that shaped the development of Spelman and Atlanta as a place. The insights gleaned in the following chapter demonstrate the ways that what it means to

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[32] "The Spelman Way" is a phrase used by Spelman faculty members and administrators in reference to the institutional approach of holistic development. Dr. Lawrence first mentioned the phrase during our initial meeting.

be a scientist at Spelman is also emergent and fluid. The narrative experiences of members of the Spelman campus community along with the institutional narrative of Spelman College are presented in conversation with science identity discourses and models. In Chapter 3, I explore the ways the Spelman narrative challenge notions African American women as scientists and the use of identity models as well as moments of convergence and transformation.

CHAPTER 3

DESTABILIZING THE IDENTITY MODEL AND THE SCIENTIFIC ENTERPRISE

This chapter positions U.S science education and the discourse of scientific knowledge production within an economic and politicized landscape. It is important to understand how the underlying paradigms of the national discourse concerning access and persistence of students from underrepresented backgrounds is embedded within a network of sometimes conflicting ideals concerning the agenda of U.S education at the federal policy level. The ideals of education as a means to achieving social justice and education for the "common good" are central to the rhetoric at both the national and specifically at the local level. However, positioning U.S science education squarely within the nexus of political, economic and sociocultural forces allows for a more nuanced exploration. The discourse of science education and inclusive learning environments, has been depoliticized and often ahistorized. Developed in an attempt to better understand the reasons certain individuals enter and remain in science, technology, engineering and mathematics (STEM) fields while others leave, the model, presumably inadvertently, erases the histories and cultural practices of the dominant group while positioning differing experiences as superficial. Further, the discussion of U.S science education within this schema allows for the framing of this discourse as a "policed cognitive system" reconstituting boundaries to access and persistence for those deemed to be outsiders. A central objective of this project is to challenging the deficit model continually enacted in the discussion of African and African American women scientists.

I begin with a discussion of the political, economic and social forces informing the contemporary scientific enterprise. The term scientific enterprise is used, rather than just science and technology, to highlight that the research is funded not only for the science itself, but also for some application that shows promise for the enterprise. This enterprise may be a private or publicly funded entity and/or serve state agenda in some facet. (Mazuzan, 1986) This is not an attempt to undermine the research interests, intellectual fervor and/or work of individuals in science and technology fields but to better outline the context of the agenda to diversify STEM programs and further, increase the STEM workforce. Additionally, I argue that the scientific enterprise is both a primary driving force in the movement towards diversifying STEM fields from a political and economic agenda as well as a mechanism for recruitment and access point for individuals historically excluded from the academic sciences. I examine the entanglement between U.S corporate capitalism, democracy and modern science on the one hand, and the implications, appropriation and deconstruction of the outcomes of this merge within the Spelman College campus community and by the women who navigate and negotiate this terrain.

I continue by directly engaging and deconstructing the recent science identity model[33] and the use of student identity as an analytical lens for exploring the experiences of students of color. The model consists of three primary components, which are identified as competence, recognition, and performance and is expanded to include different avenues for recognition.

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[33] Science Identity Model developed by Carlone & Johnson (2008)

It is important to note that recognition is identified as the most significant component of the model. I continue to address the model by destabilizing the "STEM ID Construct" which details the importance of four distinct personal goals; the first, the desire to become an authority within the respective field of study, colleague recognition, the desire to contribute to scientific knowledge, and lastly, to conduct research in hopes of addressing health issues plaguing society. (Eagan, K. & Skarkness, J., 2010) Deconstructing these more recent paradigms will highlight the pervasiveness of the diffusion and deficit models informing the question who gets to do science and whom is science for? The ethnographic findings from my fieldwork at Spelman College offer an alternative lens in understanding the reasons people choose to enter and persist within STEM fields while also highlighting how exclusionary ideals still remain prevalent in determining what it means to be a scientist, which is actively reinforced through the use of such models.

I conclude this chapter with a discussion of STEM climate science work, the social labor of the scientific enterprise and the experiences and positionality of African American women both within their communities and communities of science. Labor is always social, including the work of individuals within the scientific enterprise. Individual workers or producers' collectives can only set goals that reflect their position in society and can only engage in production by using accumulated social resources. (Marx, K., 1867) Further, the capacity to accumulate social resources is dependent on both the positionality and subjectivities individuals operate within. Positionality and subjectivity may be considered social resources along with individual and collective

networks and access to social labor. Social labor can be considered the human activity directed towards the needs of individuals and society; it is essential in linking human activity to social form. (Brown, J.K., O'Laughlin, B., Remy, D., 1974; Khalil, 1990; Massey, D.B., 1995; Postone, Galambos, Sewell, 1995; Rueda, D., 2007) I consider social labor in two spheres: in this chapter, the social organization of science work[34] and in the following chapter, social labor within the household and community economies.[35] Firstly, the work of the scientific enterprise can be discussed as socially organized labor amongst scientists, assistants and supporting staff; research teams are the expectation and this is made evident in the value place on of team building, especially in the fields of computer science and engineering. (Latour, B., and Woolgar, 1979; Barnes, 1974; Bloor, D., 1976, Knorr-Cetina, 1981, 1983) Persistence and advancement within these fields are equally dependent on the ability to establish and maintain this social resource just as it is to be a sound scientist. From my ethnographic research, I will highlight the experiences and implications for African American women within the social organization of computer science and engineering programs and industry. Secondly, the social labor demands and expectations placed on the lives of African American women within their households and communities. (Rosaldo, 1980; Betschel, 1989) This social labor is defined as the work that goes into supporting household demands, the needs of male spouses and the social expectations of the communities.

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[34] See Bloor, D. (1976) Knowledge and Social Imagery. London: Routledge & Kegan. Latour and Woolgar (1986). Laboratory Life: The Social Construction of Scientific Facts. Princeton, N.J.: Princeton University Press

[35] See Rosaldo, M., Lamphere, L., & Bamberger, J., (1974). Women, Culture and Society

I explore how these two spheres of social labor interact and the social labor demands of the scientific enterprise. The experience of African American women and subjectivities within these realms of social labor provide particular insight not only into the economies of scientific knowledge production but most importantly the complexity of competing forces that result in additional barriers to access and viability in STEM fields.

The Scientific Enterprise

There is a fundamental correlation among capitalism, democracy and modern science in that the three interdependently developed as systems of social and economic organization in the United States. U.S capitalism, science and democracy cannot be disentangled as each has worked to reinforce the core principles of rationality, empiricism and systemization within the nation state. (Needham, J., 1993) Due to this history, U.S science must be understood as inevitably political and continually engaged within the global and local economic environment. Therefore, science education should be understood as a politically and economically engaged process. The education of U.S students in the sciences (with an overemphasis on STEM fields) has been at the forefront of the national agenda for nearly 60 years. (Zimmerman, B., 1996) U.S scientists have attempted to maintain a distinction between the process of scientific inquiries and the political and/or economic sphere; however contemporary U.S. corporate capitalism[36] has heightened this relationship. (Zimmerman, B., 1998)

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[36] Distinguished from merchant capitalism in that corporations (businesses) engage in capitalism as a collective but are considered as an individual. Yet, there is no singular individual held accountable for the activities of the corporation.

The current discourse of science education and student diversity, in general, is driven by claims that in order to maintain and strengthen Nation's international competitiveness, the state must produce more scientific knowledge. It is important to understand that this framing of science education largely operates at the national and international level while there are local ideas of the purpose and participation of students in science. Over the past decade, the importance of scientific and technological resources for corporate capitalism has become more evident. The profitability of domestic industry and the capacity to compete within the international market are imperative in not only strengthening The United State's global positioning but also securing the domination of U.S. capital. (Zimmerman et al, 1993) Contemporary dependency on U.S technological innovation places science work squarely within a political economic system. Further, science and technology education becomes the key to increasing the productivity of science work and scientists.

Central to increasing labor productivity is the technological transformation of all major U.S industries into accelerated and rationalized systems. The production process of these industries, which include healthcare, food production and construction, must be reorganized into more efficient processes. However, productivity, acceleration and efficiency are not values for the common good of all people participating in these industries. Within a capitalist society, automation and acceleration is a means to increased profitability for industrial owners and stakeholders—the capitalist class. For the capitalist class, this transformation requires programmed advances in science and technology and cannot be left to the so-called natural progress of scientific knowledge

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production, which would be more influenced by individual interest and less by explicit agenda. (Zimmerman et al, 1993)

For capital investment to be considered rational it must be profitable and profitability is, of course, measurable. First, measurement calls for the spread of the values of efficiency and productivity to all entities (individual, collectives and institutions) engaging the process. However, just as any set of cultural values, it is important to understand how the concepts of efficiency and productivity become normalized. While the intimate connection between industrial profitability, higher education and federal policy has been normalized within the so-called national science education sociocultural landscape, the extension of market principles and technologies such as accountability and auditing to student learning demands a particular social condition. (Shore, C., and Wright, S., 2003) Anthropologists studying the rise of concepts of accountability and auditing outside of the financial sector refer to this condition as audit culture. (Power, M., 1994, 1997; Strathern, M., 1997) Audit culture is the value of accountancy and techniques of measurement and accountability in governance and management of human activity. (Shore, C., 2008) The discourse surrounding STEM education in college and university campuses as well as in K-12 schools operate under these precise conditions. An audit culture produces quantifiable subjectivities, students of color or low-income students for example. Individuals are reduced to quantifiable and measurable agents, which in turn, structures the sorts of conversations surrounding their experiences and also transform the ways people perceive themselves. (Power, M., 1997) Personal qualities are subjected to measurement against external benchmarks (learning

outcomes), performance indicators (standardized exams) and rating systems (grades and institutional ranking). While accountability is privileged for its ability to evaluate and police institutions, it operates under a false disguise of objectivity. The variables ascribed to human behavior, experiences and relationships are subjective and primarily immeasurable. This is precisely what makes its use outside of finance (arguably within as well) problematic. Audit culture is bureaucratic 'indifference' as well a technique employed by institutions facilitating industrial profitability and wealth accumulation all while evading social accountability itself. (Foucault, M., 1977; Herzfeld, 1992; Strathern, 1997)

Since the Second World War, scientific research and strategies of the capitalist class have been immersed within the sociopolitical environment. (Zimmerman et al, 1993) Indirectly through government regulations and directly through big corporation and tax-exempt foundations, in many ways the capitalist class has funded much of contemporary science and technology research. Most recently, the relationship between corporate capitalism, federal government and scientific research was reaffirmed by the "Educate to Innovate" campaign of 2009 which led to federal funding through the National Science Foundation. The current reiteration of the need to increase the production of U.S scientists and science workers (the previous following the successful launch of the first artificial satellite, Sputnik by the then Soviet Union) coincides with the social and democratizing need to better serve the educational needs of the nation's growing racial and ethnically diverse student population. (Mazuzan, G.T., 1996) Within science education studies, the increased racial and ethnic diversity of students within

American higher education institutions is directly correlated to decrease in domestic students completing programs in physical and life sciences. (Chang, Eagan, Lin, & Hurtado, 2011) Therefore, in order to produce more scientists, the changing racial, ethnic and linguistic demographics of colleges and universities and the lack of presence of students of color in those science fields must also be addressed.

In addition to global competitiveness and investing in the future workforce, addressing issues of the lack of diversity in science and technology and on university campuses should be a viewed as righteous endeavor. If as a nation, we seek to live up to the ideal of a truer democratic society, we must continue to strive for more equitable accessibility to all aspects of society. This is especially important in that the contemporary American form of democracy as it is increasingly becoming dictated by the hegemonic ideals science and technology. Arguably, if it were not for the explicit and implicit exclusionary practices, underrepresentation would not be at issue. And for both African American men and women, equitable representation within science and technology is imperative as these communities are at risk of further subjugation to the vacillation of scientific and technological forces.

Spelman College and its campus community are uniquely positioned as a translator in this process. Much of the local and federal investment within the campus community is geared towards better preparing and exposing students to a range of careers in science and technology. I argue not exclusively because it is the "right" thing to do as a social justice imperative of our democracy, but because preparing African Americans, especially African American women directly aligns with the agenda to increase a science

workforce and indirectly with supporting entanglement between the scientific research strategies of the capitalist class. After all, it is not as if the women of Spelman College and its administration recently decided to "join" and develop communities of science. The contemporary interest in diversity is itself a recent innovation of the continued welding of corporate capitalism, science and selective democracy.

The Science Identity Model

The use of identity theory in understanding student learning in the sciences begins as a tangential endeavor once scholars in science education studies begin to conceive science as a community of practice. (Lave, J., & Wenger, E., 1991) In its beginnings, scientific identity (see Figure 17) was conceptualized as a prototypical individual who is competent and capable demonstrating knowledge and understanding of science; intrinsically motivated to understand the world separate from human experience. (Carlone & Johnson, 2007) Competence remains as a key component of the science identity model today. In addition to possessing scientific knowledge, the model scientist is an expert in scientific inquiry and practice, and is fluent in the language of science (performance). This individual is also capable of performing the role of a scientist in both informal and formal science environments. The most significant component to the model is that the scientist identifies as a scientist and this identity is recognized by others both within and outside of communities of science (recognition). (Carlone & Johnson, 2007) Variation in science identity types lies within variation in levels of competence, performance, and recognition. For example, students may overcompensate for a deficit in

recognition as a scientist with exceptional knowledge of the content and methodology of the respective field.
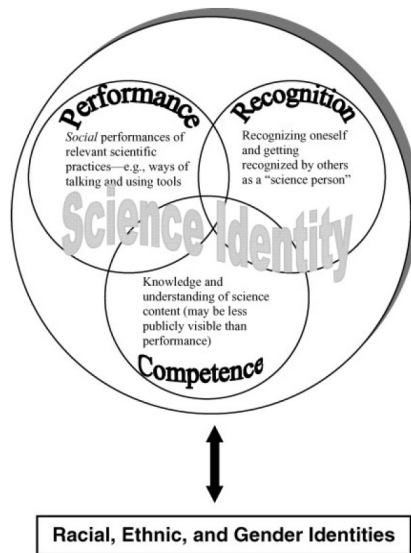
Figure 17. Science Identity Model

Carlone (2003) asserts that students must develop a science identity in order to be successful in science fields due to short term knowledge and practice do not necessarily develop into long term success and persistence in the fields of study. (Carlone, H.B., 2003) Further, Carlone and Johnson (2007) argue that this model of science identity is exclusive; therefore, in order to broaden the types of students who participate in the sciences, scholars must explore they ways "girls, women, and students of color embrace and resist the promoted identities of science." (Carlone & Johnson, 2007, p. 1190)

During our initial meeting, I provided Dr. Lawrence, the chair of the department of computer science and engineering at Spelman College, a brief overview of my project. She promptly responded with the following,

"The model scientist is a white male. White male is the standard. That's the problem".

To which I agreed. This component of the science identity model is glaringly problematic. Throughout the ethnographic research conducted within the Spelman campus community, the use of identity theories in science education was irrational. Interviewees often responded with an expression of confusion, similar to that of my own when I initially encountered this literature. Under what condition is the use of an identity theory in science learning perceived to be logical? Well, the condition of an audit culture. Under the guise of accountability and auditability, the perspectives and values of white Anglo-Saxon men are naturalized as universal and objective markers of being scientists. This facilitated the extension of neoliberal principles to a contemporary discussion of fostering an inclusive environment in science without actually considering neither the construction of these markers or the framework of the science identity model. In the Spelman campus community, a place conceptually positioned at the peripheral and as an "auditee" of the so-called normative science community, the model is inherently exclusive, and arguably useless if the true agenda is to diversify STEM.[37]

In her analysis of women in science between 1940 and 1972, Rossiter (1996) describes the Post-WWII era as the remasculinization of science. (Rossiter, M., 1996)

The social, cultural and economic capital ascribed to science and technology during the rise of the corporate capitalism and federally orchestrated STEM industry development, resulted in the readjustment of STEM fields to the racialized, gendered and classed social order of the nation. (Rossiter, 1995) 1946 marked the beginning of

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[37] Interview with Dr. Carmen Sidbury

government restrictions and quotas on the enrollment of women in science and technology departments on Higher Education campuses. (Rossiter, 1996) Historians of science and higher education added to movement towards readjustment by excluding and understating the contributions of women and African American scientists as a collective from the history of science in the U.S. (Pearson, 1985; Herzenberg & Howes, R., 1993) The intentional production of an ahistorical white male centered science is most evident in the exclusion of at least 85 women scientist who contributed to the development of the atom bomb as members of the Manhattan Project. (Ambrose, S., 1993; Herzenber & Howes, 1993; Scrivens, 2007) The contemporary discourse of diversifying STEM fields is framed as addressing the underrepresentation of women and so-called people of color rather than addressing the overrepresentation, privileging and preservation of the white-male-centrality of so called normative science practice in the U.S.

The roots of white male centrality and dominance in science and technology can be placed during late 18th century through the development of the domestic/public dichotomy of the market revolution era, (Rosaldo, M., 1974; Rosaldo, M. and Lampere, L., 1974; Collier and Yangasikato, 1987; Lugo, 1992; Radcliff, 1997) or even with the emergence of western modernity and philosophy dating back to the 16th century. (Ortner, S., 1974; Takaki, R., 1993; Longino, H., 1990; Keller, 1996, Harding, S., 2006, 2008) While explanatory work on the origins of gender inequality in science learning and practice offer insight into the underlying principles of marginalization, understanding gender relations through the interaction of political and social forces and as a product of

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concrete social practices, proves to be more useful in understanding the production of subjectivities and the preservation of exclusionary practices.

Constructed of Auditable Scientist Types

In an attempt to develop scientist identities for "women of color", Carlone and Johnson (2007) present models that are believed to demonstrate varying types of successful women scientists. From the study, the authors identify three models: the research scientist, the altruistic scientist, and the disrupted scientist. (Carlone & Johnson, 2007) The research scientist aligns most with the prototypical scientist who is recognized by both themselves and others as a "science person". The altruistic scientist also is identified by herself and others as a "science person," however they have been able to reconstitute what science means and what it means to be a scientist based on their own values. Additionally, the altruistic scientist believes that their work should also service humanity and redefined whose recognition mattered in solidifying their identity as a scientist. Lastly, for the disrupted scientist, although they perceived themselves to be "science people," when referencing their experiences within communities of science they discuss feelings of neglect, discrimination, and being ignored as both students and degreed scientists. The disrupted scientist does not perceive themselves as an integrated member of the science community and references being a tokenized representative of a marginalized group. (Carlone & Johnson, 2007) For the disrupted scientist, the racialized and/or gendered body limited their level of integration into communities of science. The aforementioned models of science identity are represented in the discourse of diverse science identities (see Figure 18).

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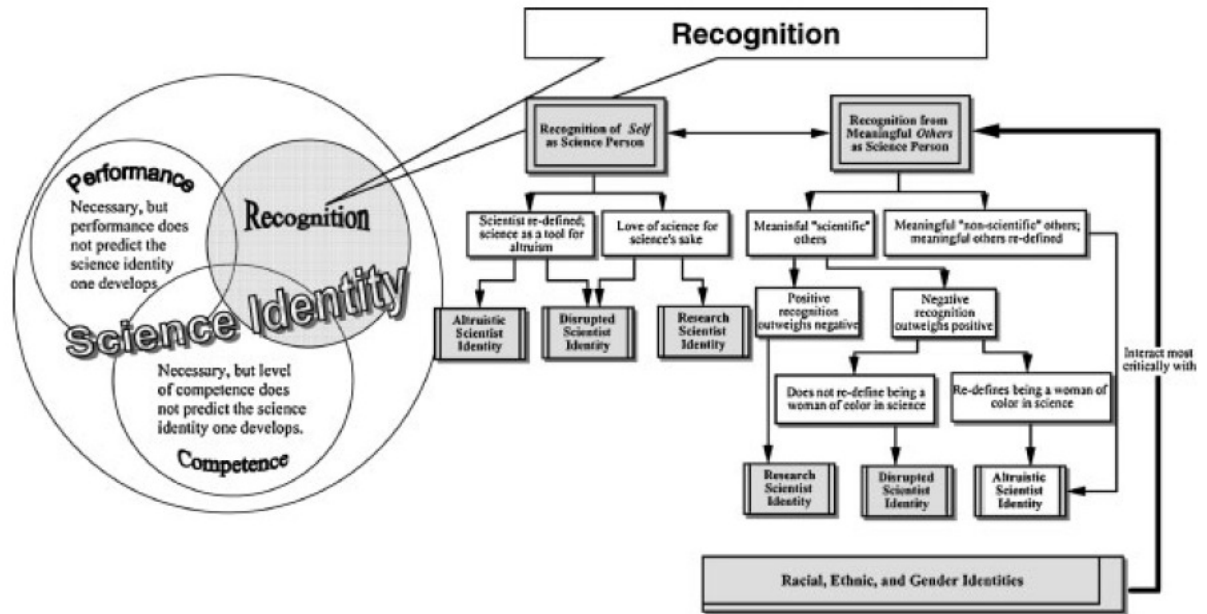
Figure 18. Science Identity model adapted

The extrapolation of data from the narrative experiences of "successful women of color" for the production of scientist typologies is an excellent example of the use of audit techniques within the realm of STEM education. First, success is subjective and culturally constructed. Yet, in the studies leading to the development of the so-called science identity model, it is simplistically defined as existence within communities of science and is defined by the researchers rather than the women themselves. (Carlone, 2003; Carlone & Johnson, 2007) Audit culture conveniently produces auditable subjectivities. (Power, 1997) This demands that the concept of success be extrinsically defined to avoid the messiness of self-identification. Second, knowledge resides in the narrative and not by "extracting" data from narrative experience. (Collins, 2000) The finding of this research demonstrate the multiple ways members of the Spelman campus community negotiate what it means to be a scientist due to the complexities of the

interactions across axes of race, gender, class, geographical and social place and the

science, itself. These complexities detailed in the proceeding chapters (racialized gender

expectations and biases), make it virtually impossible to construct distinct scientist

typologies. How construction of an analytical model linking theories of identity

development and scientific practice is a product of audit culture.

