A CRITICAL EXPLORATION OF SCIENCE DOCTORAL PROGRAMS:
COUNTERSTORIES FROM UNDERREPRESENTED WOMEN OF COLOR

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A CRITICAL EXPLORATION OF SCIENCE DOCTORAL PROGRAMS:
COUNTERSTORIES FROM UNDERREPRESENTED WOMEN OF COLOR

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ABSTRACT

Most studies exploring the experiences of underrepresented doctoral students of color in science fields focus on their socialization into predominantly white institutions. While the socialization process is fundamental to doctoral success and consequently deserves attention, it is critical to inquire into how the widespread and lasting perception of people of color as socio-culturally deficient shapes underrepresented students’ socialization into science doctoral programs. Further, the existing research literature and educational policies addressing the persistent underrepresentation of students of color in science doctorates remain fixated on increasing racial diversity for U.S. economic security rather than racial equity. In view of the limitation of existing research literature, in this study, drawing from critical race theories, fictive-kinship, and forms of capital, I use counterstorytelling to recast racial inequities in the education of science doctorates as a problem of social justice, not as an issue of the students’ sociocultural deficits or as a matter of economic security. Through interviews I examined the experiences, from elementary school to current careers, of three women of color who were science doctoral students. Participants’ counterstories revealed institutionalized racism embedded in doctoral programs exploited their identities and dismissed their lived experiences, thereby, relegating them to outsiders-within academe. This marginalization precluded the inclusive socialization of participants into their doctoral programs and ultimately set up barriers to their pursuit of scientific careers.
This study divulges the academic and career consequences of the sustained privilege disparities between underrepresented students of color’s experience and the experiences of their white and Asian counterparts. In light of the participants’ experiences, I recommend that, in order to change the existing policy of socially integrating students into oppressive cultures, researchers and policymakers must forefront the humanity of underrepresented students of color when forming research questions, determining data collection instruments, and selecting analytical tools, thus changing the sociocultural structure of the science doctoral process.
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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>LIST OF TABLES</th>
<th>xii</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST OF FIGURES</td>
<td>xiii</td>
</tr>
<tr>
<td>CHAPTER</td>
<td></td>
</tr>
<tr>
<td>I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Statement of the Problem</td>
<td>9</td>
</tr>
<tr>
<td>The Person of Color Paradox: “Problem” and Commodity</td>
<td>10</td>
</tr>
<tr>
<td>The Well-being of the U.S. Economy vs. Social Justice</td>
<td>13</td>
</tr>
<tr>
<td>Purpose of the Study and Research Questions</td>
<td>14</td>
</tr>
<tr>
<td>Diversity and Knowledge Production</td>
<td>15</td>
</tr>
<tr>
<td>Significance of the Study</td>
<td>17</td>
</tr>
<tr>
<td>Definition of Terms</td>
<td>17</td>
</tr>
<tr>
<td>Dissertation Overview</td>
<td>20</td>
</tr>
<tr>
<td>II. LITERATURE REVIEW</td>
<td>21</td>
</tr>
<tr>
<td>The “Negro Problem”</td>
<td>22</td>
</tr>
<tr>
<td>The Rise of STEM in a Nation at Risk</td>
<td>24</td>
</tr>
<tr>
<td>The Role of People of Color in a Nation Still at Risk</td>
<td>28</td>
</tr>
<tr>
<td>Theories and Strategies for Expanding Participation in STEM</td>
<td>31</td>
</tr>
<tr>
<td>Multiple Identities</td>
<td>39</td>
</tr>
</tbody>
</table>
Transcending Racism in STEM? ................................................................. 41
“The Master’s Tools Will Never Dismantle the Master’s House” ........ 44
A Framework for Social Justice ............................................................. 46
Race, Capital, and Kinship .................................................................. 50
  Critical Race Theory ...................................................................... 50
  Accumulating Capital .................................................................. 53
  The Gatekeepers of Science ......................................................... 58
  Making Connections ................................................................... 60
Moving Beyond the Periphery ............................................................ 67
Summary ........................................................................................... 68

III. METHODOLOGY ............................................................................ 70
Theoretical Frame ............................................................................. 71
  Critical Qualitative Research ...................................................... 71
  Currere Inspired Narrative Analysis ......................................... 76
  Narrative and Autobiographical Discourse ............................... 78
Reflexive Statement ........................................................................ 80
Research Design .............................................................................. 82
  Participant and Site Selection ..................................................... 82
Data Collection ................................................................................ 84
  Identity Protection and Informed Consent .................................. 84
  Interviews and Demographic Surveys ....................................... 85
  Participants’ Reflection on Sharing Stories ............................... 87
Method Revisions ............................................................................ 87
Data Analysis.........................................................................................................................92

Construction of Counterstories Using Narrative Analysis .........................92
Coding for Oppression, Capital, and Fictive Kinship ..................................93