Science Identity Remodeled: Spelman Women Speak Back

> "It didn't mean you were any less of who you were…we would slip in and out of blackness. Not because we knew or felt we were being phony. 'This is what you do, this is who I am.' If you feel they are the same, you have a problem"
>
> - Dr. Andrea Lawrence Chair of the Department of Computer Science and Engineering

The previously discussed research presents a seemingly exhaustive breadth and

diversity of means to self-identification and extrinsic identification as a "science person",

yet the categories made existent are relatively predicable. These categories and

distinctions are partially misleading in that they attempt to align aspects of an

unchallenged model of science identity with socially constructed qualities and gendered

needs, desires and expectations of women. The components of the model and the

identified scientist types hint at trends in science education studies concerning barriers to

inclusion and pathways to making STEM education more accessible to women such as a

science more engaged with the local community and with explicit application. This is

indeed a qualified truth, however, in order to more accurately understand the experiences

and positionality of African American women in science, more specifically, it is vital to

frame these categories and scientist types as largely influenced by sociocultural pressures

and expectations of both science and social networks and communities. While some scientist-in-training associate the identity of a science person as one who is an "expert", "knowledgeable" and "focused", others reference "self-awareness", "creativity" and "confidence" as the markers of a sound/good scientist. The expected production of alternate scientist types by the model and the discourse of science identity include both points of affirmation and disjunction but ultimately allow for the endurance of allowable gendered/raced identity domains within the science learning process. Identity formation within colleges and universities is navigated through an environment of competing discourses and practices including popular culture, ethnic tributary, and cultural concurrent. (Hemmings, A., 2006) This environment is far too complex to be framed as an extension of individual values and personalities. Considering that the normative student/scientist identity is reflection of the subjective qualities and values of the white-male-academic class, the seascape for African American women becomes increasing complex as the institution is not only the place where discourses and practices compete but also operates in reaffirming the transmission of hegemonic ideologies. (Singleton, J., 1974; Yon, 2000) Thus, within the science identity models and discourse, the science learning process for women, especially women of color includes learning how to appropriate parts if not all aspects of science identity, see differences amongst themselves and/or align with scientist types framed as being more accessible for women and in some ways align with raced and gendered identity domains. This process is dependent on continual reinvestment in maintaining a structurally identifiable etic environment counter to diverse situated experiences, values and qualities.

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The above is not intended to be a critique but a more nuanced examination of the science learning process and experiences of women of color, as identified by Carlone and Johnson, through the lens of identity formation theory. I began this section with the quote from Dr. Lawrence to highlight a key limit to the science identity model and what Dr. Lawrence noted as the "reality of being a black woman in America." Being able to identify/self-identify as a scientist may be a component leading to the persistence of a segment of students in STEM fields, however, for subjectivities in-between, intersectionalities and at points of hybridity sometimes disconnect, the expectation to code switch and shift between identity domains is a central component of life at the margin.

> "We didn't expect to be two people but we knew at times we needed to be different people for different reasons"

The point is that access, persistence and success (as defined in the model) of so called women of color in sciences, especially African American women, are not mere consequences of the alignment of individual values and personalities with components of science identity model. On the contrary, identity is neither static nor fixed but is fluid and malleable depending on the context and purpose. The use of identity formation theory in the discourse concerning diversifying STEM fields, positions women and people of color at the margins of the landscape and the spaces for inclusion are additionally marked as other. Given the institution's role in socializing and educating students to engage in larger social and economic structures, the alternate science identity types (particularly disrupted and altruistic) that arise can be viewed as logical and reasonable articulations between institutional expectations and sociocultural pressure. Now, we may move the discussion

from "how women manage to be successful within STEM field in spite of the obstacles" to documenting what is successfully translated through and by institutions and what is learned in institutional education that either requires alternate identity domains in some places versus more inclusive learning experiences in others such as at Spelman College.

In many ways the development of the science identity model is an artifact of cultural notions defining science, the work done by science people and who can do science. I extend this model to my field site, Spelman College, to explore whether the explicit categories and implicit assumptions of the model still remain. In addition to in-depth participant observation, I conducted large group discussions, surveys and interviews with both students and faculty. I will begin with an analysis of the large group and survey data.

It was suggested by the department chair, Dr. Andrea Lawrence, that I speak to the students in a large group setting to better examine their ideas of science learning and the department in an environment with less pressure. The opportunity offered great insight on which areas there was a larger consensus as well as the dynamics between the students. Prior to the large group discussion, I asked participants to complete a short assignment, which was distributed by a faculty member on my behalf. The primary portion requested the following:

> List the six to eight terms, ideas and/or concepts that come when **YOU** think of what it means to become a "good" scientist, the work of scientists and the significance of scientific knowledge and research.

Free listing was used to determine the relevant categories and language members of the campus community use in the ascription of what it means to be a scientist and/or technologist to themselves and others. (Weller and Romney, 1988) The goal is to identify salient terms and ideas within the campus community. This technique does not require random sampling, but requires a full range of cultural knowledge about the domain. (Handwerker and Wozniak, 1997) The analysis of the free list data focuses on two measures of an item's salience. The first being the frequency with which each term is mentioned by an informant and the second being the salience index as computed by ANTHROPAC. (Borgatti, 1996) These measures estimate the salience of cultural and local notions of science and scientific practice. The measures also define the boundaries of the domain.

First, the frequency analysis identified the following as salient terms and ideas of science and science practice by the informants (see Table 1). Second, the salience index was determined to calculate the average percentile rank of each term across all lists (see Table 2).

Table 1
Results of Frequency Analysis

Frequency	Self-Identified Terms
Three or more times	Determination, Own ideas/Creative, Confident
Twice	Focused
More than once	Curiosity, Analytical Thinking, Knowledgeable, Bold, Open-minded, Self-understanding, Persistent
Once	Integrity, Diligent, Organized, Skilled, Problem Solver, Passionate, Interested in New Things, Good at Math, Willingness to accept a challenge, Expert, Research, Technology, Experimenting, Dedication, Innovation, Leadership, Willing to Learn, Algorithmic Thinking

Note. Calculated using ANTHROPAC

Table 2
Results of Salience Analysis

Ranking By Salience Indexes					
3 or more times		**Twice**		**More than once**	
1.33	Confidence	5	Focused	2	Knowledgeable
2.67	Determined			2.5	Analytical Thinking
3.67	Creative			3	Persistent
				4	Self-Understanding
				4.5	Bold
				4.5	Curiosity
				5.5	Open-minded

Note. Calculated using ANTHROPAC

From the frequency and salience analysis of the free listing results, it is evident that there is a clear cultural domain of what it means to be a scientist. Terms such as "determination", "confidence" and "focus" indicate that capacity building and the ability to endure the terrain of the scientific cultural landscape are central to this cultural domain. Additionally, terms such as "creative", "curiosity", and "bold" indicate that the cultural domain of science and scientific practice includes an element of individuality and agency. It is important to note that the learning process at Spelman College is directly engaged with the career pathways in their respective disciplines. Students in computer science and engineering work on projects designed by corporations such as IBM and also have the opportunity to develop research projects with faculty members. This integration not only helps to solidify the pipeline into industry and academia but also allows students to have some ownership of their learning process and develop ideas about the discipline that are their own.

The secondary portion of the assignment asked students to complete the following statement:

To me, becoming a scientist means…

Participant responses included:

> "To have the ability to make discoveries that will change different aspects in the world"

> "Developing new ideas to contribute to new creations to possibly improve lives" and

> "Using your skills (computer science, biology, chemistry, etc.) to solve problems either to make things more efficient or to make the world a better place"

This portion of the data was examined using a taxonomic analysis. This process involved looking for relationships among the terms used within each response provided. Using the taxonomic analysis, I was able to resolve the participants' notions of what it means to be a scientist into three main categories: innovation and developing new ideas, problem solving and being an expert within a field. These categories were used to form the cultural domains of science identity at Spelman. In many ways, these domains differ from those identified in the aforementioned science identity model. These cultural domains form the foundation of a science learning environment that is unique to Spelman College and is reiterated through campus and programming activities to support the lives and needs of its student population.

To directly speak to the science identity model and subsequent survey developed, I developed a survey of my own to examine if these key indicators of science identity resonated with the women at Spelman College and also to gain a better understanding of

local notions of science and cultural ideals. The survey included questions from the Diversity and Learning Environments and Science Identity Surveys both developed by the Higher Education Research Institute at the University of California, Los Angeles along with questions generated to measure self-efficacy and doing/using science. Previous research states that a factor of student persistence in STEM fields is the extent to which an individual believes in their own ability. In addition to the cultural domains highlighted from the free listing results, the domains of identifying as a scientist (recognition), using/doing science (competence & performance), and self-efficacy were explored by the survey.

For the items measuring "identifying as a Scientist" and "using/doing science", student responses were similar to those reported by students marked as "successful students" in STEM disciplines on previous surveys. I suspected that there would be congruency in regards to these items as the science learning environment at Spelman College is structured to be more inclusive based on the demographics of the student population. The significance lies in the mechanism supporting young African American women in recognizing themselves as scientists both at Spelman College and beyond. Carlone and Johnson state that recognition (including self-recognition and being recognized by other science people) is a key factor for the persistence of women of color in science. I agree in that recognition is an important element of identity development; however, the findings of this project offer an alternative to the conceptions of the ways individuals gain recognition and question whether it is truly as a key factor discussed.

After further delving into my ethnographic data, it became clear that the concept of leadership is a key component the pedagogy at Spelman College and the ideals held by the students. Over eighty percent of the survey participants responded that they feel compelled to be a leader in their respective fields while sixty-eight percent responded that they felt compelled to be a leader in their community. The significance of leadership within the campus community is a core ideal of the history and mission of the liberal arts Women's College. Additionally, Dr. Lawrence states that,

> "The students view using computers as a tool to accomplishing something…not just writing code to be writing code"

The literature on science identity states that scientists recognize themselves as a science person either based on their enjoyment of science for "science sake" or that they are have redefined science as a tool for altruism. The latter may be true in the sense that many of the students do view science as a tool but I argue that it is not a redefining of science as an alternative to traditional science practice but more so a science that develops through the comingling of institutional demands, the social capital ascribed to science and the sociocultural expectations of African American women within this context. The social labor of African American women will be further discussed in the following section, but it is important to understand that the women at Spelman College and black women at large are not free to develop any type of science identity. Their choices are shaped by larger and more pervasive meanings of ''science people'' just as they are by science. These meanings are derived from the sociohistorical legacies of modern American science alongside the historical and political meanings of being a black woman in the United States. To say that these women choose to redefine science in an

effort to better recognize themselves as scientists because they view science as a tool, only highlights a part of mechanisms supporting their persistence within STEM fields.

Now, cultural production allows for the possibility of the women transforming meanings of ''science people'' and what it means to be a woman of color in science. When I asked more about the concept of leadership and what it meant to the young women as scientists, the responses did not directly align with the altruistic scientist type as assumed. One of the students offered the unexpected yet poignant response of "it means knowing who you are and knowing what you want. That is what inspires people." This response is insightful because it offers a definition of leadership that is situated in a particular experience. In an interview with Dr. Yolanda Rankin, a professor in the Department of Computer and Information sciences, she stated the following:

> In graduate school, it's about you taking the leadership and initiative in understanding your material"

While in the field, varying concepts of leadership continually emerged, as there is a legacy of Black women's leadership through learning and scholarship within communities and organizations and especially at Spelman College. (DeLany & Rogers, 2004; Collins, 2000; White, 1999) The significance of leadership as a part of the learning process for African American women in sciences will be further discussed in Chapter 4. However at this point, leadership must be understood as not solely being altruistic and to be a leader from the positionality of a multiply subjugated body has varying meanings and serves different purposes. Further, assuming the role of a leader becomes a form of individual and collective agency and becomes a tool for identity development outside of

just the realm of science. Within the contemporary era of scientific enterprise, the social

capital of science work becomes an additional access point to authority and identity

domain that may generally be inaccessible for African American women. It is also

important to highlight that the survey results show that although many of the women are

compelled to be leaders within their field, fewer are compelled within their communities.

I ask, how do these women define their community? And how do the dynamics of

leadership and science translate within the local sociocultural landscape?

STEM Climate and the Dynamics of Social Labor

> "When I went to Georgia Tech for my doctorate, people wouldn't talk to me. I
> was an older student and I didn't want to work in groups. Teachers would
> normally let me work alone but this teacher wouldn't. One day I wore a Purdue
> sweatshirt. I finished my bachelors at Purdue because my husband ended up going
> there. So I wore my sweatshirt the next day and one of the students asked about
> me going to Purdue and wanted me in their group. I don't know if it was the
> woman or the black part but I know Purdue trumped both. He assumed going to
> Purdue meant that I could do this project. I was the exact same person the day
> before."
>
> <div align="right">- Dr. Andrea Lawrence</div>

The social and cultural climate of STEM fields is cited as the leading challenge to

the persistence of women of color in graduate experiences. (S.V. Brown, 1994, 2000;

Ong, Wright, Espinosa, Orfield, 2011) This research highlights that interpersonal

relationships with other members of STEM communities and the cultural beliefs and

practices within STEM that govern these relationships produce more barriers to access

and persistence than structural barriers such as recruitment practices or financial aid.

(S.V. Brown, 1994, 2000) Research on the graduate experiences of women of color

emphasize that the cultural belief in white male superiority remains prevalent in

academia, especially within STEM fields. (S.V. Brown, 2000; Joseph, 2007; MacLachlan, 2006) The endurance of the cultural belief in the white male model and white male intellectual superiority demands the perseverance of the belief in the intellectual inferiority of both minorities and women. This underlying cultural belief is enacted through the microaggressions (indirect discrimination through the use of biased social norms and behaviors), which amend the everyday experiences for women of color both within science and beyond. (Malcom, S., Hall, P., & Brown, J., 1976) Science work and practice is mitigated by these interpersonal interactions and are a central component for the accumulation of social resources within science communities and workplaces. The increased scale, funding schema, and hyper-specialization of science and technology work require the development of teams of researchers, assistants, and support staff increasing the significance of the social organization and interpersonal interactions. (Bloor, 1976; Latour, B., & Woolgar, 1986; Karin Knorr-Cetina & Mulkay, 1983; Harding, 1991, 2008) Therefore, the presumption of incompetence, negative judgment, and lack of recognition experiences by women of color in STEM fields cannot be understood as auxiliary to science and science practice. In actuality, it is at the very core of the learning processes, stemming from the roots of the epistemology and structured through the academy. After all, it is through the science that these perceived differences, subjectivities and hierarchies are produced. A structure erected based on a male normative and a priori idea of human difference could not be anything but stratifying, discriminatory and isolating. (Harding, S., 2006; Fausto-Sterling, A., 1992, Schiebinger, L., 1994, Hubbard, R., 1990)

Dr. Lawrence's anecdote offers particular insight into the microaggressions experienced by African American women in science graduate programs and the dynamics between race, gender and place in regards to institution type and the capital associated with such. During our conversation, Dr. Lawrence mentioned that prior to this day she wore her Spelman sweatshirt every day to class. Although she completed her senior year at Purdue University, she was very much a "Spelman woman" and was negatively judged by her peers as being the only African American women in the class. The explicit expression of the home of her undergraduate training additionally marked her as other as she was socially isolated within the program. The negative judgment of African American women as intellectual inferiors extended to the institution as the marking did not carry the same cultural capital as that of Purdue. This is highly significant due to the proximity and institutional relationship between Georgia Technical Institute and Spelman College. Both institutions are within the same geographical boundaries, share dual degree programs in STEM fields along with other local institutions, and Spelman students are regularly admitted into graduate programs at Georgia Tech. I say this to highlight that lack of knowledge about the institution; programming or presence in the local STEM community may not be used as explanations for Dr. Lawrence's previous isolation. However, it can be argued that within this particular space and interpersonal interaction, the marking of "Purdue" elicited recognition and competence, which was previously denied. Access to social resources such as study groups, research teams, hence STEM communities, are limited by pervading cultural beliefs enacted through interpersonal interactions. In this instance, it becomes clear that these beliefs extend beyond that can do

science to where science can exist. In addition, the dimension of place in science is ascribed to the body. This is particularly important in addressing the pervasive notion that science and technology is neither geographically nor culturally bound. Here it is evident that place is a dimension of science that not only dictates where science may happen but that the capital associated to the dimension of place can be ascribed to the body. Further, the marking of Spelman as racialized, gendered and marginalized institution maintains despite displaying the markers of a place capable of producing scientific and technological knowledge and scientists and technologists.

The social organization of the scientific enterprise and the underlying cultural beliefs negatively impact the access, success and career trajectory of African American women in addition to altering their judgment and informing their decision-making. (Harris-Perry, 2011) Those who have been able to complete programs and thrive in their respective fields express the importance of being able to cope with microaggressions and circumvent obstacles faced within local and national STEM communities. In a conversation with Dr. Rankin, an African American woman and Professor in the Department of Computer Science, she shared the following anecdote:

> "Because there are so few of us, we know each other. At a time, there were just four of us. If one of us had to present at a conference, we would all go for support. The audience would be unfairly critical, so we just made sure to be in the crowd. We would call each other to see who was attending. One of my colleagues would never go if she was the only one."

In her study, MacLachlan (2006) found that women of color felt "surveilled" and evaluated by their peers and reported that issues of racism and sexism primarily stemmed from male colleagues. In order to persist, many needed to develop coping methods to deal

with the emotional and physiological stresses faced in this environment. As exhibited in the above quote by Dr. Rankin, same-gender and same-race peer networks provided support within the larger STEM communities. Engagement with the larger STEM community is expected and required in order to sustain a career within many disciplines, included computer science and engineer. The microaggressions faced at the intersections of race and gender stereotypes within these environments produce an unleveled plane for African American women in STEM fields where recognition and acknowledgement are withheld and engagement is limited.

In her 2007 study of African American women who transitioned from Historically Black Colleges and Universities (HBCU) undergraduate programs to Predominately White Institution (PWI) graduate programs, Joseph found that these students "fragmented" their identities to cope with the stresses of negative interpersonal interactions. (Joseph, 2007; Lugones, 1994, Ong, 2002, 2005) Students reported revealing only a portion of their selves and fragmented their "science identity" from all other "social identities". For some, this fragmentation included consciously choosing wardrobe that masked gendered or racial/ethnic identities in order to be perceived as equally competent while others learned to alter their word choice to be perceived as confident. (Joseph, 2007) The women in the study spent a considerable amount of time altering their appearance and speech in order to gain acceptance within their local STEM communities. Recalling Dr. Lawrence's statement concerning the expectation of operating within and between multiple identity domains, the ability to do this is indeed an investment of time and energy. Access to social resources comes at a greater cost for

individuals marked as outsiders. Even if the investment is made, these women may not receive the expected returns. . In an interview with Dr. Johnella Butler, Vice President of Academic Affairs she share the following:

> "The global pressures affect us, especially racism in ways you have experienced it before. How do you prepare young African American women for that? Teachers would say, 'I want you to squeeze the orange to the fullest.' In those days, there was a hope…this is a different world. How do I tell a young black woman to squeeze that orange when it is rotten?"

An essential component of the success of Spelman College and its students is the sense of shared community amongst students, faculty and staff that extends beyond the immediate campus community. The sense of shared community is fostered by a firm recognition of the significance of being women of color and that such an identity does not have to be defined by the limits and the stereotypical beliefs that permeate the larger society. (Jackson, K & Winfield, L.L, 2014) Rather, embracing this identity can be used to cultivate the individual and the collective successes of African American women. This is made possible through a commitment to excellence as well as an acknowledgement that "parts of the orange may be rotten."

I began this chapter with the intentions of examining the experiences and positionality of African American women in science and the discourse of identity in science education within a larger sociocultural politicized landscape. While my focus does not encompass the entire spectrum of complexities associated with contemporary science practice and learning, identity formation in colleges and universities and the intersections of gender and race, this chapter offers an additional theoretical lens. If increasing access and viability opportunities for students from underrepresented

backgrounds in STEM fields is to be more effectively addressed, their ideas about science and experiences must be placed in the center rather than the margins of the discourse. Through this framework, we can examine exclusionary practices and obstacles not as incidentals but as components of the very root of the science practice itself. Student persistence or "fallout" cannot comprehensively be examined with the focus on individual identity formation, as identities are not formed in isolation. Critical research leading to change requires the consideration of larger cultural and social forces as well as the role of the institution in the transmission of those forces or their correction, if they distort academic and personal potential.

CHAPTER 4

"REALIGNING THE CROOKED ROOM"
NURTURING THE DEVELOPMENT OF WOMEN SCIENTISTS

"The traditional exclusion of women and especially Black women from many fields has reached the beginning of its end. Today's woman and tomorrow's woman will not suffer lightly the indignities, oppression and stock excuses that have excluded her from positions of business and professional leadership . . . As new doors open to Black women, Spelman must provide training for new positions."

-Albert Manley, 1995
First African America President of Spelman College

Walking through the entry gates of Spelman, I immediately felt that this place was different. After visiting a number of campuses across the country and having been a college student for more than a decade, I am quite familiar with the ethos of college and university campuses. I walked through the campus with a smile, marveling at the buildings with recognizable names at the top and the beautiful landscaping. By the time I arrived on campus, I was more than aware of the college's history, mission and significance as one of just two historically black women's colleges in the nation. Intellectually, I was connected to the campus however I did not anticipate an immediate emotional connection. My excitement was more than about my project. At that moment, I recalled that in many ways, this project was about me... or girls like me, and the "crooked" environments of that steer girls out of STEM.

In Sister Citizen: Shame, Stereotypes, and Black Women in America (2011) political scientist, Melissa Harris-Perry, explores the implications of biases and stereotypes on the lived experiences of black women in the U.S. (Harris-Perry, M., 2011)

Her "Crooked Room" theses argues that the prevalence of racial and gender stereotypes about black women in the U.S make it extremely difficult them to orient themselves in political discourse. (Harris- Perry, 2011) These "crooked rooms" can be learning environments, social and work communities that are skewed by negative stereotypes. Harris-Perry argues that the pervasiveness of these stereotypes can alter judgment and decision making skills, as the women must navigate these environments despite their distortion. In an article for the Gender Equity in STEM issue for Peer Review (2014), Spelman faculty members, Kimberly M. Jackson and Leyte L. Winfield present the science-learning environment at Spelman College as "Realigning the crooked room". (Jackson, K.M., & Winfield, L.L., 2014) Jackson, associate professor of chemistry and biochemistry, and Winfield, chair of the department of chemistry, discusses the hallmark of Spelman's success in training African American women in science as claiming a place in science that is based on a "Model of Empowerment". (Jackson and Winfield, 2014) In this model, student learning and achievement in STEM fields begins with embracing the identities of African American women which may be accomplished by recognizing student potential, embracing individuality, highlight black women scholars, promoting sisterhood and providing opportunities. (Jackson and Winfield, 2014) Although, the two Spelman faculty members do not explicitly discuss the "crooked rooms", aspects of this model allude to factors contributing to skewing environments outside of the Spelman community. These factors include lack of recognition, inclusion of the scholarship of black women in the history of STEM fields, community and access to opportunities. At the core of this dissertation is the promise of and in-depth ethnographic exploration of the

ways in which institutions may cultivate inclusive learning environments for the holistic development of all students, or how to realign the skewed sociocultural landscape of science and technology. This chapter examines the subjectivity of Black women within the sociocultural landscape of current science practice and science education and the politics that arise at the intersection of race and gender in the United States. At this point of the project, I choose use to term *black women* instead of *African* and *African American women*, to move the discussion from the situated experiences of self-identified African, and African American to the positionality and subjectivity of the racialized and gendered black feminine body. While it is important to note that some African and/or African American women do self-identify as black women this identity domain is largely constructed through the processes of marking bodies as *other*, rather than from the women themselves. Additionally, the subjectivity of simultaneously being black and female within western modernity and science includes a historical context and epistemological view that is discernably different to that of the lived experiences of African American women.

To begin, I explicitly discuss black women in science and science education discourse as a domain marked as black and female and as a product of western scientific epistemology. I set out to accomplish this agenda by placing the historical objectification of black female bodies, within the context of the establishment of Spelman College and in conversation with the contemporary implications of this history, which is overlooked through the active ahistorism of science and technology in the U.S. (Adreotti, 2010)

While a key focal point of this research are the narrative experiences of African American women, I expand the scope of my research to examine the intersection of race and gender as the convergence of two pervasive systems of inequality. The interactions of these two structures of inequality produce an even more oppressive model for black women to overcome. (Crenshaw, 1998; Collins, 2000; Harris, 2014) The subjectivity of Black women and the institutions that serve them, in this case, Spelman College, are uniquely positioned at a theoretical point that offers particularly unique insights into oppression, identity politics and other points where systems of inequality meet. I conclude this chapter with a discussion of the institutional identity, and cultural models underlying the college's organizational culture that may be responsible for the success of the production of black women scientists.

Intersectionality and Science Identity Discourse

The discourse of science identity seeks to address the lack of racial, ethnic and gender diversity in STEM by examining the barriers to entry and limits to persistence faced by those historically excluded. (Carlone and Johnson, 2008) Science learning through the lens of identity development has primarily highlighted the barriers that arise as institutional ideals and the multiple social identities students operate within and between collide during the education process. (Carlone & Johnson, 2008) Discursively, these identity domains are consolidated through policy and program development as the goals of equitable representation align for both populations. Science education literature interrogating the ways in which race and gender operate in tandem are beginning to emerge. Expanding on the framework of the "double bind" of race and gender oppression

(Malcom et al; 1976) so-called underrepresented minority women (URM) are discussed

as persisting in STEM despite discrimination and bias (Ong, et al, 2011; Best. Et al,

2011) Bonilla-Silva (2003) examines the ways minority women are impacted by color-

blind racism. Faulkner (2009) discusses the invisibility of women in STEM (engineers in

this case) yet the simultaneously highly visible as women in the field" (Faulkner 2009:5;

Ridgeway and Kricheli-Katz, 2013) Saperstein and Penner (2012, 2013) add the axis of

class as an identity marker used by URM as a form of agency and construction of

community membership. (Saperstein and Penner, 2012) While Carlone and Johnson

examine the experiences of successful women of color in STEM fields, the analytical lens

is limited to population selection and does not theoretically consider the complexities of

life at the intersection of race and gender. Research specifically focusing on African

American women in STEM addresses the implications of not aligning with the image of a

scientist or engineer. Ridgeway and Kricheli-Katz (2013) contend that Black women may

enjoy "freedoms [that] result from being unprototypical of disadvantaging statuses"

including the adoption of a "loud black girl" persona to cope with invisibility. (Ridgeway

and Kricheli-Katz, 2013) In fields that require leadership, black women are discussed as

"taking advantage of stereotypes" of being domineering (Ridgeway and Kricheli-Katz,

2013; Seron, C., 2015) For URM women, building "career-fit confidence" that allows

them to perceive themselves as a scientist. (Cech et al, 2011) Success URM women are

able to find a "culture-match" by merging their personal needs and desires as women

with the gender and race neutral values of STEM profession (DiMaggio, 1992; Rivera,

2012)

The data for this research is primarily gathered through interviews with women of color at *elite* institutions and explores the experiences of so-called women of color as a collective. (Hurtado, et al, 2014; Seron, 2015) Higher education's preoccupation with so-called elite institutions is evident in the study of experiences of "successful" scientists at prestige marked science institutions (i.e. Harvard, MIT) without consideration to their histories of exclusion and discrimination. (Deem, R., 1998; Shore, C., and Wright, S., 1999) Success for women in general is measured by their participation within a particular science community/institution. The narratives of HBCUs and faculty members at HBCUs are excluded from the general discourse.

The multiple dimensions of lived intersectional subjectivities are flattened by the tendency to primarily analyze underrepresentation along the axes of race and gender as a monolith. In attempts to address the complexities of both domains of exclusion, one category tends to be the central force while the other an underlying force. Scholars engaged in the discourse of "women of color" in science have a tendency to privilege obstacles presented by the "gender component" over the "racial component". (Hurtado et al, 2014; Rivera, 2012; Seron, 2015) Further, the category of "women of color" reaffirms "white women" as the normative feminine subjectivity, differentiating women who are not offered access to this identity domain. The experiences of women marked as *other* now become colorful reconfigurations of the normative standard. The barriers posed by the interaction between race and gender are perceived as tangents of gender oppression/discrimination, personal experience rather than reflexive of institutional wide ideology and practices, or are not perceived at all. While science education and labor

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research with Black women as the focal point are limited, in the research available in these two specific areas and in subsequent programming developed, the racial component of identity is analytically privileged over the gender component. Black women are compared to black men in STEM and therefore their relative higher representation informs the way these experiences are discussed in the literature. Stereotypes of black women are framed as strategies for persisting in STEM and/or forms agency. I argue that on the research end, this is primarily due to the following key factors. First, the salience, prominence and history of institutionalization of racial oppression in the United States frames the racialization as black is conceptualized as to be more exclusionary and the boundaries more concrete. Second, the privileging of the black male experience within African American communities and consciousness, social justice movements and anti-discrimination law and policy; African American communities are still subject to the patriarchal system and ideology that governs the larger society. Despite experiencing higher rates of incarceration, racist/sexist violence and punishment than their non-black female counterparts for being "loud black girls" tropes of "empowerment", "strength" and "triumph" are deployed rather than a critical examination of the ways social and institutional structures marginalize and exploit black women. (Crenshaw, K., Ocen, P. & Nanda, J., 2014)

It is the interaction between the power structures of race and gender that form the social cultural landscape in which Black women live and navigate. In the 1980's, Kimberle Crenshaw developed the theory of intersectionality to articulate the need to think and talk about race through a lens that looks at gender while simultaneously

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thinking and talking about feminism through a lens that looks at race. (Crenshaw, K, 1986) Each axis appears and behaves differently when looked at through the lens of the other. While intersectionality theory has been extended to explore the nuances of identity politics, it is important to clarify that it was originally conceptualized to capture the applicability of black feminism to anti-discrimination law. (Crenshaw, 2014) The experience of being a black woman within the larger sociocultural landscape is the focal point and is outside of the Spelman community used to highlight the blind spots of U.S institutions and projects intended to address systemic oppression. In my research, I extend intersectionality theory by placing the experiences of black women at the center of science identity discourse, models and science education practices. By examining the axes of race and gender within the cultural landscape of science, the complexities of these experiences become illuminated and the limits of projects to address these issues are captured. Insights from interviews and document analysis offer a lens into an educational project that continually and intentionally engages with the history and actual needs of the individuals it seeks to better serve.

Intersectionality & Postcolonial Theory in Action

Critical examination of the ideological and theoretical frameworks that serve as the foundation of contemporary American education and science practice does not call for the complete dismantling of the traditional institution. Rather, my use of this framework calls for the intentional consideration of the historical, cultural and actual needs of African American women, in the development of educational and economic projects. After all, educational projects for STEM fields on both the student and

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institutional positions are directly and indirectly linked to sociopolitical and economic projects outside of the institution.

I entered this project with the hypothesis that if I extended the science identity model and theoretical underpinnings of the discourse concerning the underrepresentation of African Americans and women into a place in which African American women not only participated, but thrived in STEM fields that the model would not sustain. This hypothesis was proven to be partially correct. While I expected the curriculum, institutional ideology and practices at Spelman College to directly challenge the core tenets of the traditional science identity model, the data collected during my fieldwork highlighted particularly located points of convergence and divergence between the college and the larger institution of American science education, rather than a direct counter to traditional models of science learning. Admittedly, it took sometime before I could reach this point of analysis as I initially found the lack of evidence of a markedly alternative approach to science learning troublesome. Reflecting on my fieldwork experience, it was my own personal experiences and theoretical commitment to a particular analytical frame that limited my understanding of Spelman College as an institution and as a cultural community. Because the science identity model did not extend to my experiences as an ex-STEM major, nor my conceptualization of identity, preliminary research exploring women in STEM fields, initially focused on the ways that "what it means to be a scientist" at Spelman were different rather than looking at the sustained engagement of Spelman College as an institution and cultural community embedded within and between other institutions and communities. While the exclusion of

both historically black colleges and women's colleges positioned Spelman college

discursively outside of the model, examining the interaction over both time (archival) and

place (local and global engagement) the conceptualization of what it means to be a

scientist and the scientist typologies framed as representative of women of color as

scientists discussed in chapter 3, persists within both spaces. This is a testament to the

pervasive nature of western epistemology and ideology. While the abstract

characterizations of scientific universalism, are merit based and are thought to be

intrinsically motivated by objective human curiosity and are thought to occupy the points

of convergence, the purpose of science, the conceptualization of learning and the central

institutional vision embodied by faculty and administration are where the two diverge.

This continued conversation is the keystone to the foundation of the success of Spelman

College as an institution and the virility of the campus cultural community. While I

entered the field with the intentions to action postcolonial and intersectionality in

examining the experiences of aspiring black women scientists, as my fieldwork

progressed, it became clear that, Spelman college as an institution and in its

organizational ideology were in fact already an actualization of this theoretical lens.

Building the Foundation

     Fluid, contradiction…ugly and beautiful

     My first on campus meeting with Dr. Butler, Vice President for Academic

Affairs, was intended to have her give me an overview of the campus, but that meeting

organically progressed into an extended conversation on the current status of education in

the U.S.[38] My informal conversations and scheduled interviews with Dr. Butler over my time at the university were very open and candid. As a humanist with extensive background in higher education administration and leadership which began as an undergraduate at Ellis College, the women's liberal arts institution. Provost Butler offered personal anecdotes to anchor her philosophy on higher education, which is paraphrased below:

> "Education should begin with a real strong sense of the history of ideas and is about communal learning. There must be a strong sense of how they all work together. Then, connecting this knowledge to your institution and seeing what we wind up with. Education should draw out the best in a person."

Provost Butler's philosophy frames the college's contemporary mission and ideology of student learning and development. While the focus on STEM education is a more recent extension of that ideology, what has remained consistent is the institutional mission to connect student learning with institutional, community and the history of African women across the diaspora.[39]

Provost Butlers continues to discuss education on the national stage and why we are still facing inequities in education; Provost Butler presented the rhetorical question,

> "What is missing? ...Well, a true understanding of the history and significance of this country. If you do that, it will directly deal with the global and local issues we face. The fluid, the contradiction, the ugly and the beautiful. Then they (students and faculty in reference to administration) will understand the

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[38]Dr. Butler and I initially met during the annual conference for the American Association of Universities and Colleges in January 2013. Coincidently the meeting was held in Atlanta, Georgia a few days after I arrived to conduct preliminary fieldwork. Dr. Butler and Dr. Yolanda Moses, the chair for this project, scheduled to have dinner during the conference to which Dr. Moses invited me along. I also meet Dr. Sidbury during the conference.

[39] 2Archived Personal Papers of Johnetta B. Cole

importance of what we are doing. If you don't then you can't meet goals of bettering the human condition."

Referencing her experience as a faculty member at Smith's College (1974-1988)…

"We have to get back to there. It's not only about what should be taught but also what should resonate. I had a tough time teaching about race to my students. I found that it is important for white students to understand racism and discrimination through immigration. White students weren't just white. They also have a history of discrimination, which is left out of the curriculum. When the Jews became white and the Irish. They were able to understand the process of becoming white. They were able to resonate. And then they were able to talk about race in a way they couldn't before. We have to make knowledge resonate."

This discussion demonstrates the ways historical narrative is operationalized in the persistence of the institution identity, the ideological perspective of campus administration and in curriculum. Due to scheduling conflicts, I was unable to conduct an interview with the college president, Dr. Beverly Tatum. However, through documents shared through the office of the President and executive personnel, history is significant in determining the trajectory (while not always positive) of the campus community and reaffirming institutional identity and purpose. The archived documents and personal papers of Dr. Johnetta Cole, Spelman's first African American female president and mastermind of the Spelman Science Initiative campaign also highlight the significance of history in ideology and curriculum. The current Director of the Smithsonian's National Museum of African Art and anthropologist, Dr. Cole believed that leadership should be grounded in history as well. In an interview reflecting on her perspectives on leadership, Dr. Cole stated the following:

"I'm not a historian. But I will tell you, Julian Bond, keeping grounded in history will keep you on a decent path. Because it will never allow you to isolate yourself from what already has taken place. So there was just no choice. It wasn't worth it

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to be haunted by all them race women and race men who had done so much more than I could ever conceive of." (Interviewed with Julian Bond, Feb 5, 2015)

Dr. Cole's presidency marks a transformative point in Spelman's history and institutional growth. As the college's first black female president in its 107-year history, Dr. Cole and the student activists who protested for a change in leadership formed the foundation for the college identity and mission visible today.

An *Un*-Collective History

As displayed earlier in this chapter, history plays a significant role in the persistence of an institutional identity that is transmitted from the top (administration and faculty) down to the students. This is achieved both formally through curriculum, regulations and informally through social expectation, imagery and the continual reaffirming of what it means to be a "Spelman woman". The identity of the Spelman woman and Spelman, the institution, is directly linked to a lineage of women leaders across disciplines. In the sciences, this linkage is most explicit on the walls and display cases of the Science Center. As previously discussed in Chapter 2, the history of African American women in science is displayed beginning with the first women to complete a doctorate in mathematics, Winifred Edgerton from Columbia University, to the current chair of the department of computer science, Dr. Andrea Lawrence (see Figure 19).
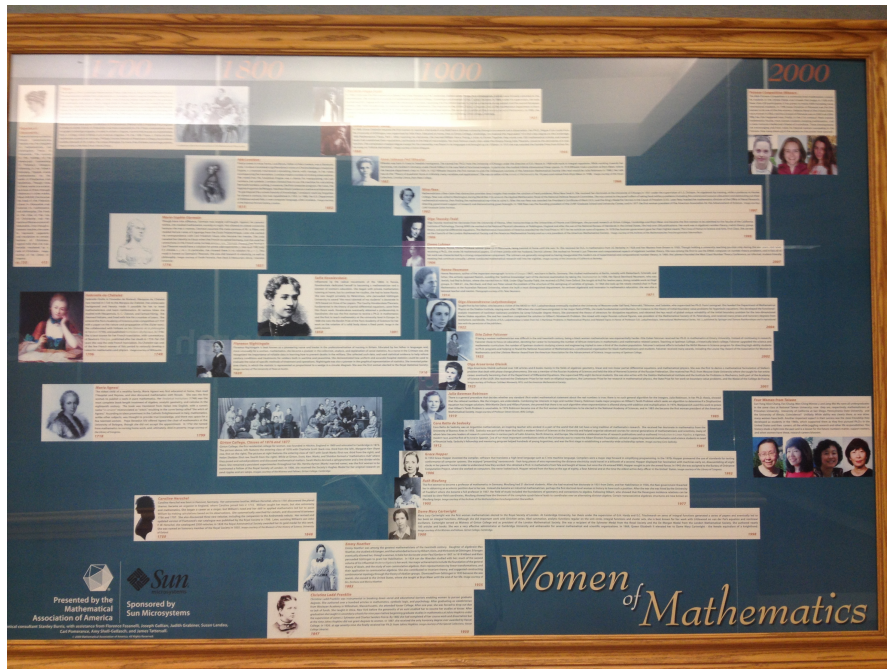
Figure 19. Timeline of Women in Mathematics

Although the display aligns with the linear narrative of progress and collective history

operationalize in the larger scientific community, it is in the framing through African

American women scientists that the two narratives diverge. Generally, the inclusion of

women in the "collective history" of western science is limited to moments of singular

contributions, if included at all. (Adreotti, 2011) The contributions of African Americans

(predominately men) are relegated to black/African history and not to the general history

of scientific knowledge production. (Pearson, 1989) A narrative through the prominent

positionality of Black women scientists challenges the perpetuated linear progression of

science and humanity, which excludes African American women. In addition, this

narrative challenges the positionality of the fixed, knowable and constructed *Other* and

the knowledge producer-subject relationship that predicates the role of black bodies in

western science. (Bhabha, 1990; Spivak, G., 1998; Harding, 2008; 2009) However, the

construction of western science as universal for all identities rather than as a culturally embedded and as a sign of advancement remains unchallenged. While, other "ways of knowing" are promoted in disciplines outside of the science center, evident in the prominence of liberal and self-identified activist and radical faculty members, this is not the case in the STEM disciplines. I do not content that it should be explicitly challenged these ideals but this highlights the complexities of the sociocultural landscape of the institution and members of the community and the experience of being between yet betwixt.