Data Validation.........................................................................................................................94

Credibility.................................................................................................................................95
Transferability .........................................................................................................................96
Dependability and Confirmability .......................................................................................97
Generalizability .......................................................................................................................97
Researcher Responsiveness and Adaptability .................................................................98
Trustworthiness .......................................................................................................................99

Conclusion..............................................................................................................................99

IV. FINDINGS ...................................................................................................................................100

Avenus ......................................................................................................................................101
Context ......................................................................................................................................101
Counterstory ..........................................................................................................................103
Reflections ...............................................................................................................................119
Avenus’s reflection ..................................................................................................................121

Soraya ......................................................................................................................................121
Context ......................................................................................................................................121
Counterstory ..........................................................................................................................123
Reflections ...............................................................................................................................139

Devina ......................................................................................................................................143
Context ......................................................................................................................................143
REFERENCES .................................................................................................................. 218

APPENDICES ............................................................................................................. 236

APPENDIX A. ORIGINAL CONSENT FORM ................................................................. 239
APPENDIX B. REVISED CONSENT FORM ............................................................... 241
APPENDIX C. QUALTRICS CONSENT FORM ............................................................ 243
APPENDIX D. DEMOGRAPHIC SURVEY ................................................................. 244
APPENDIX E. INITIAL GUIDELINES FOR JOURNAL ............................................... 246
APPENDIX F. INTERVIEW GUIDE ............................................................................. 251
APPENDIX G. FOLLOW-UP REFELCTION REQUEST ............................................... 258
APPENDIX H. VALIDITY MATRIX .............................................................................. 259
APPENDIX I. A PRIORI CODES .................................................................................. 261
APPENDIX J. REVISED CODES ................................................................................. 263
APPENDIX K. THE UNIVERSITY OF AKRON INTERNAL REVIEW BOARD (IRB) .............. 269
LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1. Summary of Participant Profiles</td>
<td>161</td>
</tr>
<tr>
<td>4.2. Characteristics Common to Oppression in Relation to STEM Doctoral Experiences</td>
<td>164</td>
</tr>
<tr>
<td>4.3. Characteristics Common to Forms of Capital in Relation to STEM Doctoral Experiences</td>
<td>166</td>
</tr>
<tr>
<td>4.4. Characteristics Common to Fictive Kinship in Relation to STEM Doctoral Experiences</td>
<td>169</td>
</tr>
<tr>
<td>4.5. Thematic Categories Developed from Modified Analytic Induction</td>
<td>171</td>
</tr>
<tr>
<td>4.6. Context in and Timeline along Which Cultural Capital was Accumulated</td>
<td>172</td>
</tr>
<tr>
<td>4.7. Occurrences in Participant’s Activation of Capital in Educational Institutions</td>
<td>176</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2. Proposed alternative theoretical framework to critically analyze racial inequality in STEM doctoral programs.</td>
<td>49</td>
</tr>
<tr>
<td>3.1. Timeline of emergence of research design and data collection.</td>
<td>91</td>
</tr>
<tr>
<td>4.1. Revised theoretical framework.</td>
<td>183</td>
</tr>
</tbody>
</table>
CHAPTER I

INTRODUCTION

My own feeling, that I try to share again and again, is that when it comes to creating a multiracial, multiethnic, multireligious, democratic society, we are still a developing nation. We have only been thinking about this for half a century and there is still so much that we don’t know, [but] knowledge, like all knowledge is available to us if we seek it. (Harding, 2014)

There have been several moments in the 20th century when the military and economic powers of the United States (U.S.) appeared threatened by international forces (Nemet, 2009). The U.S. government consistently responded to these apparent threats with policy and funding to train a workforce capable of scientific and technological innovation (Nemet, 2009). Science and technology policy have been part of U.S. government action since President Washington’s directive to Congress in 1790 (Stine, 1986) “to promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries” (U.S. Constitution, Article I, Section 8, Clause 8 as cited in Stine, 2007, p. 1). However, systematic educational policies and accompanying massive financial investment to consciously create a military and an economy driven by science and technology started, primarily, with the space race, which was sparked by the Soviet Union’s launch of Sputnik in the 1957 (Audretsch, 1995).
Included in the educational policy response during the space race were funding increases for science and engineering education at the doctoral level, with the doctorate being the educational level where acquisition of the specialized knowledge and skills to conduct independent research and innovation occurs (Freeman, 2006). The remnants of the space race overlapped another threat to the U.S. economy, the Arab Oil Embargo of 1973. The Arab Oil Embargo caused rapid and large increases in energy prices, leading to government policy and funding that sought to encourage the creation and innovation of alternative energy technologies (Nemet, 2009).