The points of divergence between science education at Spelman and in the larger national landscape lie in its conceptualization of who can *do* science, approaches to science learning and who is included in the historical narrative. Through document analysis and a review of the archival documents of the development of the science center, I conclude that the points of divergence between Spelman's science ethos and the larger western science ethos is only limited to western science practice; that is who is able to be designated as a scientist, and not epistemology or ontology to the overlying agenda of increasing access to the STEM job market for Spelman graduates. The historical narrative is reflective of the institutional identity and simultaneously helps to serve the mission of increasing the status of African American women at Spelman College and beyond. This more inclusive history is a key mechanism in "realigning the room" in multiple ways. First, by providing the foundational history for students to begin to visualize themselves as scientists; second, by countering trends in science education discourse, which can, at

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times, frame the participation of African American women in science as relatively new phenomena or trends.

While finding the use of an alternate "ways of knowing" or science at Spelman was not anticipated, this research is important as it exemplifies the consideration of historical, cultural and actual needs of a desired population in the development of an educational project which also engages with the social and economic needs of the larger population.

Reconciling Historical Exclusion And Subjugation

> "I mean, I know the history…why would I want to be a part of something that I could never really be a part of? I can see why scientific racism may stop some black women from being interested in science. I don't see it that way but I can see how some might" –Student Respondent

The above moment occurred during a discussion on the topic of science history amongst nine computer science students in their junior year. This marks the third moment that the history of scientific racism in the U.S was mentioned as possibly impacting the decision to pursue a career in science. The first was during an informal conversation with Dr. Butler and the second with Dr. Sidbury, the Director of Institutional Research. In both instances, the topic was briefly discussed in reference to the curriculum in the humanities and social sciences on campus. My working hypothesis presupposed a correlation between the historical exclusion and objectification of black and black female bodies informed the underlying mechanisms relegating both practicing and aspiring scientists to the margins of science communities of practice. I anticipated the connection between the two to operate in the institutional and ideological conceptions of "who can do" science

and the scientist types that are deemed to be more accessible for women from historically excluded backgrounds. Unexpected was the explicit consideration of this history on the part of the students. While student, institutional and the wider science community's formulations of what it means to be a scientist are not disparate; I anticipated the mechanisms informing the identity domains of science to be. And I hardly expected this relationship to be verbalized during my informal interviews with students. This nuanced understanding of the positionality of black women in science both contemporarily and historically can be attributed to the interdisciplinary curricula and institutional mission to educate and nurture women and girls through the legacies of women from African descent globally.[40]

Generally, science curricula in the US constitute and maintain an ahistorical, objective ideal of scientific knowledge production. (Kuhn, 2012) Modern science is believed to progress in a linear sequence of scientific developments and revolutions-- to be universal, replicable and value-free. The history of scientific racism and the objectification of gendered and raced bodies, which was prominent both in the social and natural sciences, is removed from the general scientific curriculum and consciousness. (Harding, 1991, 1998; Haraway, 1997, 1998) Critiques of this seamless history and philosophy of western science are typically held separate from science communities of practice. While scientific racism and sexism may be perceived as a relic of a dishonorable period of modern scientific knowledge production, there are contemporary implications and reminisces of this history.

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[40] Interview with Johnella Butler

The constitution and classification of quantifiable difference, objectification and dehumanization are central to the science rather than at the margins where science and society interact.[4] Its erasure from the larger discourse of science and science education is problematic in that the issue of under participation and retention of African American women and men is not rooted in the science nor framed as a product of institutions of science. (Carter, 2004) Therefore, projects intending to address these issues generally are aimed at approaches to science and science socialization rather than understanding of science and scientific knowledge production. (Carter, 2004; Adreotti, 2012) The contemporary agenda to make STEM environments more inclusive and to diversify science learning and labor communities must address that, at some point, explicit discrimination based on race and/or gender was institutional practices. Further, that the science itself produced the sort of marginalization, exclusion and stereotypes that bound the scientific landscape those African American women must intricately navigate. While it may seem counterintuitive to include this history in science curricula, particularly in the education experience of African Americans today, the findings of this research demonstrates that a more nuanced telling of history helps to ground student development, anchor institutional mission and clarity for the entire campus community.

Research Findings: Faculty Interviews

"Personnel is important"

Gaining access to Spelman College was an arduous task. After weeks of unanswered emails and letters to the office of institutional research, I received an email response from Dr. Dmeji Togunde, the Director of the Office of Global STEM.

Dr. Togunde was intrigued by my project but also recognized my last name[41] as well as the name of my advisor and mentor Dr. Yolanda T. Moses. Through our email exchange, Dr. Togunde agreed to be my faculty sponsor for the project on campus. It was an email sent by my advisor to the Provost, Johnella Butler that later garnered full access to the college as a Visiting Scholar. My advisor and mentor, Dr. Yolanda T. Moses and Dr. Johnella Butler were friends and colleagues as higher education administrators. In addition to me being able to conduct this research on the campus, these relationships are significant as it highlights the organizational culture of Spelman College. While I am unsure if I would have been granted access to the campus without this connection, it became clear upon my arrival that personal connection and relationships played a significant role in the institution's organization. Faculty and administrators operate as gatekeepers and are central to the Spelman College campus community and institutional vision. The human factor (personnel) is important.[42]

Conversations and semi structured interviews with faculty and administrators offered immense insight into the institutional vision and ideology of the people that contribute to Spelman's success in serving its student. Interviews were conducted with key personnel beginning with the Dr. Togunde, my faculty advisor at Spelman and Provost Butler. Both administrators offered suggestions for other administrators or faculty. In Table 3 below, are the administrators and faculty members including a brief

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[41] A recognizable Igbo Surname from eastern Nigeria. Dr. Togunde is Yoruba, from the western Nigeria
[42] 5 Interview with Johnella Butler

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description of their background. Information of was compiled based on references and

through participant observation.

Table 3
List and Description of Key Faculty and Administrators

Dr. Johnella Butler Vice President for Academic Affairs. Prior to Spelman, Dr. Butler held appointments at the University of Washington, Seattle associate dean and associate provost of the graduate school, and was the first Black woman to be tenured at Smith College
Dr. Andrew Williams Roboticist, Professor of Computer Science (Now at Marquette University) and founding Director of Spelbots robotics program at Spelman College
Dr. Dmeji Togunde Associate Provost for Global Education and professor of International Studies. His roles include providing leadership for the implementation of the College's Strategic Planning and its Quality Enhancement Plan (QEP), also known as Spelman Going Global!,
Dr. Carmen Sidbury Associate Provost for Research, Prior to coming to Spelman College, Dr. Sidbury served as a program director for the Graduate Research Fellowship Program, in the Division of Graduate Education in the Education and Human Resource Directorate at the National Science Foundation through the Intergovernmental Personnel Act.
Dr. Yolanda Rankin Assistant Professor in the Department of Computer & Information Sciences. Dr. Rankin also co-advises the African American female robotics team known as the Spelbots and supervises undergraduate research in Human Computer Interaction.
Dr. Andrea Lawrence Associate Professor, Chair, Department of Computer and Information Sciences. Dr. Lawrence began her bachelor's degree in mathematics at Spelman but completed the degree while at Purdue with her husband. Dr. Lawrence is credited for the development of the Department of Computer science at Spelman College.

These interviews were scheduled in advance and were semi-structured to allow participants to respond freely. I requested 30-45 minutes for each interview however, most lasted nearly 1 hour as our conversations were open and organic and the interviewees offered many informative anecdotes. Interviews were similarly structured to include 3 central questions from the questionnaire developed using information from the Higher Education Research Institute (HERI) Diversity and Learning Environments Survey (DLE)[43] and findings from preliminary research.[44]

Top Priorities

Participants were prompted to identify their top priorities in constructing a department or institution. This offered an opportunity for key personnel to share educational philosophies and institutional perspectives.

> If you could create a computer science department (or institution) from bottom up- one that would effectively prepare students for many local, national & global realities & challenges in the coming decade, what would you need to achieve this goal?

As highlighted in the responses, the prompt indirectly provides insight into how their institutional ideals match up to the actual mission and practices at Spelman college. Each participant was asked the question detailed above. Faculty members were prompted to reply in reference to department level but were encourage referencing the institutional level, if desired.

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[43] 2012 Surveys developed by the Higher Education Research Institute at UCLA
[44] Document review pre-ethnographic research

Institutional Mission & Faculty

At the administrative level, there is continuity both in vision and the approach to reach this vision. Change and adaptability are key priorities for administrators at the college. Openness to change is a more recent evolution of the Spelman institutional identity. Prior President Cole's term at the college, Spelman was considered a conservative college. (Cole, 2015) As a self-proclaimed feminist from an upper-middle class background, Cole may be cited for bringing the sense of the need for change that was present in the student body, to the administrative offices of Spelman College. Change was institutionalized. Provost Butler's response displays that there must be a clear understanding of the Institution and how institutions, in general, change.

> "Faculty understanding, developing levels of leadership that is ongoing and organic. Have people understand organic nature of the institution and that it is not set in stone."

Provost Butler references her undergraduate experiences and positionality as one of the reasons why she says change is a top priority.

> "I was aware at a young age of institutional change. I was always a leader. I brought lots of speakers to campus. As a black person I knew institutions must change."

Provost Butler connects the need to understand change to the subjectivity of being black in America. As demonstrated in Chapter 3, the identity domain or lived experience of being an African American women requires adaptability, fluidity and at points fragmentations. In the case of institutions supporting the lives of African American women through a lens that positions this lived experience at the center of its organizational structure, adaptability and fluidity (change) must also be at the center.

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Dr. Sidbury echoes this particular notion of change and connects it to self-awareness and cultural competency:

> "Clarity of where you are, where do you want to go? What do you need? ...When you know yourself and where you come from…cultural competency begins with self. African American experience is not monolithic. New technologies, we need to change pedagogies."

From the interview responses and document analysis, there appears to be a deep understanding of change that is rooted in the history and lived experiences of African American women. Institutional change is a key part of moving Spelman "forward" because of the historical marginalization of African American women by institutions. Although the college was established to serve black women, the pedagogy and structure served to train the student in a particular way that preserves social order. (Scrivens, 2004) Self-awareness, both individually and collectively is complex and fluid, therefore, the institution must also operate under the same framework.

Institutional change is not always a seamless transition, especially in an institution in which individual connection plays a significant role in the institutional organization. During one of our meetings, Provost Butler shared the importance of having faculty and administrators who also believed in the initiative for change and the trajectory of the school. In this case, faculty is central to Spelman College identity and to the trajectory of the institution. Provost Butler asserts that collectively, faculty must understand the institution and how institutions change. In addition, Dr. Sidbury states that the second priority should be building personnel to support institutional mission.

Dr. Togunde adds to the discussion of faculty as key to institutional change through expertise.

> "Transformation begins with a well-defined mission statement that places teaching at a high value…Quality teaching and quality research abilities on the part of the professors. Research should be based on 3-4 characteristics or competencies of faculty. Facts dictate change."

Responses from Dr. Togunde reiterate the importance of building a faculty to support and execute the institutional mission. For Dr. Togunde, change is facilitated through the expertise, research and teaching strengths of the faculty. In alignment with correspondence from the Office of the President[45] and the archived files of Dr. Cole, these responses highlight that clarity in mission along with a culturally embedded notion of change, and a faculty supporting the actualization of this mission is the general ideals of the upper management branch of the institution.

Findings through participant observation and informal conversations on campus highlight that the concept of 'change', at moments, operates as a euphemism for progress. Although 'progress' was not used by any of the interviewees, phrases such as those listed below, indicate that there is a sense of 'change' from one point (the past) to another point located in the present.

> "I'm not a person of the past. I am a person of the future"
> "I am here to bring Spelman forward."-Anonymous[46]

This change is not neutral. Although, I am unable to detail past events shared in confidence, there were forces limiting the development of the institutional identity of the

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[45] Archived Personal Papers of Johnetta B. Cole

[46] Respondent requested not to be identified

college at this particular moment. Hence, a notion of change, as in fluidity, adaptability and/or progress is repeatedly referenced throughout this project.

For Dr. Lawrence, her top priorities have been actualized through her work at Spelman.

> "That's what I did over 20years. Find strong faculty concerned w/studies. Strong curriculum matched standards. Encourage nonacademic experiences, internships, research, we design, & program content, conferences & meetings. Bring in people from Academy, government & market to the field."

Dr. Lawrence has been a faculty member at Spelman for over twenty years and developed the department of computer science. Dr. Lawrence's response of faculty being a top priority is generally in line with the responses provided by the other interviewees. However, student learning, development and access to research and career opportunities are the central markers for institutional success. Faculty is a top priority for the purpose of providing strong curriculum for students.

Skill/competency

Competency and performance were shared as a top priority for all interview participants. Varying indicators and metrics for measuring student competency and performance were also shared. For computer science and mathematics faculty members, the core competencies and skills students needed to develop were precise and detailed. Below, Dr. Rankin details the core competencies that students in computer science must develop before exiting the program.

"They should be proficient, when I say proficient, able to write code from scratch, able to write an algorithm. Should be algorithm 1st code from scratch in less than an hour for a problem but it works? I'm not saying for a substantial build me a system but if I gave you a simple thing like um write code for a web caller that calls websites that text every mention of Spelman. They should be able to do that. …And then 2, you should be able to code or at least read the code and translate it to say oh this block of code is doing this in other languages. That's a skill that any computer scientist, even if you're not [going to] code you should be able to do. How to read code and know what that code is doing. We call it tracing, code tracing. So you have the algorithmic that they can design to help them solve the problem then be proficient in one core computer programming language. Then having sufficient knowledge in other computer languages. They also should have a basic foundation in theory. Algorithms is a study of how you problem solve and what we do in computer science is we talk about various algorithms, typical algorithms, there are sorting algorithms that you can sort numbers or text base information what have you… They should have core competencies in operating systems. The core components how they work together… And understand how to navigate an operating system. So at the shell level, back when I was in school, UNIX was the thing. Now they use Linux. Linux is a version of UNIX. It's an upgrade for it. There is of course the windows based operating system…any CS should be able to manipulate from a tunnel screen where its Unix, Linux, red hat, u be able to do all…Editor, once you establish core competencies and database is a huge part of that."

Dr. Rankin identifies exact and measurable skills that must be ascribed for all students in computer science, as her top institutional priorities. Further, Dr. Rankin elaborates on why it is important to focus on skill development

"So technology is about competency at the end of the day. If the students well prepared and can demonstrate their competency they will have no problem doing well in that field..."

Dr. Butler, as an administrator, also shared competencies as a top priority for student learning.

"Performance being able to write code, algorithms. Translating of other languages. Code tracing. For theory, students should be able to problem solve. They should be proficient in Linex edition. Basic databases and building. Each student should have a specialty track. Understand research and its labor connection and using industrial perspective…awareness in levels of research."

Dr. Togunde also shares competency and skill development as a top priority. In his first response, Dr. Togunde shares the importance of building competency in reference to faculty members. In the response below, he explains his perspective in reference to student learning.

> "Computer literacy, analyze information but not just dump information but use it. Prepare to critically think and make use of information. We need to build and inquisitive mind. Ability to read & write is grade but students can read but can't write... Those who cannot write well you cannot be successful. Technology is making communication easier but writing difficult. Ability to write critically and present information is important. Quantitative literacy, understanding basic statistics. Knowledge of global issues beyond your environment is critical to success."

While detailed areas of competency were anticipated from Computer science faculty members, the responses from administrators outside of the discipline were not anticipated. These responses highlight an integrated institutional mission, in regards to student learning from administrators to faculty. There is a shared notion among them of preparing students to actively engage in the labor market and both local and global communities.

Liberal Arts & Service Learning

The interview responses demonstrate that service learning and liberal arts pedagogy are also a prevailing top priority. Service and civic engagement are at the core of Spelman institutional identity, and it is evident that the faculty and administration believe that that element of Spelman college mission and curriculum should be preserved. Dr. Sidbury cites the merger of liberal arts and science to be central to the college's success in STEM education and student performance.

"What do students need to know? Students need a liberal Arts & STEM interactive interdisciplinary. We need to teach quantitative literacy to all students. How do we not have it viewed as separate or opposing? Spelman success is based on liberal arts ideology. Liberal arts education in engineering. Future engineer we want the best produced from liberal arts."

Dr. Sidbury continues by explaining the connection of liberal arts education and STEM…

"Models talk about mentoring. At Spelman, service begins with new students. It is very intentional. Service is giving back"

The value of the liberal arts and STEM interactive is embedding the learning process in a continual engagement with other fields and extending it to application in the lives of the students and the general populous. Dr. Sidbury contends that the model of mentoring and service that has gained popularity in the larger discourse of science education has always been a part of science curriculum at Spelman College for years. For example, first year students engage in mentorship with students at local middle and high schools. Service, in the form of outreach is expected from all students across all disciplines. Additionally, students are expected to engage with the campus community across disciplines. This is referred to as "in reach". Further, Dr. Lawrence identifies student-faculty relationships and peer tutoring as a key priority. Service is expected of all members of the campus community. Below, Dr. Togunde also expands on the importance of service learning to both students and the campus community.

"Must promote service learning by faculty & students. We live in a globalized society we must promote intercultural competence. Knowledge of global issues and intercultural global learning should be embedded in their mission statement. Students cannot function in global society without this. Service learning demands that people must give back through service. People find meaning to life through service. Research shows that they are happier than just giving money. Service needs to be promoted at all levels"

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The findings from this research demonstrate that a specific ideological framework is operationalized in establishing an institution to meet the learning and development goals of African American women scientists. Preparing students to thriving in an environment embedded with barriers to access and persistence for African American women requires clarity in vision and intentionality in practice in their educational program and experience. While there are moments of convergence as discussed earlier in this chapter, those moments are segments of the continued engagement necessary to address the actual needs of African American women scientists.

The Spelman Model for Empowerment

The Spelman cultural models of sisterhood, legacy and service frame the institutional identity and mission. The cultural model nurtures and develops the collective strengths of women and prepares students to enter an arena where they are not only underrepresented but also invisible. (Jackson & Winfield, 2014) Science environments outside of Spelman College must change but to do so, there must be an increase in the participation of women of color. "For diversity, numbers matter."[47] While this is the overall agenda of the Spelman science initiative, students must be well prepared to engage in an environment lacking diversity now. To do so, cultural models of Spelman have been transferred in the development of a Spelman Model of Empowerment (see Figure 20).

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[47] Interview with Carmen Sidbury
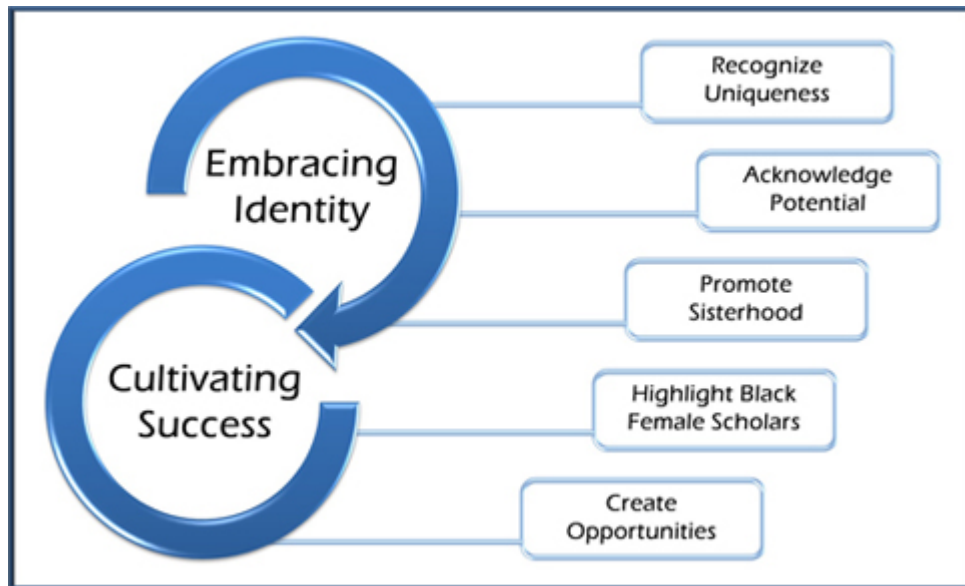
Figure 20. Spelman Model of Empowerment

Based on the college's cultural values of sisterhood and social integration, the model begins with embracing student identity by recognizing the individual uniqueness, acknowledging student potential to be "agents of change", supporting the intellectual and personal growths of all women and highlighting the legacy of scholars and alumna act as role models for the students. By focusing on developing the whole women and developing a core curriculum that is centered on the experiences of women of African descent, Spelman College is an environment for cultivating success. The model of encouragement does not model that of science identity. The model of encouragement focuses on fostering an environment for student growth and develop that begins from student experiences. While the science identity model focuses on elements of what it means to be a scientist as neutral components auxiliary to student experiences. Academic achievement and development begin with embracing the identities of women of African descent rather than framing the as limiting.