During this time period, U.S. policymakers decided technological innovation was the solution to a dependency on a foreign energy supply (Brown, Baer, Cox, & Kim, 2013; Yergin, 2006). In the late 1970s, yet another international force challenged the global dominance of the U.S. economy. In the late 1970s, changes in international trade laws resulted in the U.S. receiving an influx of low cost manufactured goods from Japan and other countries in the Pacific Rim (Gordon, 1994), leading to a decline in U.S. manufacturing jobs and wages (Revenga, 1992). The decline of U.S. manufacturing marked a shift in an industry that had fueled U.S. economic power for decades (Charles, Hurst, & Notowidigdo, 2013; Revenga, 1992) and policymakers recognized the need to adapt to preserve the economic growth of the U.S.

This need to adapt brought new strategies for economic growth based on the research of historians and economists (Schumpeter, 1947; Solow, 1956; Usher, 1954) from the 1940s and 1950s who characterized the important role scientific and technological innovation plays in stimulating economic growth. By the early 1980s policymakers decided to substitute the commodities or “raw materials” of “knowledge,
learning, information, and skilled intelligence” for manual labor and low skill driven manufacturing jobs being lost (National Commission on Excellence in Education [NCEE], 1983).

Throughout each of the challenges to the U.S. economy briefly described above, the U.S. relied on a stable migration of scientific talent from other countries. Most notably, inflows of talent from outside U.S. borders occurred through the immigration of leading European\(^1\) scientists just prior to World War II and then through the Immigration Act of 1965. The Immigration Act of 1965 extended immigration to the U.S. to hundreds of thousands of adults and their children each year, and created a new, large, and diverse pool of scientific talent (Huntington, 1989). However, the 21\(^{st}\) century has brought unexpected challenges to the science and engineering education pipeline at its most innovative level, the doctorate, and subsequently challenges to the ability of the U.S. to stimulate economic growth through scientific and technological innovation.

While international students have accounted for nearly all the growth in the population of students earning doctoral degrees earned in science and engineering at U.S. universities (National Science Foundation [NSF] & National Center for Education Statistics [NCES], 2013), other nations, including those within the European Union (EU) and the Pacific Rim, are educating more of their students in science and engineering at the doctoral level by investing in their education, research, and development sectors (Freeman, 2006; Leggon, 2010).

\(^1\) European scientists dominated science research and development before World War II (Freeman, 2006).
This vigorous investment in science and engineering doctoral education by countries such as those in the EU and the Pacific Rim had U.S. universities on track to award approximately 15% of the world’s doctorates in science and engineering in 2010; this was a record low from its peak of awarding over 50% of the world’s science and engineering doctorates in 1970 (Freeman, 2006). Additionally, the limitation of security sensitive science and engineering jobs to U.S. citizens after September 11, 2001 (Marburger, 2002), coupled with new U.S. visa policies restricting the flow of engineers into the U.S. (Colwell, 2003; National Science Board, 2004) have caused the U.S. government and private corporations to seek a viable long-term solution to securing science and engineering talent.

Shifts in the global redistribution of the education and retention of doctors of science and engineering are occurring concurrently with significant population growth of people of color in the U.S. who have historically been excluded from science and engineering education at all its levels (Campbell, Denes, & Morrison, 2000). Blacks, Latinas/os, and American Natives, currently representing more than a third of the general U.S. population and growing (U.S. Census Bureau, 2010), remain

Elizabeth Cook Lynn (2007) argued native populations in North America cannot be considered minorities, underrepresented, or included in the collective term people of color as they are the indigenous people of the continent. Native populations in North America possess dual citizenship, tribal and U.S., and are the only population grouped in the term people of color that have not been required to deny their previous citizenship in order to possess U.S. citizenship (Lynn, 2007). This study understands the resulting political distinctions, however, data from primary and secondary sources unanimously include native populations when discussing quantitatively and qualitatively racial underrepresentation in STEM. This lack of disaggregation confines me to including native populations in North America when discussing racial underrepresentation in STEM.
underrepresented\textsuperscript{3} in science and engineering (NSF & NCES, 2013). In 2006, Blacks, Latinas/os, and American Natives accounted for 9.1\% of the U.S. science and engineering workforce (The Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline et al., 2011). Resultantly, U.S. policymakers now view the historical exclusion of people of color from science and engineering as “underproduction” and “underutilization” (The Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline et al., 2011, p. 38) of national human capital that can fill the vacuum of science and engineering talent created by international competition, national security concerns, and visa restrictions.

In response to the declining attraction of international doctoral students and the projected rise in underrepresented people of color, recent government policy is being specifically designed to recruit and retain underrepresented people of color to pursue doctorates in the fields of science, technology, engineering, and mathematics (STEM)\textsuperscript{4}. However, this urgent call for broader participation of people of color in STEM doctoral education arises alongside an enduring legacy of racism in the U.S.

Racism in the U.S. has been transformed from its explicit exploitation of people of color for economic gain of White males of European descent in the eras of slavery and segregation into more subtle systematic and systemic institutional rules, both formal and informal, which still preserve positions of power and economic wealth for white males of

\textsuperscript{3} A population group is defined as underrepresented “if the members of a profession include a significantly smaller proportion of people from that population group than exists in the total working-age population” (Campbell et al., 2000, p. 8).

\textsuperscript{4} The fields within science and engineering are also referred to as science, engineering, and mathematics (SEM; Campbell, Denes, & Morris, 2000), and as STEM fields, which also include STEM education and learning research (NSF, 2006).
European descent (hooks, 1995). This use of people of color for the economic gain of whites and of the power elite is foundational to the character of racism within the U.S. (Delgado & Stefancic, 2012; hooks, 1995). The inequitable economic underpinnings of racism strongly reverberate in STEM education as research and policy prodigiously and often solely cite the economic advancement of the U.S. as justification for broader participation of people of color in STEM.

As the importation of STEM talent becomes increasingly unviable, policymakers, comprising the power elite, now propose the urgent necessity to promote the educational success of people of color in STEM fields. STEM fields, long being viewed as institutions of power in the U.S., have been and remain institutions from which people of color are excluded (Blackwell, Snyder, & Mavriplis, 2009). Institutions of power tend to reflect and reinforce inequities present in U.S. society (Fox, 1999) and since STEM fields are powerful institutions within the U.S., they have not escaped the U.S. legacy of racism and other forms of oppression that exclude students of color from their doctoral programs (Lewis, 2003). By using racism and other forms of oppression (whether consciously or subconsciously5), STEM institutions preserve STEM doctorates for White middle-class and upper-class males of European descent (Gonzalez, 2006; Stewart & Dotollo, 2005). It is therefore unsurprising to find enduring trends indicating people of color are inequitably encountering barriers in pursuit of a STEM doctorate.

People of color, with the exception of Asian males, are underrepresented throughout the STEM pipeline, but particularly at doctoral level (NSF & NCES, 2013)

and within university faculty (Burelli, 2011; NSF & NCES, 2013). Additionally, underrepresented students of color experience higher rates of attrition from STEM doctoral programs than their White and Asian counterparts (Council of Graduate Schools, 2009). The approximately 4-7% of underrepresented students of color who have graduated with STEM doctorates each year in the last two decades (NSF & NCES, 2013) find the choice of an academic career more challenging than their white and Asian counterparts primarily because of stress from the effects of racism and less access to resources (Blackwell et al., 2009), challenges that mirror their doctoral experience (Gildersleeve, Croom, & Vasquez, 2011).

Studies on the experiences of underrepresented people of color throughout all levels of the educational pipeline indicate racism is often manifested as stereotype threat (Brown & Day, 2006; Steele, 1992), where individuals feel “at risk of confirming, as self-characteristic, a negative stereotype about one’s group” (Steele & Aronson, 1995, p. 797). Stereotype threat encompasses the social and psychological influences an individual experiences, as anything they do or any feature they possess that conform to negative stereotypes associated with their group that make the negative stereotype more plausible in the eyes of others and even in the individual’s eyes (Blackwell et al., 2009).

Stereotype threat can overwhelm the self-efficacy and academic productivity of underrepresented people of color in all stages of the STEM educational pipeline and even after they have earned the doctorate (Blackwell et al., 2009). Compared to Whites and Asians, underrepresented STEM doctors of color have been less likely to obtain a position at a university with high research activity, less likely to get tenure at the universities in which they do find employment, and less likely to transition into a full-
professorship in the universities that do grant them tenure (Burelli, 2011). Underlying each of these challenging experiences is the less diverse and less affluent social networks of support people of color tend to have in their personal lives and throughout their academic and career experiences (Ibarra, 1993; Mehra, Kilduff, & Brass, 1998; Mollica, Gray, & Trevino, 2003; Putman, 1993; Stanton-Salazar, 1997; Stanton-Salazar & Dornbusch, 1995).

The social networks of people of color are more likely than Whites to reflect their cultural heritage, a heritage underscored by centuries of being legally barred from accumulating wealth (Heller, 2010). Therefore, the social networks of people of color tend to also be less affluent than their White counterparts (McPherson, Smith-Lovin, & Cook, 2001). An absence of racial diversity and economic affluence in social networks bleeds into the social nature of the STEM doctoral process.

The STEM doctoral process, from its inception to today, is fundamentally social (Elliott, Stewart, & Lagowski, 2008; Golde, 1998; Rocke, 2003). This inherent social dimension makes individuals’ socialization into institutions the focus of much of the research on doctoral experiences across all disciplines (Golde, 1998; 2005), and of underrepresented students of color (Antony, 2003). Race and ethnicity are the strongest delineators of social networks (McPherson et al., 2001) and since Whites dominate STEM fields (NSF & NCES, 2013), opportunities for social success, and by extension academic success, of students of color in STEM become limited.