CHAPTER 5

"SCIENCE: IT'S A GIRL THING!"

Nearing the end of my fieldwork, I hosted an informal focus group with students to explore science learning and what it means to be a Spelman Woman seeking to become a scientist from their perspective. Prior to this point in my research, I engaged and built rapport with students primarily through informal interactions in the halls of the department, dormitories, and the campus recreation center. The students I met in the computer science department were already familiar with my position as a visiting scholar as I was formally introduced. However, for those I encountered outside of the department, this information was surprising as many assumed I was a student similar to them. This dynamic generally worked to my favor as many of the young women found me to be relatable and were more at ease in sharing their experiences and views on the topics we discussed. All of the participants of the focus group were computer science majors in their junior year. The women represented varying career trajectories including wanting to be research scientists, consultants and to pursue careers in software development and network securities.

I opened the focus group with a clip from a heavily critiqued commercial produced by the European Commission (2012), the governing body of the European Union (EU) (see Figure 21). As a part of the Committee's Women in Research and Innovation Initiative, the advertisement (which can be downloaded in 24 different languages) was developed as an attempt to appeal to young women and girls from the 29 member states of the union and to recruit them into STEM fields.

Figure 21. Image A from "Science: It's a girl thing!" video

In a written statement, Maire Geoghegan-Quinn, the European Research, Innovation and

Science Commissioner, presented the intentions of the commercial:

> "This campaign will show women and girls that science does not just mean old
> men in white coats. We hope that by providing positive role models and by
> explaining the options we can persuade more young women to stick with
> science."(Geoghegan-Quinn, M., June 22, 2012)

Though the commercial was originally intended for the EU audience, through the

availability of the World Wide Web, the commercial has gained international popularity.

The concept "Science: it's a girl thing" was originally created in the U.S by the Education

Equity Center (EEC) at the Academy for Educational Development in 2009.

(EdQuity.org, 2009) The EEC developed activities and materials for parents to help foster

interests in science at home with their daughters. Through the funding of the National

Science Foundation, flashcards and booklets were produced and distributed to families at

no cost. Expanding on the EEC science programming, the makers of the "Science: It's a

girl thing!" commercial, visualized the ways they perceived the linkage between science

programming and the interests of young women and girls, in general.

I chose to use this clip primarily for the purposes of opening the focus group

discussion with a lighter topic and also to explore the types of responses the commercial

would illicit from the students. The fifty-three second commercial, "Science: it's a girl

thing", begins with three women appearing to represent different racial/ethnic

backgrounds, walking down the corridor of a white room in high heeled shoes similar to a

fashion show runway. At the end of this runway walk, the women pose and garner the

attention of a white male scientist looking through a microscope until the three women

purposefully distracted him. The women then flirtatiously giggle and model their

sunglasses. This introductory segment is then followed by short interchanging sequences

of cosmetics, one of the women appearing to solve a mathematics equation on a clear

board, and explosions of cosmetic products and chemicals, which are purposefully

indistinguishable. The commercial ends with the word "science" written using a cosmetic

pencil at the top left corner of a pair of protective goggles followed by the women now

posed wearing these goggles. And finally, the phrase "Science: it's a girl thing!" sprawls

across the screen (see Figure 22).

Figure 22. Image B from "Science: It's a girl thing!" video

Following its 2012 launch, scientists and science communicators took to social networking sites such as Facebook and Twitter, to express their outrage over the "sexist" and "stereotypical"[48] imagery, referring to the commercial as a viral fiasco.[49] Although not explicitly stated, the underlying theme of the commercial suggests "the prospects of making cosmetics and attracting male scientists would make science more appealing to young women." Heavily criticized for perpetuating stereotypes about the values and contributions of women who choose to pursue science, the commercial was promptly removed from the commission's website.

Sara O'Connor shared the video on YouTube with the following caption:

> "This Disgraceful video was published by the European Commission for a campaign designed to attract more women to a career in science. The commission said that the video had to "speak their language to get their attention" and that it was intended to be "fun, catchy" and strike a chord with young people. "I would encourage everyone to have a look at the wider campaign and the many videos already online of female researchers talking about their jobs and lives,"

From the comments section of the shared video, references on social media and blogs, the general consensus from viewers (which included women currently working as scientists), was that the video was condescending and degrading. Comments in support of the commercial asserted that it reflected the interests of the intended demographic.

> "Well, we are trying to get young girls into science not women. How may young women respond to this?"

While I do agree that the commercial perpetuates limiting stereotypes of the interests of women, I find the choice in the representation of scientists to be equally as problematic.

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[48] Sharp, G., June 22, 2012
[49] Rice, C., June 29, 2012

First, the only male scientist in the commercial appears to be a white male and the lead women scientist is depicted as a white female. Both stereotypes of the white male standard scientist and his white female counterpart are maintained. Women scientists are portrayed as having alternate research interests and practices that vary from those of the stereotypical male scientists. In the commercial, science for women is fun and flirty and less serious then the typical science conducted by men.

Second, of the two remaining scientists, one is depicted as racially ambiguous while the other is depicted as markedly African American (connoted by her hairstyle and dress). Both characters play secondary roles in the commercial. As highlighted in the preceding chapter, the discourse concerning women and science is still based on white women as the standard. The imagery of the commercial aligns with the model. The women in the commercial are visibly marked as different but that is where diversity stops. All three of the women scientists are conducting experiments in the field of cosmetics, at different stages; each exhibiting similar behaviors and vying for the attention of the same presumed male counterpart. The lack of commentary concerning the persistence of the white male standard and his white female counterpart in the commercial's casting, exemplifies the tendency of the discourse to position so-called women of color at the margins of science communities. Overall, the commercial frames the gender disparity is STEM fields as stemming from the lack of interest in science amongst women and girls rather than from the exclusionary practices and notions about women in STEM fields and communities.

The participants of the focus group at Spelman were not prefaced with the background of the commercial nor its commentary. Also, none of the participants reported seeing the commercial prior to the focus group. As third year computer science and engineering majors, the participants were further along in their studies than the intended audience of adolescent girls undecided on a particular career path. Therefore, I anticipated student responses to somewhat align with the general consensus held by viewers of the commercial. All of the participants watched the clip and a few giggled as some of the imagery was a bit exaggerated. At the end of the clip, I looked to the group with an encouraging expression and asked the participants to respond…

"So, what do you all think about this commercial?"

The students looked around, some grinning at each other. The room was quiet until a student sitting in the front row responded.

"Well it was interesting. I've never seen a commercial like that. It's different."

Other students began to chime in with similar responses. In an attempt to allow for more critical responses, I presented the background and critiques of the commercial. Then a student promptly responded in agency with the following critique:

"Yea, it is kind of stereotypical. Like all women care about is makeup"

Additional students chimed in…

"Well that's not all we care about."

"I can see why someone would say that but that's not all women"

It appeared as if some of the students were waiting to gauge the type of response I expected. Once I presented the critiques of the clip, students were freer in responding.

The "icebreaker" worked. However, the variety in student responses prompted by these images was the most significant result of the activity. The range in student responses from "yea that's [kind of] stereotypical" to "we never see girly or feminine scientists" offers a unique lens to look into what it means to be a scientist across multiple identity domains. The critiques of the commercial by Sarah O'Connor and others showcased under the clip, demonstrates the tendency to challenge images and connotations, which portray women as hyper-feminine. Counter arguments to the stereotype highlight the multiplicity and complexity of women and the fact that the interests of women as scientist are no more impacted by gender than their male colleagues. A plausibly inadvertent outcome of this video is that, women as scientists are perceived as **less** feminine because science is construed to be a masculine endeavor. Being a scientist and being "feminine" (including stereotypically and self-identified) are polarized positions in both discourses but in different ways. The first framing, as depicted in the commercial, connotes a science that is inclusive of the perceived interests of girls—science is not inherently inclusive of young girls, but we can incorporate the interests of women to depict a type of science suitable for girls. The second, highlighted in the critiques of scientists such as Sarah O'Connor and other women currently in science careers, challenges the stereotypes about women perpetuated in such projects, but also dictates "what is science" for women based on a particular understanding and set of experiences of womanhood and feminisms. Neither discourse however, provides a more nuanced and diverse dialogue in how to increase the number of young women in science, especially young African American women.

Science identities that are perceived to be accessible for all women and people of color, pose an additional obstacle for women of color who may not align as well with these fixed categories. Feminist critiques of science practice represent a particular experience of exclusion from science and do not fully consider the collision between multiple axes of oppression for women at the intersections. As previously discussed throughout this project, white middle and upper class women are the central focus in addressing gender bias and sexism in institutional practices and cultural landscape of scientific knowledge production here in the United States and the western world. In addition, the experiences of men are central to efforts addressing racism and racial discrimination. Both critical lenses highlight exclusionary practices and ideals that impact access and viability of women and people of color in science education and careers but together, do not capture the experience across both axes of oppression. For the participants in the focus group, the monolithic portrayal of women in science extends beyond just the stereotypes about the interests and work of women but also to the types of women who do science. Gender through the lens of race does not afford the same sort of femininity to all women. (Okazawa-Reya, M., Robinson, T., and Ward, J., 2008)

Research on the social and learning experiences of African American adolescent women in schools, demonstrates how their experiences differ from African American males due to the interaction of race and gender. (Fordham, 1993; Koonce, 2012; Ispa-Landa, 2013) According to this research, the stereotypical association of aggression, loudness and toughness resulted in African American girls feeling as though they "failed to embody characteristics of femininity" yet for African American boys stereotypes about

black men worked in their favor. (Ispa-Landa, 2013) Institutionally, African American girls are treated differently than other groups of girls in schools. In the report, Black girls matter: Pushed out, over policed and under protected (2014), intersectionality theory pioneer, Kimberle Crenshaw found that black girls were disciplined and expelled from schools at higher rates than their non-black peers. (2014) In addition, black girls received more severe sentences once they enter the juvenile system. The domains of race and gender are stratified in which all persons do not have equal access to the identity domains. The intersection of the axes of race and gender shape a markedly different experience and set of social expectation for African American women and girl in comparison to their peers.

Science, Feminisms and Femininities

Participant responses highlight how the decision to pursue a career in science and technology is impacted by negotiations made at the intersection. Most of the participants stated that they thought the depiction in the video was a positive image of scientists.

> "I think it's a different representation of scientists. We never see more girly scientists."

> "Its kind of fun. I liked when the girls strutted down the runway"

> "Just because we can do science doesn't mean we can't be women too. That's a good message"

> "I think they did a good job showing different sides of scientists"

The responses demonstrated the ways characteristics marked as *hyper-feminine* and/or stereotypical by critics such as Sarah O'Connor are not perceived as problematic

for the young women in this study. Many of the participants stated that maintaining their femininity/feminine identities were important to them.

Interested in their notions of feminine and/or femininity, I asked students to share their definitions of the terms. Student responses included "well doing things like dressing fashionable, hair, make up, you know", "being a girl, just because I work with computers doesn't mean I'm not a girl" These responses represent the general consensus of the group as the other students nodded in agreement. In my analysis, the concept of femininity, within this space, primarily refers to physical appearance and behaviors that are recognizably "girly".

Femininity may be defined as the socially constructed standards for women's appearance, demeanor and values. (Bordo, 1993: 316). In the United States, it is hegemonic in that it is generally Eurocentric and necessitates that women, individually and collectively, support men's dominant place in society by being nurturing, emotional, caring and, physically attractive. (Connell, 2002; Dyer, 1993) Physical appearance is presented as a key element of hegemonic femininity in the U.S; however, African American women's ideal body standards are discussed as varying from those of the larger society. (Connell, 2002; Dyer, 1993) Appearance, as in perception of a female body ideal and standard, may be a point where African American women diverge from the standard. However, I argue that appearance, as in performance, is far more significant for African American women than for their non-black counterparts. (Chaney, 2011) The intersection between race and gender increases the significance of the demonstration of femininity through performance. (Brewer, RM., 1999; Collins, PH., 2004; Lester, J., 2008) This

demonstration includes performing acts, which portray women as nurturing and "soft", and is also expressed through etiquette and clothing selection. Performing gender is the repetition of acts, an imitation or miming of the dominant conventions of gender. (Butler, J., 2002) At Spelman College, this is evidenced by the history of strict behavioral and dress code regulations and expectation of students (discussed in Chapter 2) and the reminisce of some of these regulations such as the "White Dress Tradition"[50] as a part of the legacy and identity of a "Spelman Woman", at the time of this research.

Research exploring African American women perceptions of womanhood and femininity find that both are impacted by the level of educational attainment, social class and economic position as well as in relationship to black men (to be further discussed later in the chapter). (Collins, PH., 1994; Hill, SA. 2005; Chaney, 2011) Essentially, this research shows that education and socioeconomic status are correlated with femininity and womanhood due to intersections of race and class. In her 2011 study exploring perception of womanhood, Chaney finds that for the African American women in her study, womanhood is defined by aspects of dominant feminine behaviors and attitudes but is grounded in social and familial roles such as being a daughter, mother and/or wife. (Chaney, 2011) These traits are perceived as accessible through educational attainment and/or a rise in socioeconomic status as well as from transformative experiences such as childbirth. (Cornell, 2002) These ideals were consistent among the women in Chaney's (2011) study who ranged from 16 years old to 80 years of age.

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[50] The White Dress policy requires Spelman students to wear of **pure** white to all special occasions and formal events on campus. Initially, the policy required Spelman students to wear white dresses however in 1996, students were allowed to wear a white skirt, suit or dress. Spelman Resource Guide, 2012-2013

Similarly, the student participants in my research project expressed attitudes about femininity that in some ways aligned with the behaviors regarded as stereotypical by critiques such as Sarah O'Connor and framed them as not opposing to their aspirations of being scientists and/or technologists. Institutional learning environments are primarily intended as places for educational attainment but also operate as the environments in which transformative moments such as the development of an identity as a woman or a feminine identity may occur.

Keenly aware of the role of the institution in this process, the institutional ideology at Spelman College is geared towards fostering an environment for the holistic development of African American women that considers the complexities of the intersection of race and gender. This is done institutionally through interdisciplinary and social programs promoting the values of service and social engagement, hosting conferences such as Women in Leadership and the hosting of invited panels composed of African American women from varying STEM fields. Informally, this is done by faculty members and administrators actively providing research and mentorship opportunities for students and developing a network amongst Spelman students and alumnae reflecting the values of the institution. This is not to be confused with a monolithic Black/African American feminine or womanhood identity. Students at Spelman have in the past and continue to challenge authoritative ideals and expectations of African American women, femininity, womanhood and education since the college's foundational period. (Guy-Sheftall and Stewart, 1989, 1991; Falconer, 1989; Fallon, 2009) Instead, it displays the ways science learning within the institutional and historical identity of Spelman College

as a place is engaged with larger social conventions of gender/race. There is no general consensus amongst the Spelman students who participated in this research project about ideals of science, femininity, or what it means to be a scientists and a woman. The research conducted throughout this project demonstrates that there is diversity amongst and fluidity within and between these notions with the Spelman campus community and that the uniqueness of each student is valued.

During our interview, I asked Dr. Sidbury, the Director of Institutional Research, to share any commonalities or characteristics she has observed amongst students in STEM at Spelman College.

> "They are all individuals. For the students who do care to get on the path can go anywhere. Student willing to make a commitment. Even when they don't buy in or trust the institutions. Someone will meet them where they are. We (Spelman faculty members and administrators) try to meet students were they are. If you want to do research, there is an opportunity to do so right here. If you want to travel, we have someone to help you do that. As long as students take the first step, we will meet them halfway. They don't have to know everything right then."

In my analysis, this organizational approach reflected the belief that each student is considered an individual. Students do not perceive that they have to negotiate between pursuing a career in STEM and their personal aspirations, social roles or expectation, or desires because of the fluidity in the pedagogical approach at the college. This approach offers the opportunity to gain the skills and experiences that are markers of a "sound" scientist-in-the-making through various avenues. Graduating senior, Jazette, stated that accessibility to STEM resources through Spelman was a great advantage.

> "I'm from New York but moved to savannah, GA with my mom to be closer to her parents. She's from Georgia. She didn't want me to go to school out of state. I chose Spelman because the computer science department is really good. I have four years of research experience on different projects on campus. That helped me get into one of the top PhD programs in robotics. You've got to have research experience"

Here, Jazette discusses the ways she has been able to gain research experience in robotics and computer science while still remaining relatively close to her home community. Spelman College is unique as a small liberal arts university in its offering of research experiences to undergraduate students by offering a variety of sponsored research funded research opportunities for Spelman students. The dimension of place in science practice at Spelman is stable. Students do not have to choose because the climate does not force them to choose. Further, they are not forced to conform to notions or ideals of what it means to be a scientist or a "competitive" science student. Dr. Rankin, an African American female faculty member discussed the importance of openly offering opportunities for young women.

> "I completed my undergrad at an HBCU[51]. My professors were so helpful. We could give them a call if we had questions about an assignment. When I went to graduate school at a PWI [predominantly white institution] the professors were not as helpful. They worked with students who were very active in seeking them out. It was so competitive. I was a bit intimidated. I didn't do well my first semester. That's why I try to offer guidance to my students but also help them to develop the confidence to seek help when they need it. With our students we have to put out a hand first."

The learning environment at Spelman is intentionally structured to foster the student learning and development in science through the consideration of ideals that permeate the

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[51] Dr. Rankin completed a B.S in mathematics from Tougaloo College in Tougaloo, Mississippi. She completed an MA in Computer Science at Kent State and a PhD in Computer Science at Northwestern University

so called normative structure of science as well as the actual needs of African American women students produced by the skewed model that results from the intersection of race, gender, and class biases.

In isolation, student responses and faculty ideals may appear as stemming from other factors such as individual personality, and personal aesthetics and preferences. However the assertion that black women could be both women and scientists is directly in line with the vision of the two African American women faculty members who laid the framework for the development of the science center. (Falconer, 1989) Dr. Etta Falconer and Dr. Shirley McBay envisioned an environment that nurtured the holistic development of Spelman women through a curriculum that allowed them to be both "female and scientists". (Falconer, 1989; Scrivens, 2006) Affirming an identity as a woman is framed as a social need beginning with the conceptualization of the center in the late 1980s and has been maintained over time. Dr. Lawrence, chair of the department of computer science, stated that what makes Spelman special is "the fact that we are all women". This ideal of a science-learning environment specifically developed to train African American women that is not gender neutral but rather welcomes diverse notions of what it means to be a "woman-scientist" is evident in the ideals shared by students and faculty members in STEM. (Falconer, 1989)

What does it mean to be a Spelman Woman?

The emergence of a womanhood identity generally occurs through lifecycle transitions such as motherhood, maternal family influences and by cultivating wisdom through life experiences and formal education. (Murray, N., 2010) For the young women

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in this research project, Spelman College operates as both the site of and as an active agent in the emergence of this identity. With a keen awareness of this role, the pedagogy and institutional approach at Spelman focuses on fostering a learning environment that nurtures and empowers the development of women of African descent. (Guy-Sheftall and Stewart, 1989) The significance of a Spelman Education is outlined in the "Spelman Standards of Excellence Honor Code"[52].

> "A Spelman education requires the highest standards of excellence and inspires passionate, goal-oriented, responsible, respectful, compassionate, gifted, humane, and socially conscious women to take action to positively impact the world"

The values of academic excellence, social engagement, responsibility, and service represent the essence of the Spelman campus community and are embodied in the institutional approach and identity. What it means to be a Spelman woman is also embedded in this ideology and explicitly outline in the Standards of Excellence shown below.

> "Spelman women are socially and politically conscious, educated to be aware of themselves and their environment. I am a woman of Spelman: intelligent, beautiful, intrepid, confident and socially conscious. I am Spelman College, and Spelman College is me."

As indicated by the above excerpts from the Spelman Honor code, the Spelman College identity as a place and the identity domain of Spelman woman are dynamic and engaged with broader notions of African American womanhood and feminism. The institution willingly assumes an active role in the development of women as social agents through the process of higher education. STEM knowledge production, learning and practice, just

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[52] The Spelman Standards of excellence Honor Code is given to each student during the freshman orientation. By signing their addition documents, each student agrees to adhere to the standards outlined.

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as all experiences within this space, is situated within a particular form of what it means

to be a woman of Spelman. As indicated by the statement above, she is intelligent,

confident, and socially conscious. She is also beautiful and intrepid. Throughout the

fieldwork of this research project, I have observed the ways the values detailed in the

honor code construct the cultural domain of the college. At this point of the dissertation, I

have explored the values of excellence, responsibility, and social engagement evidenced

in the foundational framework discussed in Chapter 2, the notions of science and identity

formation (Chapter 3), institutional ideologies and pedagogy shared by faculty members

and administrators (Chapter 4), and the perceptions of being a woman and a scientist

earlier in this chapter. What it means to be a woman within this space is shaped by the

institutional history, the region and by the legacies of Spelman alumna. Based on my

research, I have come to the conclusion that the values of service, responsibility, and

compassion are at the core of the institutional identity but stem from the women of

Spelman. This is explicit in the statement, "I am Spelman, Spelman is me." In an

interview with Dr. Sidbury, the director of institutional research, she states:

> "Service learning is a key part of the pedagogy at Spelman. But what's so
> important is that the students here already come with this value. They are
> volunteers and mentors in their communities and high schools. We don't
> have to do much in that area."

Along with insights gained through interviews and observations, I note that service to

others is honored and possesses a positive connotation amongst the campus community.

Seniors in the Department of Computer Science, Zazie L. and Jazette J., discussed the

significance of service and being a role model in their academic experience.

> "Learning science is important. Exposing African Americans to science is very important. A lot are not exposed they may never get into. They may do well and maybe strong in it. I want to help introduce younger students to science." –Zazie L.

> "I have a younger brother and an older sister who did not go to college. My younger brother is looking up to me. He is graduating from a STEM middle school. I see him watching me. I'm role model."- Jazette J.

Zazie and Jazette both participated in mentorship and community service activities as high school students. They share a sense of responsibility to contribute to the development of younger African American students and are both working on senior projects (to be detailed in Chapter 6) that are tailored to address social ailments impacts their communities.

Service also includes outreach programs and informal networks for other Spelman women on campus, referred to as "in-reach".

> "Within the [comp] science department, freshman and sophomores look up to you. We have a research day where we present our work to students from other departments. My advisor is always trying to recruit new students. I tell them they can do it, they say they cant but I always tell them, no they can!"- Jazette J.

During our interview, Jazette discussed her position as a senior in the department as being a role model to freshman and sophomore students. For Jazette, being a role model and inspiring other students at Spelman is an important part of her academic career at the school.

Nearly all of the students in the focus group had participated in mentorship programs with students at local middle and high schools, and believed that it is important for them to recruit other young African Americans into STEM fields. This value of service to others is organic and ubiquitous. Service is a key component of the cultural

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domain of the campus community and institutional identity because both are situated within a particular ideal of a Spelman Woman.

The below image was taken during my initial observations of the Science Center. Directly above the bulletin board for the department of Health Sciences, read the statement "I Am An Engineer, I Serve Mankind!" (see Figure 23). Each letter was individually cut and pasted with the first letter of each word capitalized.

Figure 23. Photo of "I Am An Engineer, I Serve Mankind!" display.

There is no indication of the author or meaning behind the statement. However, this image is the clearest depiction of the explicit connection between STEM learning and service as a part of the cultural domain at Spelman College. It is also important to note the use of the term "mankind". This is the only time the term was used or referenced throughout the fieldwork of this research project. The value of service shared by students, faculty and administrators was in reference to either peer or faculty student mentorship, community service, outreach programing or local, national and/or global social engagement. The closest reference to "mankind" was in a conversation with Dr. Johnella

Butler during which she used the term "humankind". [53] I cannot gauge the significance of the use of this term in the display however; I believe it is important to note its singularity in this dissertation.

The identity of a "Spelman Women" is in conversation with a particular notion of African American womanhood that includes the expectation and value of service and responsibility, and transcends the science learning curriculum and student experiences. Faculty members also reaffirm the deeply held value of service through their own roles as individual mentors and role models for students. Dr. Sidbury explains the importance of both for young African American women in science:

> "Models talk about mentoring but we've known that. At Spelman, service begins with new students. It is intentional. Service is given back. Personnel and Faculty make up inspire students to replicate this model and faculty role models help students to connect with science. This is VERY SPECIAL. No one can do it like Spelman, we graduate students. We have a legacy of outstanding women including poets, filmmakers and politicians."

While student- faculty mentorship, STEM learning discourse and service learning is becoming a top priority in higher education nationally, these principles have been the cornerstone of the Spelman learning experience for decades.

Gender Dynamics Amongst Students and Colleges

> "I dated a guy and he knew I was a teacher but assumed I meant K-12. One day he asked me what I taught and I said computer science. He said, "Oh that's hard". I knew he wasn't the one for me. There are negative associations with women as computer scientists because there are issues with women being smart." - Dr. Andrea Lawrence

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[53] Interview with Johnella Butler March 2013

Science is hard…math is hard. Therefore, to learn either of these perceived difficult subjects and then to pursue a career related to these fields, one must be very smart. Dr. Lawrence addresses a central underlying factor informing the biases against individuals historically excluded from science. The perceived difficulty of STEM fields is associated with individuals who are capable of meeting the intellectual demands of pursing a degree and working in STEM. Intelligence and academic performance, both auditable metrics, are ascribed to men, along the axis of gender and white man and women across that of race/ethnicity. The privileging of the white maleness within the social structure and historical narratives of US society extends to also the privileging of "white maleness" in the social structure of western science practice. The characteristics described as markers of a "sound scientist" such as intelligence and knowledgeable are constructed as inherent white male traits and freely ascribed to constructed white male bodies. While these assumptions/biases have shifted due to changing student demographics and shifts in some cultural stereotypes (academic performance and intelligence in Asian American populations), biases against African American men and women have been maintained. Efforts to make science learning more inclusive for young women generally focus on presenting a science that speaks to the perceived needs of women as presented by commercial discussed earlier in this chapter. Regardless of the accuracy/inaccuracy of these needs, the cultural underpinnings and assumptions of what makes science socially exclusive for women is not challenged. Science is perceived as a masculine endeavor less suitable for women due to conceptualizations of the rigor and

demands of science learning and careers as being too demanding or uninteresting and beyond the capabilities of women. The cultural and identity domains of science are informed by stereotypes of men with measurable and exceptional levels of intelligence which best suitable for them becoming scientists versus women. The persistent belief in notions of inherent characteristics such as intelligence and access to universal and objective perspectives of the natural world are, in the 21st century still perceived to be innate in some people and not others - in men and not women. Dr. Lawrence cites the negative associations of women in computer science; generally begin with the biases that science is hard and smart women are less desirable as mates.

Reflecting on her dating experiences, Dr. Lawrence also touched on the presumptions of the types of careers suitable for women. The man Dr. Lawrence was dating at the time assumed she taught at the primary or secondary level. It was not until he directly asked about her work that he found out that she taught college level computer science and had aspirations of completing a doctorate in the field. Dr. Lawrence stated that their relationship ended soon after the above moment. Dr. Lawrence's boyfriend did not perceive her being a teacher as problematic up until the moment detailed above. The characteristics associated with being a primary and secondary teacher (nurturing, caring and supportive) did not challenge his presumptions about her roles based on gender and/or race. Dr. Lawrence cites her then partners response to the discipline and academic level as the final indicator that they were incompatible. While the relationship between the two may have been strained up to this point, an underlying theme of their disagreements was driven by gendered expectations. A career in STEM, particularly as

an expert, has connotations, which extend beyond area competence, performing and identifying with science. Within an environment, which prioritizes scientific and technological knowledge and skill, experts in STEM fields are regarded with authority. However, being an authority challenges preconceived gender roles in some spaces and demands a particular set of negotiations. The conceptualization of science as authoritative in non-science communities interacts with community gender expectations. In conjunction with findings discussed earlier in this dissertation, regarding students opting to become authorities in their field rather than in their communities, choosing science demands negotiating competing identities and arguably forcing fragmentation.

Dr. Lawrence continued by also sharing that it takes a "special man" to be okay with a smart woman and that some men find it challenging. I translate the adjective "special" to mean considerate of the demands and negotiations made by women at the intersections of race and gender in both science and social communities. The challenge is to consider the implications of the interactions between multiple axes in conversations of women. While Dr. Lawrence and her then boyfriend, may not have been compatible, this experience at least allowed her to develop clarity in what it would mean to pursue her academic and professional trajectory as well as to understand better the characteristics of suitable partner.

With Dr. Lawrence's permission, I shared the above anecdote with students during the focus group to examine if being a young woman in computer science presented similar issues in personal interactions and relationships with men. Many of the students found the anecdote a bit comical presumably due to Dr. Lawrence's position at

Spelman. Overall, students were shocked by the narrative and did not perceive that their

respective field of study would impact current or future personal relationships.

> I'm not dating at the moment but when I was, he was always proud of my
> accomplishments. Whether it was grades or an internship. That's the
> norm. When you get older maybe it can be a problem but that's more so if
> the other person is unsure of their career path. – Zazie L.

For the young women in this study, Dr. Lawrence's anecdote was a "sign of the times" to

quote a student in her junior year. Other faculty members shared similar experiences with

Dr. Lawrence. The differing experiences and perspectives of the interaction between

gender and STEM careers indicate a shift in gender expectations over time. The

generational gap between Dr. Lawrence and the undergraduate students at Spelman can

be cited as the source of differing perspectives and experiences. Dr. Lawrence began her

career in computing prior to there being a computer science department at Spelman;

therefore her undergraduate degree is in mathematics obtained in the mid 1970s. I say

this to say that, Dr. Lawrence began her career at the forefront of a budding new field,

Computer Science, and helped to pave the way for her students today. While African

American women are still grossly underrepresented in the field of Computer Science, the

students in this study are able to build on a legacy of women in science and leadership in

an environment that is more inclusive of women, in general. This allows for the

development of more dynamic women in STEM fields, and therefore more dynamic ways

of defining who and what a scientist looks like and acts like.

Generally, students perceive ones clarity as opposed to the others uncertainty in

career trajectory to be more impactful than their specific field in dating relationships. In

addition, students shared that they are more likely to date someone who is also in their

field than someone in an unrelated discipline. This can be attributed to the dominance of

men in computer science and all fields of engineering.

> "There are so many guys in CS. If one doesn't support your goals, it's
> easy to move on and find someone who does."

> "I think guys in computing are interested in girls in the field too. We have
> a lot of things in common."

For the young women in this study, computer science and engineering communities

increase their options for potential partners. Their male counterparts perceive their

interests in the male dominated fields of computing and engineering as attractive rather

than as deterring. As discussed earlier in this chapter, the aesthetic values and behaviors

of African American women differ from those of hegemonic femininity in that they are

largely informed by the values of African American men rather than Eurocentric

aesthetics. Chaney (2011) argues that the African American women perceive themselves

as complementary to African American men and visa versa. Therefore, for African

American men and women, suitable partners possess similar values to one another. From

my analysis, this appears to be true in the shared Spelman and Morehouse campus

community. A Spelman Woman is complimentary to a Morehouse Man. The values of

character, scholarship and leadership that define a Morehouse man reflect the values of

academic excellence, social consciousness, and grace that define a Spelman woman.

From my analysis, these values overlap yet are tailored to align with local and regional

sociocultural gender expectations. For instance leadership for Morehouse men is defined

the legacies of prominent Morehouse alumna, specifically, civil rights activist Dr. Martin

Luther King Jr. A quintessential Morehouse man is a visionary that uses his intellect and compassion to lead both men and women. While leadership for a Spelman woman begins with self-awareness and social consciousness. Her scholarship and compassion are tools for self-empowerment and impacting the community. She leads by example and empowers other women. This is evidenced by student perceptions of leadership (discussed in Chapter 3). In this study, Spelman students' responses indicated that being a leader in their field or industry was very important however being a leader in their communities was not as important.[54] While a more in-depth examination of gender dynamics between the two institutions is needed, this data alludes to the ways historical events and intragroup sociocultural gender expectations shape institutional science learning.

Spelman's proximity to its "brother college", Morehouse, places gender expectations, ideals of womanhood and femininity in continual contact with men. This conversation is different from typical male-female interactions found in colleges and universities in that each institution directly governs the interaction between men and women. At the beginning of the academic year, each Spelman freshman, a sister, is paired with a Morehouse freshman her brother.

The Brother-Sister network[55], referring to the collaborative efforts between the institutions to educate and empower African American students, is extended to the students on both campuses. With the intentions to remain platonic, this exchange

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[54] Survey responses

[55] Reference to the formal support network between Morehouse and Spelman Colleges

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encouraged the co-development of African American men and women and solidifies the ties between the two institutions. The emphasis on "standards" and "excellence" were enacted through the encouragement yet regulation of social practices at Spelman, which informally defined African American womanhood as heterosexual, smart, "non-promiscuous", spiritual, and developed healthy relationships with Morehouse men. (Fallon, 2009) In some ways, these characteristics reflect hegemonic feminine aesthetics and values and in other ways attitudes about the type of education and training that should be offered to black women. (Guy-sheftall and Stewart, 1981) Overall, the structural and social engagement between these institutions adds an additional dimension to the learning experiences and personal development of the women at Spelman.

The archetypal Morehouse man and Spelman woman continually engage in a mutually dependent and reaffirming relationship that also operate to produce "acceptable" representations of African Americans. These images were broadcasted to a national audience through media in films by Morehouse alum and social commentator, Spike Lee as well as sitcoms such as "A Different World" which was based on African American women attending a women's HBCU, Hillman College[56] (read as Spelman college).

Morehouse men and Spelman women were constructed as *class* privileged and publicized as respectable ideals and images for African Americans. It is difficult to pinpoint whether these ideals are rooted in the historical and cultural identity of African

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[56] The sitcom airing between 1987 and 1993 and taped on the Spelman college campus, addresses issues faced by African Americans at the time but also constructed and transmitted images of social expectations of gender and interaction amongst African Americans

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Americans in Atlanta, Sweet Auburn district (discussed in Chapter 2), or extensions of

the foundational frameworks of the institution. The values of reciprocity between African

American women and men, communal identity, and complementary male-female

relationships are also present in the larger community of Atlanta. (Dorsey, A., 2004;

Jowell, J., 2009) However, it is clear that the relationship between the two colleges and

orchestrated and informal dynamics between their respective student populations are

engaged with the same social and gender-based expectations that permeate the larger

society.

Science amongst Spelman Sisters

During an in-depth interview with Spelman Senior, Zazie L., she discussed the

value of teamwork in computing research and her experience as a summer intern at the

University of Indiana.

> "I got to meet other students. At Spelman, I already knew everyone in the lab. But now I made friends at Indiana. Our first night we did team building activities and then we picked roommates. Everyone was nice. Most of us didn't talk to everyone. You stuck to your roommates because you lived and worked with them. The research brings people because your home is your lab. You're with your group all day. Teamwork is essential. If you're unsure about something, you have someone to work on it with."

For Zazie, teamwork and team building are an important part of research in computer

science and engineering. Echoing the statements of IBM architect and Spelman Alumna,

Dana Taylor, skill and the work of science are what bring people together. I then asked

Zazie to discuss her experiences conducting research at Spelman.

> "Same thing at Spelman just takes a lot longer. The girls here, work more alone than other schools."

I asked why?

> "For a lot of people… They're more focused on grades.
> If you can't be of assistance to them, they don't really work with
> you. Some like working alone because it is a distraction."

Here, Zazie perceives teamwork on research projects at Spelman to be inhibited by the

priority of earning high grades over collaboration. This perception may be partly

attributed to the differences between her internship experiences spanning over the course

of a short summer versus on-campus research during the school year. During the summer

research, students primarily focus on their work as interns and are not required to take

coursework. However, similar dynamics can be found amongst student populations at

many colleges and universities. Zazie's perception more so speaks to the implications of

quantifiable measures of student learning under the conditions of auditability. (Shore,

2008; Deem, 2011)

In general, students at Spelman work collaboratively in supporting other women

at Spelman through peer tutoring as displayed by Jazette's service activities and through

leadership of student organizations for example; Zazie is also president of the

programming club. Students and faculty members actively support science learning with

the environment and reinvest in the Spelman Model of Empowerment. Spelman women

support Spelman women.

Classroom Dynamics

The preliminary portion of my fieldwork was spent as a participant observer in

the campus community and semi structured interviews with campus personnel. After

gaining insight on the overall campus structure, institutional identity and the primary

pedagogical approaches and expectations, I moved on to observe the classroom setting. The department chair suggested that I observe the elective course, Network Securities. The students in this class were computer science majors in their junior year and the course included both lecture and lab activities. The chair, Dr. Lawrence, also was the instructor of the course. Through my review of institutional documents and observations, I learned that elective courses included computer science majors at both Spelman and Morehouse colleges. The two institutions agreed to offer courses to both student populations to build on the strengths of the faculty on both campuses. The course was offered twice during the fall semester with the same instructor. I observed both classes to examine the differences and similarities of the student groups as well as classroom climate.

By this point of my fieldwork, I was well immersed into the campus community through participant observation. From the beginning of this research, I found the interaction between students and faculty members to be generally formal yet personally engaged. Students addressed faculty and staff using titles such as Mrs., Ms., Professor or Dr. The use of titles and greeting is informed by both campus and local cultural practices. The concepts of respect and "proper etiquette" are apart of the cultural domains of the campus community and the hegemonic style of communications in "the South." Generally, interaction between students and faculty and staff, would begin with a formal greeting such as:

> "Good afternoon, Dr. Lawrence"
> "Hi, Helen. How's it going? Were you able to find out more about_____?"

At this point, the conversation would organically develop based on the student's topic, which may be either personal, academic, and about local events or news. Faculty and staff encourages open conversations but still maintained their role as an authority. While these interactions may not appear to be unique to Spelman, I found student-faculty/staff interactions to be encouraged. Further, these interactions were not limited to particular relationships (student/advisors, PI/student researcher) but to all students in the campus community. During my observations on campus and in the science center, there were a number of times faculty and staff members inquired if I needed assistance or asked to know more about me, assuming I was a student. This is reflective of the value of holistic learning experiences through the personal and academic development of Spelman students as discussed by Drs. Sidbury and Lawrence.

The first class proceeded as I anticipated. Based on observations outside of the classroom, I was familiar with the instructor's approach to student learning and teaching and communication styles. I also had prior knowledge of the instructor's involvement with students through extracurricular activities, mentorship, and outreach programs. The class was generally led by the instructor and students alternated between taking notes and working on in-class assignments. Intermediately, the professor would ask a question and students would respond accordingly. The professor's delivery was at moments, direct as she appeared to have high expectations for her students and simultaneously encouraging. As junior computer science majors, the students were familiar with the instructor's approach and teaching style. Overall, the classroom climate was conducive for most students to actively engage with the material and with the professor.

Men in the Classroom

Although students enrolled at Morehouse are eligible to attend joint classes held on the Spelman campus, I rarely saw young men public spaces, in or headed to classrooms. Men were restricted from entering the living and dining areas of the campus. During incidents when I did see male students, they were heavily monitored by campus staff and administration and behaved as such. To enter the campus, male students were required to provide a campus identification card, the reason for their visit and an estimate of the time they would be on the campus. Campus policies and surveillance practices both formally and informally limited the male attendance on the campus. It is presumed that the intentions of such policies are to limit interaction between the genders. However, these policies also preserve the Spelman learning environment and campus ethos, which is reflective of the history and mission of the institution. Within a landscape of competing values, ideals and biases, fostering a learning environment best suited for the holistic development of African American women requires a firm commitment to protecting institutional ideals and the campus population.

Based on my observations during the first class, I anticipated the dynamics and climate of the second to be similar. As the class began to slowly trickle in, the instructor informed the class that representatives from the technology company, IBM[57], would be presenting information on a new program in development. Soon after, two representatives

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[57] International Business Machines (IBM) corporation representatives visit Spelman college twice a year to recruit graduating seniors. The group Black IBMers is a network of African American IBM professionals and is based in Atlanta, GA.

from the company arrive, one being Dana Taylor, a Spelman alumna[58] and Dwayne

Branch. While the representatives are setting up their presentation, two young men

dressed in black suits with black and gold ties, entered the room. Despite appearing

young, initially, I assumed they were also IBM representatives. It was not until I noticed

that they were both wearing backpacks, that I remembered that students from Morehouse

also attended classes and programs on the Spelman campus. I became accustomed to

being in the predominantly female environment; therefore, the two young men

immediately caught my attention. Continuing their conversation from the hall, the two sat

at the front of the room. Once class started, the two men listened attentively. Initially, the

classroom climate appeared to be the same. The material and activities were the same as

the class prior however the climate shifted, once the instructor posed a question to the

class. One of the two young men quickly raised his hand to answer. His response began

with the answer to the question and was followed by the context to which the other male

student commented. After a brief exchange, one of the students poses a question back to

the instructor. She responds, and continues to introduce the IBM representatives. The two

students were very engaged and knowledgeable of the material and contemporary topics

in the field.