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6 I view race as an idea constructed by people of power to manipulate those they view as marginal or subordinate (Mohanty, 2003). However, I use the term race when it is a key form of description in a cited reference. See Defining Race and Racism for more detail.
Thus, STEM doctoral students of color in primarily White institutions, already facing stereotype threat derived from racism, also must contend with the scant or sometimes non-existent presence of other students and faculty who share their racial or ethnic heritage. In contrast, research and policy on STEM doctoral experiences of underrepresented students of color overwhelmingly propose theories and strategies that place the burden of socializing into institutions, which reflect and reinforce negative stereotypes about people of color, on the student of color rather than explicitly (or sometimes even implicitly) addressing racism within STEM institutions. By placing the burden of socialization on underrepresented students of color while ignoring racism, researchers and policymakers by extension place the blame of departure from and/or failure to socialize into STEM institutions on students of color (Antony, 2003; Braxton, 2000; Ryan, 1971). This extrapolation of placing the burden of socialization on students of color, to the implicit blame of failure to socialize into STEM doctoral programs on students of color, has largely been ignored in the field of STEM education research and learning. However, a similar extrapolation was not missed by Black civil rights leaders in the 1960s and 1970s who lambasted government policy that attempted to address concerns about a growing Black population, racism, and economic well-being via socialization of Blacks into White, middle-class culture.

In the next section, I briefly describe this extrapolation by Black civil right leaders in the 1960s and 1970s to highlight that the STEM research and policy community need to lucidly reflect racism in their work not because the U.S. economy and military power are at risk, but because doctoral attrition comes at such high personal costs that it can
ruin lives (Lovitts, 2001); in STEM doctoral attrition, those ruined lives are disproportionately those of people of color.

**Statement of the Problem**

The tensions among U.S. economic advancement, a shrinking pool of STEM intellectuals, a growing population of people of color, systemic and systematic racism, and the prodigious proposition by STEM education researchers and policymakers of socialization as the solution (while excluding racism and its effect on the socialization process) to increasing students of color success accompanies a ten year stagnation in underrepresented students of color shares of STEM doctoral degrees (NSF & NCES, 2013). To move research beyond this stagnation, research and policy must move beyond socialization as the cause of and solution to students’ of color low enrollment in and high attrition from STEM doctoral program towards socialization challenges as a symptom of racism.

Latina scholar and poet Gloria Anzadũla (1990) asserted people of color have been denied access to academia and therefore the formation of knowledge and theory. She further asserted that people of color must occupy theorizing space and it is the occupation of this space that is foundational to this study. I argue STEM education researchers and policymakers must begin to use theories that not only explore the social nature of the doctorate, but also illuminate the historical and contemporary contexts of racism and other forms of oppression which unduly advance the economic interests of whites while undermining the academic opportunities and career experiences of people of color in the U.S.

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7 See Figure 2.1.
The Person of Color Paradox: “Problem” and Commodity

Problems within the context of dominant cultural norms are produced by dominant discourses, discourses that consistently classify marginalized or subordinated groups as the problem (Carlson, 2012). The emergence of social-science discourse, monopolized by White heteronormative males, on the “problem” of the Negro caused W.E.B. Dubois to famously respond: “how does it feel to be a problem?” (Dubois, 1903/2005 as cited in Carlson, 2012, p. xvi). The Negro Problem was articulated by Daniel Moynihan in the 1965 Office of Policy and Planning release of The Negro Family: The Case for National Action. Through Moynihan’s Report, the Johnson administration formalized a tone and agenda of Blacks in the U.S. as both a problem and a commodity.

Blacks were projected to represent one in eight U.S. residents by 1972, a 20% population increase in one generation; therefore Blacks, according to the Moynihan Report, were also projected to become a greater economic burden to the federal government. Given this rapid population growth, the need to transform Blacks from an economic and social “liability” to an “opportunity” is cast as urgent. Additionally, part of the “Negro Problem” was the insufficient socialization of poor Black individuals into the culture of middle-class Whites; the report quoted E. Franklin Frazier (1960) to illustrate the nature of the Negro’s social deficiency:

As the result of family disorganization a large proportion of Negro children and youth have not undergone the socialization which only the family can provide. The disorganized families have failed to provide for their emotional needs and have not provided the discipline and habits which are necessary for personality development. Because the disorganized family has failed in its function as a socializing agency, it has handicapped the children in their relations to the institutions in the community. (p. 48)
Black civil rights activist and sociologist William Ryan (1971) countered that the Moynihan Report preserved racism by basing the Negro problem not upon a history of slavery, segregation, and racial inequality, but upon Black individuals’ inability or unwillingness to adapt their behavior and cultural patterns to white middle-class citizens.