Throughout the presentation, the two continued in the same manner to

enthusiastically answer, add context and ask questions. While their inquisitiveness and

confidence in the course are markers of the level of engagement most faculty express as

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[58] Dana Taylor is a Spelman alumna of the class of 1997. After an on-campus interview during her senior year, Dana has worked at IBM for 15years. An in depth interview was conducted in March 2013

desirable, it appeared as the rest of the class was not as engaged. The two students began

to dominate the conversation until the instructor interjected and asked for other students

to respond. The two young men recognized their behavior and did allow for other

students to respond. However, the women did not respond with the same level of

recognizable confidence in their answer as their male classmates. Though there may be

extenuating factors informing the way the students engaged in the classroom, such as

personality and conversational style, my observations lead me to believe that there is a

relationship between classroom climate and dynamics and the normative gendered

expectations within the shared social community between the colleges.

In both classes, Spelman students responded in similar ways. However, the

participation and behavior of the two male students highlighted varying expectation

based on gender. Prior to the instructor's interjection, the behavior of the two male

students appeared to be expected. The two students appeared to engage in a typical

manner. Additionally, Spelman students did not perceive their behavior as unusual.

During subsequent individual interviews, I asked students from the class to share their

perspective on that particular class. I anticipated students to reference the two young

men, in some way, however they did not. When explicitly asked about Morehouse

students in class, the young women did not perceive it to be problematic. One student

responded with, "well they can be very confident". Both Spelman and Morehouse

College emphasize leadership and empowerment to be imperative in developing their

respective student populations. However, the findings from this research highlight the

ways in which leadership and empowerment are framed relative to these expectations. It

is possible that the Spelman students who attended more classes on the Morehouse campus may display similar behaviors as the two male students discussed above. However, this research along with findings through interviews and participant observation show that leadership and empowerment are framed differently based on gendered expectations. Conversely, gender based expectation frame the ideals of leadership and empowerment to reaffirm these expectations. The findings of this research project offer insight into the dynamics intragroup gender roles and expectations and institution type within the realm of institutional learning. Further research is needed to explore the ways the science learning experiences of women trained in an all women's environment are implicated by the addition of men.

In the past, the Spelman College advisory board has been critiqued for championing an ideal Spelman woman, which preserves gender biases and women as secondary to men. The proximity and engagement between the two institutions supports the perseverance of such notions and behaviors, which makes Spelman markedly different from Bennett College (the other one of the two Women's HBCUs in the U.S.). The classroom climate discussed above, places the "Spelman Model of Empowerment" firmly into context. Here, the intersection between race and gender are institutionalized and produces a racialized gender that, at moments, is negotiated across the larger cultural landscape of science and during other moments, at home. In future research, I am motivated to explore the ways the emergence of Spelman College, as an institutional leader in STEM education for African Americans (both men and women by the numbers), inform these dynamics—that is, if they do at all.

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CHAPTER 6

CHOOSING AND BELONGING in SCIENCE and TECHNOLOGY

The unequal interactions between axes of oppression make the theoretical task of exploring their impact on the lived experience simultaneously an arduous undertaking. In both the lived experience and in practice, identity domains capture, transgress and at times, amplify the implications of each other within varying social, political and economic structures and dynamics. Within the United States, identity domains categorized as race/ethnicity, gender and class interact in particular ways depending on the demands of the social structure and those that benefit from its exclusionary practices-- just as any constructed subjectivity. It is important to highlight that while systems, institutions and structures may have inherited discriminatory practices; these practices are maintained by the efforts of individuals. To reiterate Provost Butler's point regarding the importance of the human factor, we must also consider the human factor in institutional and systemic oppression. If the successes of Spelman College lie in the development of an institutional ideology, mission and approach rooted in the experiences, histories and actual needs of African American women in the region, then we must assume that other institutions, similarly identified as science producing but varying in student demographics, have done the same. Exploring the lived experiences of African American woman and Spelman College as an institution demands the unveiling of systems of oppression and the often invisible and neutralized structures that preserve them. The veiling cloaks the human aspect, which discreetly preserves the advantages of some while maintaining oppression of others. In this chapter, I explore the lived experiences of

African American women in science environments at Spelman College in conversation with the so-called larger science and technology social landscape in addition to exploring familial and social expectations and the personal aspirations, perspectives and notions of science and technology of the women in this study. The research in this chapter will explore the ways the young women in this project navigate and negotiate across identity domains and create a place in science and technology, despite structural and social limitations. I end this chapter with the narratives of Jazette J. and Zazie L., two graduating seniors at Spelman College who's work, research and academic and personal development reflect the legacies of Spelman women in the past and now.

The Indivisible Scientist

A key indicator of the invisibility of African American women in science is the response to a brief description of this project. My research centers on the fieldwork conducted on the Spelman campus however, my time in transit between the campus, my home and university community and in the city of Atlanta also offers insight to the visibility of women of African defense in science and technology. Whether I was on a plane, on public transit or at a local eatery, the question of "what are you studying?" seemed to always come up during small conversations. Initially, the complexities of the theoretical framing of this project posed a challenge to provide a response that could easily be understood, for both our sakes. I soon settled on a short spiel, which began with, "I am exploring the experiences of African American women in computer science and engineering." In the large majority of these brief informal conversations, the other person responded with a brief pause and an utterance along the lines of "Oh. Oh wow." This

response may partially be attributed to a seemingly unconventional topic for anthropological inquiry but more explicit responses such as "wow, they exist" or "where could you study that?" lead me to believe otherwise.

Despite the successes of the Spelman college national and internationally competitive robotics team, the demand for Spelman alumnae in the technology labor market, and the increase of national attention to the topic of diversifying STEM students faculty and professionals, the concept of African American women and computer science, at an HBCU, typically receives a visibly intrigued, surprised and sometimes confused response. Additionally, the topic of diversity in STEM in the public sphere is generally dominated by quantified disparities or anecdotal experiences, hardly in tandem. In both instances, the landscape of computer science and STEM fields in general, does not discursively include scientists who are women and who are women of color. As stated throughout this project, the topic of STEM diversity is generally centered on the participation of women *or* people of color. This discourse and subsequent projects, rarely includes women of color and African American women, even less. However, for the women who do pursue degree programs and careers in these disciplines, the discursive invisibility additionally alters an already skewed landscape.

Throughout my fieldwork, I intentionally referred to focus group participants, faculty members and students I interacted with in the field, as scientists or scientists in training. Just as the respondents in the informal conversations highlighted above, students themselves were surprised and sometimes confused.

"Me?" A student responded, followed by a low chuckle. " I mean, I guess so"

Despite my encouragement, many students did not see themselves or their peers as scientists. This may partially be attributed to debates of whether the field of computer science and engineering is defined as a "science" based on its more recent development as a discipline and the conflation of computing as practice and computing as scientific inquiry. (Denning, P.M., 2005; Zweben, 2012) However, the debate concerning whether computer science is indeed a science subsided by the 1980s, is now one of the more popular majors on college and university campuses and self-identification as a computer is not uncommon for those within the field. (Zweben, 2012; US Dept. of Labor, 2012; NSF, 2013) Although I did not necessarily anticipate students to confidently affirm their identity as a scientist, I also did not anticipate responses of discomfort and lack of assurance. Aware of this tendency expressed by students, midway through the focus group, I prompted participants with the following:

> "I'm really interested in African American women scientists and scientists in training…such as you all in this room."

This statement was followed by a brief pause to allow and observe student responses. The room was silent. Sensing a bit of confusion, I proceeded in an encouraging manner:

> "You all are scientists... you do science right"?

Then, a student sitting in the front row, responded with the following:

> "I don't know. I guess I just don't see myself as a scientist. We do science but scientists are in labs. And I don't plan on doing that. I think of chemists"
> [Chuckles from the crowd]

At this point of my fieldwork, the above focus group responses were expected. Of the group, only one student shared that her career aspirations were of becoming a research scientist. However, even for her, identifying as a scientist was a challenge.

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It is clear, from the exchange highlighted above that explicitly identifying, as a scientist is not necessary for learning science not to do science. After all, participants of this study were either committed to completing their bachelors' degree in STEM, have completed or were nearing completion of those degrees. For computer science faculty interviewed, all holding doctoral degrees in STEM field, self-identification, as a scientist was not the primary identifier used. Scientist, as a label, connotes an experience, perspective and expectation, which do not necessarily align with the science promoted within this space (Spelman College).

In the broadest sense, a scientist is an individual engaging in a systemic activity towards knowledge production. (Kuhn, 2012) More narrowly, a scientist uses the scientific method and may be considered an expert in a field. Responses from the survey, focus group and interviews demonstrate that students and faculty at Spelman College generally accept this definition of a scientist. However, within the campus community there is a distinction made between **identity** as a scientist and the **practice of science** that transcends all disciplines. Rather than using the methods of science to add to the body of literature or knowledge in the field, at Spelman scientific knowledge itself is used to address the everyday lives and needs of the women. In this campus community, this distinction is intentional. Decoupling scientific knowledge production and the individual producing or using this knowledge allows for the opportunity to learn a science that is more personally engaged rather than intangible. STEM education is framed as having a use-value rather than as an extension of personal interest in a particular field. Identifying, as a person who "does science" is not perceived as a central component to working in the

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field or to science learning. During an interview, Dr. Lawrence's touted the framing of scientific knowledge and skill (here she refers to coding) as a useful key factor in the persistence and development of computer science majors at the college.

> "Our students are not just writing code, just to write code.
> They are using it to do something more than that"
>   -Dr. Lawrence

Echoing Dr. Lawrence, the young women in the focus group perceive science as a tool. During our interview, Spelman senior, Jazette J., stated "you can use robots to help people in different ways." For some, this tool is used to address health issues faced by family members such as an Alzheimer's-tracking device. For others, it is the financial stability and economic mobility that a career in STEM offers. Zazie, also a Spelman senior, shared that that "my family supported me more when they started to see that there's money in it." As previously discussed, STEM, as an enterprise is profitable an as a good career choice. Careers in STEM fields, especially engineering, offer some of the highest entry salaries for baccalaureate graduates. STEM education and skills are capital in the contemporary U.S. Labor market. While students may vary in the way they describe the use of science, the concept of science as a tool remains consistent.

In addition to the framing of science as a tool, the Spelman model and imagery associated with what it means to be a scientist contributes to the young women in this study's capacity, to self-identify and to be identified by other scientists (see Figure 24).

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Figure 24. Results of Image Search of "Scientists"

Some may attribute the invisibility of African American women as scientists, as informed

by their relatively limited representation amongst scientists. However, the persistence of

the stereotypical white middle-aged male scientist contributes to the underrepresentation

of African American women in STEM fields. The images shown above are the results of

a superficial web search of the term "scientist." These results demonstrate the prevalence

of this stereotype. Images of white men as scientists and innovators dominate the image

results of the search. A web search of 'scientist in a lab' is a bit more diverse as white

women as scientists are more prevalent. The web searches for 'women scientists' and

'scientist clip art' provide the most diverse depictions and 'technologist' produced the

least amount of diverse images. In the final image highlighting notable scientists, Mary

Curie and Neil deGrasse Young are the sole outliers from the stereotypical model. The

intentions of this search are to visualize the imagery associated with the identity of

scientists through historical and artistic depiction in social media. However, the

experiences and references to scientists made by the participants in this study at Spelman College are the most indicative of the saliency of the model and stereotype.

By this point in the dissertation, I have discussed the multiple ways Spelman College has developed an environment and approach to learning that directly addresses the needs of the student population. Additionally, the college is unique in providing visible role models of African American women as scientists and accessibility to these women. Below, Dr. Sidbury explains the significance of this experience for students in the following quote:

> "I never saw African American women as scientists.
> Also, here there are choices of African American women as advisor on graduate schools and careers. With faculty and advisors, there are no bias or motivation."

Yet, students still associate the idea of a 'scientists' with similar images (White and male) of the so-called normative structure of the science community.

> "When I think of a scientist, I think of Einstein."
> "I think of a guy, working in a lab"
> "Some one older. An expert"

Generally in a playful manner, participants in the student focus group and during interviews discuss images of scientists that align with the national model and stereotype. Their ideas about what scientists look like do not include themselves or the African American women scientists, technologists or mathematicians; they interact with on the campus. It is not until students are encouraged to think of themselves as scientists that race/ethnicity and gender are considered in this image. This finding speaks to the pervasiveness of this stereotype in their lives. That even in this environment- inclusive of

African American women scientists, accessible role models, and a legacy and historical

narrative of African American women in STEM fields, the primary image of a scientist as

white and male persists. More importantly, students state that this model/stereotype must

change. Not only for their pursuit of careers in STEM but if equitable participation in

these fields is indeed the goal.

> "There was a time there were only four of us in the field.
> If one of us were presenting at a conference, we would call up the others to see
> who was going. We would try to be in the audience to support them.
> I had a friend that would not go if we were not going to be in there.
> Sometimes it was tough. The audience would be set on challenging every aspect
> of the research. Unfairly attacking the research and us as researchers. We need
> each other to deal with that."
>
> - Dr. Yolanda Rankin

Science identity and the capacity to self-identify as a scientist, cannot be adequately

discussed without considering who and how this identity domain is policed.

Microaggressions are cited as a key mechanism obstructing the academic development

and career trajectory for women from all underrepresented backgrounds. The above

anecdote shared by Dr. Rankin, African American woman and computer scientists at

Spelman College, exemplifies the ways in which science communities mitigate

accessibility to the identity domain. Here, career progression and viability is depended on

the support of informal relationships between women with a shared experience of

oppression. Not included in the above quote, Dr. Rankin also shared that members of the

audience did not come to their defense. The silence of the crowd permitted the behavior.

The faculty and administration of the Science Center at Spelman are well versed

in understanding the salience and negative impact that this exclusionary model can have

on the experiences of African American women in STEM at Spelman. Their own

experiences as African American women in computing and engineering are used to develop an approach to science learning that prepares their students to also engage in an environment that may not value or include them. To gauge the effectiveness of the Spelman learning approach, faculty members and chemists, Dr. Kimberley Jackson and Dr. Leyte Winfield, conducted a survey amongst Spelman STEM alumnae who went on to complete doctoral degrees. Of the 43 survey participants, 58% indicated that the perceptions about what scientists "look like" must be changed, and 39% indicated that there is a need to increase the presence of more relatable role models. (Jackson, K., & Winfield, L., 2014)

Spelman senior, Jazette J., perceives the accessibility to African American women in science and technology at Spelman College to be an asset to her academic development. Jazette shared her aspirations of earning a Ph.D. in Computer Science and is well aware the gender and racial disparities that currently dominate the topic of women and STEM. However, Jazette stated that she "rather not know" the details of these disparities as she experiences them and is beginning her graduate career.

> "The things they say about women in tech affect their confidence. If you say they shouldn't be here or that they aren't here, they won't take that risk or wont even go for it. Why would I go into it"?
> "They say they're aren't African American women but there actually are. There just are not enough."

For Jazette, the current topic of diversifying science and technology conveys the idea that there are little to no women, especially African American women in science and technology. Jazette perceives this framing as negatively impacting the choice to enter the field and the experiences of those currently in technology. From her perspective as a

student and peer-mentor, the prevalence of discussion of the lack of women in computing negatively impacts the self-esteem and confidence required to compete and engage in the reality of a male dominated field.

In conjunction with the findings of this research, invisibility and lack of recognition in science communities skews the landscape for African American women practicing and may detour students from pursuing careers in STEM fields. There is a need for more multiplicity in the sorts of conversations concerning the agenda to diversify STEM fields and more diversity in the narratives women scientists and technologists.

Belonging in Science and Technology

During a video seminar[59], Dr. Andrew Williams, a humanoid roboticist, former faculty member and founder of the Spelbots robotics team at Spelman, shared the stories that inform his perspective as a scientist who is vested in developing students in technology from all backgrounds and experiences.

> "As an African American child growing up with five siblings in a two bedroom trailer society may not have viewed me as someone with lots of potential and promise, nor belonging in technology…little did I know that I would become a professor teaching robotics to students and how to program these robots how to use them to help people. Since I had these live experiences, I can see the potential in any boy or girl, regardless of their background, regardless of their race, regardless of their family situation to belong in technology. I've had a hand full of encounters that have taught me why I believe anyone can belong in technology…my first encounter happened when I was a PhD graduate student in electrical engineering at the university of Kansas. I was attending a NSF

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[59] Dr. Williams spoke during a TEDx Talk hosted at Marquette University. I spoke with Dr. Williams via email regarding his experiences at Spelman College and as a roboticist.

engineering education scholars program at the Big Ten research university. And while there I visited computer science department there, the department chair told me. Oh we would never hire you, you didn't go to the right school. You don't belong here. I could've let that box that he created in his mind, stop me, but he was actually right. I didn't belong there. His big 10 rival, the University of Iowa (go Hawkeyes!) hired me to the assistant professor of electrical engineering position. There I began an academic journey that would lead me to thrive and become a distinguished chair at the University of Marquette.

My second was after reading the book, A Purpose Driven Life and taking a position at Spelman College, an historically black college for women; and there at Spelman I started a team of students the Spelbots, a robotics team. We competed in an international competition called the Robocup. In 2009 we competed in the Robocup Japan Open against a team from Japan. We reached the championship match and came up with a tie. We were all excited to go to the awards ceremony to hear our team's name announced. We went there and we waited and it never happened. They never announced our time; they never announced our team's name. In so many ways, they were telling us we didn't belong.

My third encounter was with the Spelbots. We were invited to speak at Stanford. So while we were in Silicone Valley, we went to go visit Google for breakfast and went to Apple for lunch. Google's lunch was free, Apple's we had to pay for. "

-Dr. Andrew Williams

Dr. Williams' shares these encounters as illustrations of the ways African Americans are signaled that they do not belong in technology. These moments or micro-aggressions subtly, and not so subtly communicate who can be a scientist and/or technologist and that that person is not you as an African American.

In this project, I have intentionally focused on examining the experiences of African American women in science and technology as a continual conversation among an agenda towards inclusion, pushing back against a systemic process of structural exclusion and an academic legacy institution committed to advancing the science identities and livelihoods of African American women. Dr. Williams offers three moments in the incidents cited above during which he and others similarly positioned

were directly and indirectly told they did not belong in STEM. These moments highlight the tenacity and commitment of Dr. Williams, the courage and confidence developed by the Spelbots and also the tenacity of the structural barriers and gatekeepers of the traditional science identity domain of the cultural landscape of science and technology. But here, I consider all those potential scientists who may have resembled one of the Spelbots, or Dr. Williams, Dr. Rankin and/or Dr. Lawrence, who actually left science after being, told they did not belong. Just as this research is a testament to the conviction, intentionality and commitment of faculty, administrators and most of all, the women at Spelman College, it also speaks to the entrenched and embedded nature of the hegemonic ideals of scientific knowledge production and the biases of those who work to preserve them and construct new barriers in opposition to those who do not fit the "ideal."

The science identity model and discourse in STEM education literature cites recognition as a scientist by others and oneself as central to the success of women of color in the STEM fields. (Carlone and Johnson, 2008) But who is given the authority to recognize women as scientists? The capacity or power for African American women to ascribe a science identity to themselves and to others must be examined in conversation with the people who actively work to ignore, hinder or block the development of this identity.

The Next Generation Of Spelman Women In Science And Tech

Jazette J.
Spelman senior majoring in Computer Science and Engineering (see Figure 25)

> "A main reason I want to get a PhD is to show women they can do a PhD too. There aren't a lot of us. I want to show people that getting a PhD in computer science is possible. I want to extend the pipeline."
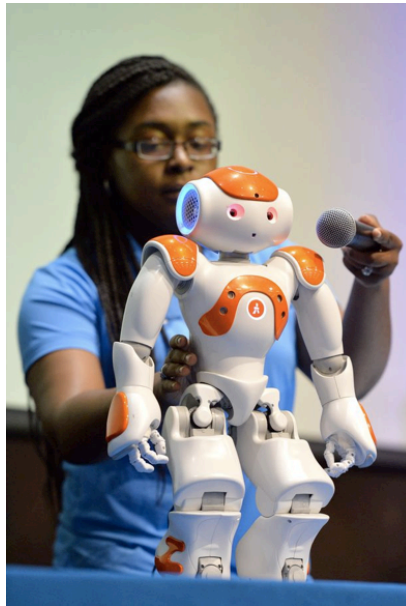

Figure 25. Photo of Spelman Senior, Jazette J., with robot "Sugar"

In the above image, Spelbots co-captain, Jazette J., is photographed introducing "Sugar" the team's robot during the Spelbots Day on March 14th, 2014. Jazette is graduating senior the Spelman College class of 2015 with a major in computer science and engineering with an emphasis in robotics. Jazette and I first met at an event during Geek Week, an annual event hosted by the department of computer science to showcase student work, present research and graduate program opportunities to current majors and to recruit other students on campus. During the event, she briefly discussed her work and experiences as a member of the Spelbots, the college's competitive team. I was intrigued by her work and passion for robotics as well as her commitment to increasing the access

to STEM fields for African American women. Once learning about my research project,

Jazette readily volunteered to participate in an in-depth interview.