The Moynihan Report shifted the responsibility of poverty from systemic and systematic political, social, and cultural structures (which the Moynihan Report cogently described) to deficiencies in the behavior and the culture of poor Blacks. The government portrayal of people of color in the Moynihan Report as a problem that could be solved through socialization into White, middle-class, heteronormative culture persists as the U.S. currently faces the issue of a shrinking pool of STEM talent.

Almost five decades after portraying the growing population of Blacks as a problem, policymakers continue to use socialization of a growing population of a diverse group of people of color into the White, middle-/upper-class, heteronormative culture of STEM programs (Stewart & Dottolo, 2005) to maintain a growing economic edge. In the government-mandated report Expanding Underrepresented Minority Participation: America’s Science and Technology Talent at the Crossroads (The Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline et al., 2011), the theoretical framework of social learning theory (Bandura, 1977; 1985) and more particularly Tinto’s interactionalist theory (Tinto, 1987) are used to explain and offer solutions to underrepresentation of students of color are reminiscent of Moynihan’s “problem” perspective of people of color.

Tinto’s interactionalist theory does not and cannot account for the effects of racism on an individual who does not belong to the racially dominant culture (Braxton,
Tinto’s theory cannot account for racism, because the underlying three phases of integration of separation, transition, and assimilation is based, in part, on Van Gennep’s rites of passage (as cited in Tinto, 1987), which assumed the outside individual is trying to integrate into a welcoming culture or group; that is, there is reciprocity and adaptivity in the socialization process (Rendón, Jalomo, & Nora, 2000). This is an erroneous assumption because as discussed earlier, primarily white STEM institutions have cultures that reflect and reinforce negative stereotypes about the culture of people of color and because it assumes that people of color would desire or choose to separate from their cultural identities (Rendón et al., 2000) and assimilate into a white, middle-class culture. Additionally, *Expanding Underrepresented Minority Participation*, like the Moynihan Report, commoditizes people of color by providing the following three premises for more inclusion of people of color in STEM:

- Underrepresented students of color will account for more than 50% of the U.S. population by 2050.
- Research and innovation in STEM remains the U.S. advantage in the global economy.
- It is economically impractical to continue to underutilize this segment of growth in human capital as importing scientists from outside the U.S. becomes less assured.

That is, people of color can be a commodity to the U.S. government.

The use of theories reflecting and reinforcing people of color as socially and culturally deficient, and using them to advance the wealth of the power elite handed down from the Moynihan Report, is reflective of researchers and policymakers using the
master’s tools (socialization) to dismantle the master’s house (racism), and it is well-accepted by researchers of color that “the master’s tools will never dismantle the master’s house” (Lorde, 1983, p. 94).

**The Well-being of the U.S. Economy vs. Social Justice**

In continuing to view socialization as the problem rather than a symptom of systemic, systematic, and subtly violent racism (Adams, Bell, & Griffin, 2007), the master’s tools, represented in this study by the social and cultural deficiencies of people of color depicted in the Moynihan Report, continue to be used to describe and dismantle an intransigent issue and propose the ersatz solution of social integration. In approaching the underrepresentation of people of color in STEM from a social justice perspective, I query the increasing link between creating knowledge with creating wealth in government and education policies.

The link between using knowledge with the primary purpose of creation of wealth raises profound questions about the role of education and universities in this enterprise (Etzkowitz, Webster, & Healey, 1998), because the end of education has been portrayed by government policy not as self-knowledge but the making of money (Noble, 2001). Social justice “refers primarily to the full participation and inclusion of everyone in society’s major institutions, and the socially supported substantive opportunity for all to develop and exercise their capacities and realize their choices” (Young, 1990, p. 173). At the doctoral level, it means students of color should have as much space for free scholarly inquiry and exchange in a non-oppressive environment as their White peers do, and with equal participation in all the social groups that affect their lives (Mohanty, 2003).
Due to the effects of racism and limited social networks, students of color are more likely to encounter an oppressive environment, their academic ability, and social acceptance into their doctoral program are more likely to be hindered than their White and Asian male peers. Therefore, it is important to center oppressions such as racism, sexism, and classism in the exploration of students’ of color lower enrollment in and higher attrition from STEM doctoral programs. These oppressions can be used to strengthen or build theories by centering students’ perception of the presence or absence of those oppressions (Solórzano & Yosso, 2002), and subsequently completing their STEM doctoral journey.

**Purpose of the Study and Research Questions**

As a comprehensive look into the academic lives of Blacks, Latinas/os, and American Natives, the overarching purpose of this study was to obtain a rich description of how various forms of oppression may be reflected in doctoral students’ STEM academic experiences. More specifically, this study was developed to illuminate the influences (or lack of influence) of racism, sexism, classism, and other forms of oppression on former students’ of color lifelong educational experiences, with particular focus on experiences in their STEM doctoral programs, and their perceived ability to persist in their STEM field. This study was also designed to explore if and how racism, sexism, classism, and other forms of oppression become evident to selected participants and the possible influences the evidence of these oppressions have had on their academic experiences and eventual career outcomes. To achieve these purposes I asked:

1. How do selected underrepresented STEM doctoral students’ of color experience their educational institutions?
2. How do the experiences of selected underrepresented STEM doctoral students’ of color influence their perceived ability to persist in their STEM field?

Diversity and Knowledge Production

Firestone and McElroy (2004) explained, “organizations are complex adaptive social systems that collectively learn” from two knowledge processes: knowledge production and knowledge integration. Knowledge production is the process an organization practices to create generalizing knowledge (Firestone & McElroy, 2004). Knowledge integration is the process that presents this new knowledge to individuals and groups within the organization, for example, through peer-to-peer conferences. Included in knowledge production is an ongoing generation of truth-like or meta-claims (claims about the world) that survive group analysis of individual knowledge claims (claims in the mind). That is, knowledge is recursive and consists of beliefs, belief predispositions, and/or claims that are mentally (individually) and culturally (group) bound. The continued exclusion of people of color and women from STEM means that these communities have also been widely excluded from knowledge processes within STEM organizations.

A Report on the Glass Ceiling Initiative (U.S. Department of Labor, 1991) legitimated that women and people of color are often left out of the knowledge processes of the organizations in which they work, especially if those organizations are institutions of power. Subsequent research verifies that such inequities remain a serious concern in institutions of power especially at the upper management levels (Pichler, Simpson, & Stroh, 2008) where meta-claims are ultimately tested, evaluated, and shared. Further, A
Report on the Glass Ceiling Initiative (U.S. Department of Labor, 1991) also validated that minority groups confront artificial barriers based on attitudinal or organizational bias that prevent them from advancing upward into upper-level positions (Wooten, 2008).

Since this report, organizations have been encouraged to incorporate more inclusive recruiting practices as a strategy for vitality of knowledge production (Cox & Blake, 1991; Hubbard, 2003). Organizations’ knowledge production can be vitalized or re-vitalized when diversity is embraced, because individuals from historically excluded communities bring with them different meta-claims that allow them to identify new problems (or see old and/or entrenched problems from a new perspective), ask different questions, and apply different methods to answer those questions (Leggon, 2010).

Such vitality of knowledge production often brings institutions that holistically embrace diversity competitive advantages and consequently, economic profitability (Cox & Blake, 1991; Hubbard, 2003). Therefore, this study does not argue that economic profitability and increasing racial diversity are or should be mutually exclusive. However, this study does argue that economic profitability should not be the primary impetus for driving organizational changes on diversity. Organizations that attempt to increase diversity for economic gains, but fail to centralize transformation of organizational cultures that prevent employees from reaching their highest potential and using their full range of skills and competencies, often also fail to have those economic gains materialize (Harvey, 1999; Miller & Katz, 2002; Robertson, 2006). Thus, increased diversity benefits are all involved when there is holistic transformation in higher level thinking, such as analysis and synthesis of knowledge that engages members of an organization with an imperative for change with the goal of developing social justice oriented inclusiveness.
The significance of this study was delineated by this orientation toward social justice.

Significance of the Study

This study was developed to build the social, political, and cultural resistance against oppression within science doctoral institutions and the exploitation of underrepresented students of color for the advancement of U.S. economic interests. I sought to provide opportunities that allow us to bear witness to the once unacknowledged lived academic experiences and offer stakeholders a bridge to the common humanity between themselves and underrepresented students’ of color. Humanizing this research problem reminds stakeholders that “personal problems are political problems” (Hanisch, 1970), and once you bear witness to injustices “you can’t unsee it. And once you’ve seen it, keeping quiet, saying nothing becomes as political an act as speaking out. There’s no innocence. Either way, you’re accountable” (Roy, 2002, p. 7). With the humanity of underrepresented students’ of color at the forefront of science education research and policy, stakeholders become compelled to transform their sociocultural and political research agendas to broaden underrepresented students’ of color participation in the science doctorate for the purpose of social justice rather than economics.

Definition of Terms

STEM

Science, technology, engineering and mathematics (STEM) refer to a wide range of disciplines. According to the National Science Foundation, Division of Science Resources Statistics (2011), STEM fields include mathematics, biological sciences,

8 The word political is being used in a broader sense to refer to institutionalized power relationships rather than electoral politics (Hanisch, 1970).
physical sciences, medical sciences, engineering, computer sciences, psychology, social sciences, and STEM education research and learning. However, many state and federal enterprises focus on mathematics, computer sciences, engineering and biological, physical and medical sciences, and research and learning in these fields (Kuenzi, Matthews, & Mangan 2006; National Governors Association 2007). Therefore, for the purposes of this study, the social and behavioral sciences were excluded.