Born in Mount Vernon, New York Jazette relocated with her mother, older sister

and younger brother to Savannah, Georgia to be near her grandparents. Although, she has

lived in Georgia since she was ten years old and attended both middle and high school in

savannah, Jazette honorably claims New York as her hometown.

> "Savannah is really slow. I like fast pace. I'm always doing something.
> Everyone thinks savannah is beautiful but its not where you want to be at
> 21. Its 'slow-vannah'." [We both laugh]

Jazette has always wanted to do graphic design and was introduced to computers by her

mother, who she references as her role model. While training to become a medical

assistant, Jazette's mother taught her how to install software on their home computer.

> "My mom taught me about computers when I was younger.
> She was taking a business class when she was studying to become a
> medical assistant. I would install her software. She would buy me games
> like "going fishing".
> She was just preparing me in general. Not in computing."

During her freshman year at Spelman, Jazette was introduced to robotics and

programming.

> "I want to develop rehabilitation tools for hospitalized children.
> I love it. You can use robot to help people in different ways."

In fall 2015, Jazette will move on to the next step in her academic goal of earning a PhD

in computing by beginning a masters to PhD program in human robotics interactions at

Vanderbilt University.

Jazette has participated in a number of research opportunities offered at Spelman

College and has received NSF funding and recognition for her innovative research and

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work in computing and robotics including the development of a mobile Alzheimer's

tracking device inspired by her grandmother's illness (see Figure 26).

> "This particular research project was inspired by my grandmother, Henrietta Kelley. In the summer of 2012, she passed away after living with Alzheimer's for about 7 years. The idea came about because I often sat and observed the way my family cared for her during those years. From observing I felt the need to develop something for the family caregiver with the patient in mind."
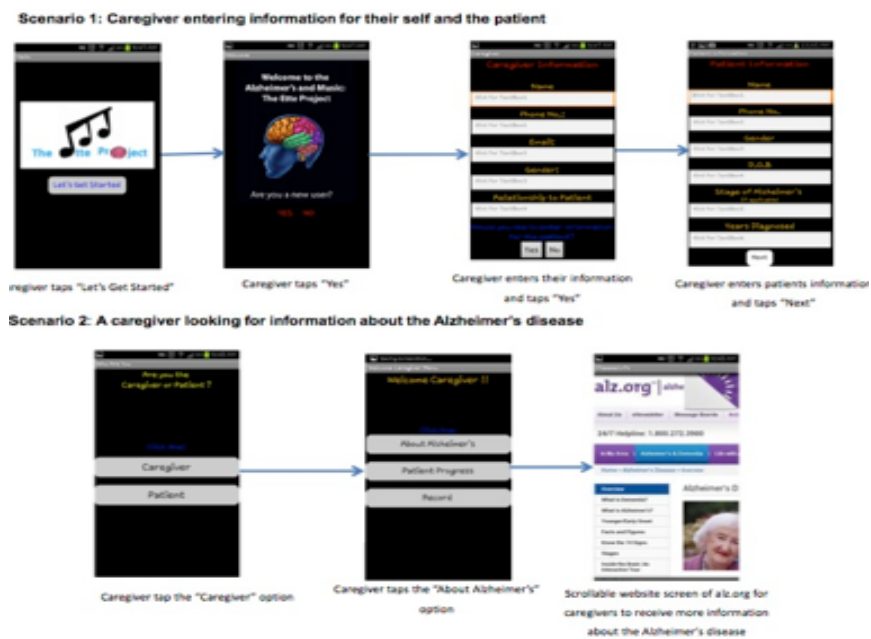

Figure 26. Excerpt from mobile Alzheimer's tracking device poster.

For her senior project, Jazette applied her knowledge in robotics and experience

as a member of the SpelBots team to develop a physically engaging video game for

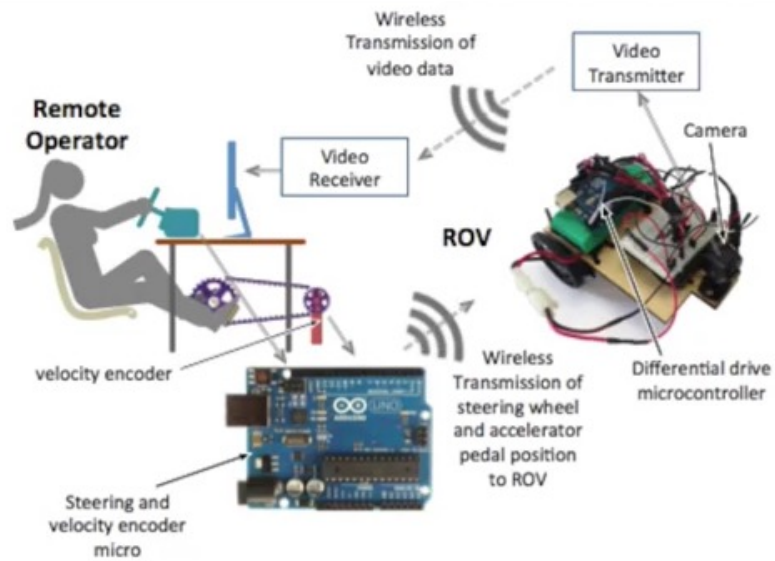hospitalized children (see Figure 27).

Figure 27. "Physically Engaging Video Game for Hospitalized Children"

Zazie L.
Spelman senior majoring in Computer Science and Engineering (see Figure 28).

"In my first year, I thought of changing my major but there was nothing else I imagined I could do or would have been."

Figure 28. Photo of Spelman Senior, Zazie

Zazie is a campus leader and outgoing member of the Spelman graduating class of 2015. Zazie and I also met during Geek Week and is majoring in Computer Science and engineering with an emphasis in game design. She was an avid participant in fieldwork for this research project.

Zazie grew up in the local downtown Atlanta area but moved to the suburbs during the seventh grade. She was introduced to computing through an introductory to website building in last year in high school.[60] She became familiar with the college through her mother who worked in administration on campus.

> "During my senior year I took an introduction to website building. I enjoyed what I was doing. I found out it was something I liked to do. I was interested into web design at Spelman and I'm in game design now. I actually enjoy it, the process making games."

Zazie has accepted a job offer as a consultant for the technology company IBM and will begin working at the company soon after graduation.

For her senior project, Zazie along with a research partner at Spelman, have developed an interactive software program to teach third grade students math skills. Zazie's innovative project uses an avatar modeled after a third grade version of herself, as a virtual guide/site pal as students complete math problems on their home or school computers (see Figure 29). The two students are examining the effectiveness of the program at a local elementary school. The voice of the avatar is similar to Zazie's southern accent.

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[60] Zazie did not take any additional coursework in computing, prior to attending Spelman College.
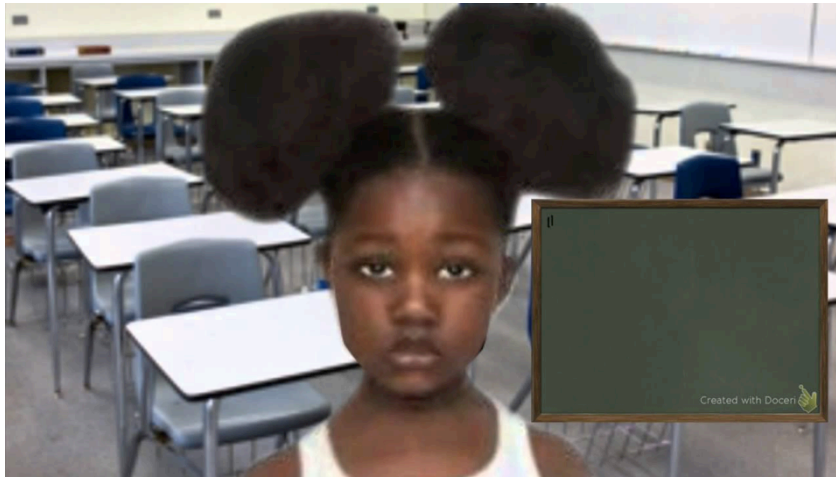
Figure 29. Still image of avatar for the interactive software developed

Discussion

The research projects and technologies developed by Jazette and Zazie are representative of the essence of the ideology and cultural values of the members of the Spelman campus community and the outcome of fostering an environment that would nurture their development. Both students share an ideal of scientific and technological knowledge production and practice that is socially engaged, empowering and very much their own.

During our interview, Jazette stated, "learning in class is okay but now I am able to apply it and do research. That is why I love research" This represents the STEM interactive environment, discussed by Dr. Sidbury and Dr. Lawrence, today and the vision of science center founding African American female faculty members, Dr. Falconer and Dr. McBay nearly three decades ago. "A center that was warm and inviting and not dark and cold. A center that believed African American women could be both

female and scientists and nurtured their development."[61] In many ways, Jazette and Zazie

are the embodiment of these ideals and the legacies of the African American women-

scientists from Spelman College. Continuing and contributing to this legacy, Jazette and

Zazie have both chosen to use their scholarship to increase access for other African

American men and women and have learned how to do so through the Spelman

curriculum.

> "Learning science is important. Exposing African Americans to science is
> very important. A lot are not exposed, and they may never get into it."
> –Zazie

> "A main reason I want to get a PhD to show women they can do a PhD
> too. There aren't a lot of us. I want to show people that getting a PhD in
> computer science is possible. I want to extend the pipeline."

> "The SpelBots team not only helped with my coding skills, but it also
> helped me to develop an awareness of minorities in science, technology,
> engineering, and mathematics (STEM). It has been a pleasure participating
> in many outreach events across the United States to inform minority
> students about STEM and how fun it can be. As I continue my
> undergraduate journey, I plan to participate in many more STEM outreach
> events to encourage young women and other minorities on the importance
> of STEM. My goal is reach at least three minority students a year"
> -Jazette

Throughout the fieldwork of this project, I was not only impressed by the

scholarship and research being conducted by undergraduate students, but I was also

inspired by the clarity and conviction of the young women as scholars and social agents.

Zazie and Jazette are representative of the type of scholars, technologists, scientists— and

most importantly the women, the visionaries of the Spelman Science Center, Dr. Helen T.

Albro, Dr. Etta Z. Falconer and Dr. Audrey F. Manley. Along with the other members of

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[61] Archived personal papers of Johnetta B. Cole; "Initiatives for the 90s"

the campus community, they sought to produce a Science Center with intentionality and one that would persist and thrive. The ideals and values of the Spelman College campus community reside in the living legacies of the women of Spelman.

CHAPTER 7

CONCLUSION

This theoretically and methodologically innovative research project pushes the boundaries of the debates concerning increasing diversity within the academy, and race and gender studies in science through an in-depth ethnographic case study of a local site and an academic community that has largely remained absent in the literature (African American women in science, HBCUs, Women's and small Liberal Arts Colleges). This dissertation has mapped the ways in which members of the Spelman College campus community navigate and negotiate across the axes of gendered, classed and racial stereotypes, both external and internal expectations and contesting? Ideals that weave together the social fabric and the structural dynamics of science and technology education in the U.S. and how it is played out or manifest at Spelman College.

At its core, this research presents new models of scientific knowledge production, learning, and technological innovation created by and for African American women in a structured educational, community and cultural environment that enabled students to believe they could be both women and scientists and committed to nurturing their growth. From a seminary for newly freedwomen in the 19th century to a nationally recognized higher education leader in educating women of African descent in science and technology, the narrative of Spelman College is a critical piece to understanding the overall history and socially constructed nature of science and higher education in the U.S. Making a place for science at Spelman challenged conceptualizations of the role of African American women in U.S society as a whole. The curriculum implemented at

black institutions at the founding in the late 19th century reflected the attitudes of what African Americans should learn, were capable of learning and their place within the social structure of the United States. For the Spelman college community, these attitudes persisted until the early 1960s. (Falconer, 1989; Guy-Sheftall and Stewart, 1991) In addition, training black women to become teachers and nurses to aid their own communities was acceptable. However, the initiatives of the 1990s, which sought to transform Spelman College into an institution focused on training black women to become scientists, technologists, scholars and doctors, did not compute. During the period following World War II, higher education institutions were charged by the federal government with the task of securing the nation's international and economic status, institutions for African American women and men were excluded. Despite historical and contemporary structural limitations, structural racial and gender biases and blatant discrimination, Spelman College and the members of its campus community have claimed a place, and a way of knowing and being for African American women to prosper. What specifically does the on-going narrative of Spelman College tell us about the structural dynamics of science, the dimension of place and positionality, and the implications of gender and racial oppression on institutional learning and individual development that can be shared with other institutions that educate students of color across the nation?

Contrary to the discourse surrounding science identity, the *process* of becoming a scientist and learning science, is far less an extension of individual identity and more so a function of the learning environment itself. In fact, the use of identity theories in

examining science learning, practice and knowledge production is arguably of little value to diversity initiatives. The findings of this research project demonstrate that the value to the success of diversity initiatives and an increase in the diversity of students in STEM fields begins with intentionally developing an inclusive environment that values, affirms and empowers students. It is an environment that does not impose inherently exclusionary notions of science and what it means to do science, but instead fosters the holistic development of students. This begins with understanding and valuing their unique experiences and perspectives and how those values engage with their communities and with the larger society. The condition of a society compelled by ideals of accountability and evidence-based decision-making requires quantifiable variables and outcomes of science learning for the development of universal models of approach. However, the complexities produced by the intersection of multiple identity domains, make this virtually impossible. Students are **NOT** a monolith. Neither are women, so-called people of color, minorities, etc. These are the reasons why the science identity model did not resonate within the Spelman campus community. My research showed that educational projects intended to develop inclusive environments for African American men and women must be in conversation with the sociocultural, historical and actual needs of African Americans.

Spelman College is nationally regarded as one of the top higher education institutions serving African American students. This marks Spelman College as an elite institution, extending beyond the label of HBCUs. With a legacy of honorable African American women alumnae leaders, activists, academics and poets, what it means to be a

Spelman woman is already cloaked in notions of excellence and prestige. The dynamics between the factors of legacy and prestige, work together to shape the values and actions of the student population on campus. Through participant observations, I discovered that many students' family members were people who either had attended or worked at Spelman. Similar to the individual relationships which shape and preserve institutional identity and a positive climate, personal relationships (family and alumni) also support the recruitment of students who align with the Spelman Way. Spelman students, staff and alumni are themselves, the cultural capital that validates the success of Spelman's mission. Each and every one of them believes in and reaches out and brings in others to believe in the institutional commitment to the development of African American women. It is a personal mission as much as it is an institutional mission. That is one of the things that make it such a powerful mission. The values of this mission come from within, as much as it does from outside of the institution. **SPELMAN WOMEN VALIDATE SPELMAN WOMEN.**

I contend that technological innovation materializes through an engagement between human ability; the mastery of skill and knowledge acquired through our narrative experiences and the conditions of the environment of human activity. However, none of the aforementioned components or processes is politically or socially neutral. Attitudes about race, gender, class, education and ways of knowing, unethically stratify and skew the sociocultural landscape of science and technology in the United States and society. This dissertation research explored this engagement with technology through the experiences of women from African descent as scientists and technologists in the past,

today, and as scientist in the making. By drawing upon the analytical models and theoretical lenses of postcolonial, gender studies, intersectionality, anthropology of education and identity formation, this dissertation provides a comprehensive examination of the ways the women in this study come to understand, navigate and negotiate racial and gender based expectations and biases in the social structure of science, larger social communities, as well as within their local social and learning communities. The analysis of student learning experiences and development through the work of Spelman students, Zazie and Jazette demonstrate the ways innovation by women may be fostered in an institutional learning setting.

Future Research and Contributions

The experiences of African American women scientists are largely absent in the literature and what has been explored arguably further utilizes the deficit model in that gender, ethnicity and race are placed in opposition to science. This project explores the positionality of African American women in science as powered and a key agent in navigating the contemporary cultural landscape of science. The findings of this study add to the limited body of knowledge on the complexities of the lives of African American women, feminist critiques of knowledge production and the implications of the narratives of historically black institutions in the contemporary discourse of STEM diversity. In addition, these findings inform domestic STEM program recruitment, retention and innovation efforts, both nationally and locally. By understanding the dialectic occurring between STEM departments at local institutional sites and how the framework of "what

is a scientist?" is constructed, produced and reproduced juxtaposed to historically exclude subjectivities.

The findings of this dissertation provide an ethnographic analysis of what NSF reports, research and literature on African Americans in science have known. HBCUs have now and in the past played significant role in the training African American scientists. (Manning, 1989; Pearson, 1996; Jordan, 2006; Scrivens, 2008; NSF, 2013) political rhetoric regards HBCUs as a "national resource" yet the funding for black institutions has not increased passed capacity building. Spelman's success presents an excellent case for large-scale federal investment in facility maintenance, curriculum development and faculty recruitment for HBCUs and designated minority serving institutions yet, this has not happened. Why not fund the institutions where the most "diverse students" are educated? If increasing diversity amongst STEM graduates is the true goal, it seems logical to invest in the places most operate in. Or is the dimension of the place of science as similarly oppressive as are race and gender? The findings of this research demonstrate that there are implications of being in "the south" as well as the "right school" as indicated by Dr. Williams' exchange with the department chair at a prestige marked Big Ten research university. More research is needed to examine the dimensions of place and institutional type in U.S science and science production. More research is also needed to examine the stereotypes and what it means to be marked   as an "HBCU" within the social and hierarchical landscape of higher education, science and social communities in the U.S

The federal agenda to increase the number of U.S students in STEM fields in order to increase economic and international status and maintain scientific hegemony is hardly fresh idea. Now approaching 60 years after the launch of the Soviet Union's Sputnik and over 50 years after the establishment of the National Science Foundation, the agency reports marginal increases in African Americans, as scientist and engineers at 4.5% (NSF, 2013) In addition, the percentage of women in computing has decreased from 30% to roughly 18% over the last 25 years. (Zweben, 2012) The numbers for women are actually going in the opposite direction! Future research is needed to explore why disparities in STEM fields have persisted and even exacerbated despite federal efforts to address these issues. Further, what role does NSF as a primary funding agency and prestige marker for "sound science" play in this process?

Technology companies such as Google, Apple and Facebook have publicly initiated diversity campaigns to address their predominantly white male labor forces. (Google report, 2014; US economic report, 2015) With percentages as high as 70% white men, the overrepresentation of white males in technology industries is clear. (Google report, 2014) Tech executives cite the lack of diversity in technology as a reflection of the low percentage of qualified African Americans and Latino applicants. Tim Cook, the CEO of Apple computers cited improving education as "one of the best ways in which Apple can have a meaningful impact on society. We recently pledged $100 million to President Obama's ConnectED initiative to bring cutting-edge technologies to economically disadvantaged schools." (Apple Diversity Blog, 2014) However, in a *USA TODAY* analysis of the graduation rates in relation to staffing rates per year, the findings

show that in universities and colleges there are African American and Latino students in computing and engineering at twice the rate they are being hired. (Weise, E., and Guynn, J., 2014) This report calls for a number of critical examinations including one focused on the pipeline between K-12 education, higher education and the job market. What are the implications of racial and gender bias in STEM hiring? How does the Spelman experience translate after Spelman women enter this environment? What happens to these women?

There is also a pervasive notion that those underrepresented are underprepared; therefore diversity in industry begins with schools. More research is needed to examine STEM practices amongst STEM professionals. What are the implications of this notion on African American students, scientists and technologists, in the field? What are the ways exclusionary practices persist and marginalize African Americans, despite explicit agendas to address them? How we conceptualize the position and contributions of people from historically excluded backgrounds is exceptionally important in increasing access and diversity within the academy. It is often through the unchallenged discourse and literature that we construct deficit models that fall woefully short of understanding the experiences of diverse communities and it is through this same avenue that we can correct them through research. This anthropological ethnographic study is a step in that direction.

This dissertation has presented how the women of Spelman College and members of the campus community have institutionalized an effort to educate, nurture and invest in the holistic development of themselves and the women and girls in which faculty and

staff they see themselves. They have challenged notions of what black women can do, should do and what it means to be a scholar and a social agent by defining the concepts for themselves. Despite marginalization, structural limitations and discrimination solely based on attitudes about race and gender, members of the Spelman community thrive. The values of mentorship, civic engagement and service-learning are just becoming a part of the lexicon of the so-called social landscape of STEM education across the nation, yet have been the cornerstone of the pedagogy and institutional identity of Spelman College for over a century. If this is the case, what can be learned from the Spelman narrative? It appears the Spelman College has set standard, maybe it's time to change the source code.

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