Race

Race is a social construction (Burr, 2003) used in the U.S. as an organizational structure primarily to define the ideas of citizenship through regulation of immigration and naturalization laws (Heller, 2010; Higginbotham, 1983, as cited in Mohanty, 2003). In the U.S., race remains subject to change based on the economic interests of those who hold power (Heller, 2010; Stefancic & Delgado, 2012). Within this study, I did not accept the term race as an objective reality or form of classification, and thus preferentially use the terms person of color or students of color. Rather, race and the categories of Black, White, American Natives (including Native Americans, Alaska Natives, and Pacific Islanders), and Hispanics or Latinas/os is used when inferences drawn from references, which do use these terms would be distorted. However, I do accept the real effects of racism.

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9 The biomedical community generally characterize race as non-scientific (Haga & Venter, 2003) or “biologically meaningless” (Schwartz, 2001, p. 1392) and though some in medicine use ethnicity or race as a useful category such as age or gender, caution is recommended because policymakers who do not understand the social construction of race can succumb to typological thinking (Jorde & Wooding, 2004).
Racism

I subscribed to Elizabeth Higginbotham’s (1983, as cited in Mohanty, 2003) definition of racism as an ideology with which people of color have to live. Racism, according to Higginbotham, legitimates the exclusion of non-whites from particular areas of social and economic life while promoting a tolerance among whites for these inequities. Further, I add bell hooks’ (1995) definition to clarify the personal ramifications of racism, as defined by Higginbotham, on the lives of people of color. I concur with hooks (1995) that:

Racism is oppressive not because white folks have prejudicial feelings about blacks (they could have such feelings and leave us alone) but because it is a system that promotes domination and subjugation… The prejudicial feelings some blacks may express about whites are in no way linked to a system of domination that affords us any power to coercively control the lives and well-being of white folks. (p. 154-155)

Oppression

Racism is one form of oppression, where race is used as a construct around which oppression can be enacted. The definition of oppression used in this study is a process described by Mar‘i (1988): “Oppression involves institutionalized collective and individual modes of behavior through which one group attempts to dominate and control another in order to secure political, economic, and/or social-psychological advantage’’ (p. 6). Further, as described by Freire (1970/2012), oppression is an instrument of dehumanization. Dehumanization makes people monolithic objects of history and denies their capacity to be self-defining subjects creating history and culture (Glass, 2001). Therefore in keeping with this broad definition of oppression, I included classism,
sexism, heterosexism, and country of origin as structures used by dominant groups to secure their advantage in STEM (Gándara & Maxwell-Joy, 1999; Harding, 2008).

Dissertation Overview

Chapter II of this dissertation explores and critiques more deeply how the U.S. government, through various national reports, has framed the role of people of color in its society, its economy, and in STEM. Chapter II also offers an alternative theoretical framework to understand why underrepresented people of color continue to be excluded from STEM. Chapter III details the critical qualitative research methodology of this study. Chapter IV presents the findings of this study through counterstorytelling and how these counterstories relate to this study’s proposed alternative theoretical framework. Chapter V discusses conclusions and recommendations that can be made from this study. Chapter VI provides my final reflections on my own doctoral journey to understand my departure from a chemistry doctoral program.
CHAPTER II

LITERATURE REVIEW

*The truth is...that the oppressed are not “marginal,” are not people living “outside” society. They have always been “inside”-inside the structure which made them “beings for others.” The solution is not to “integrate” them into the structure of oppression, but to transform that structure so that they can become “beings for themselves.”* (Freire 1970/2012, p. 51)

In this chapter, I critique several national reports that collectively present mainstream research and social thought on: being a person of color in the U.S.; the relationship of STEM to the U.S. economy; and finally what it means to be a person of color pursuing a degree in a STEM field. Specifically, I critique the economic premises used to justify increased inclusiveness of students of color in STEM and the inadequacy of theories of socialization, little changed from the segregation era, that recent reports use to explain the high attrition of students of color from STEM fields. Next, I examine why STEM education researchers and policymakers cannot continue to use theories and strategies that are reluctant to explicitly include how racism and other forms of oppression influence the STEM experiences of students of color. Finally, I use my experiences as a woman of color in a chemistry doctoral program to intertwine three theoretical concepts that capture a more comprehensive understanding of the STEM doctoral experiences of students of color. The interweaving of my own voice with the
literature review foreshadows the critical qualitative epistemology of this study, and is a reminder to myself as researcher, as well to the readers of this study, once again that “education must be kept in broad ideals before it, and never forget that it is dealing with Souls and not with Dollars” (DuBois, 1902, p. 81).

**The “Negro Problem”**

The fundamental problem, in which this is most clearly the case, is that of family structure. The evidence — not final, but powerfully persuasive — is that the Negro family in the urban ghettos is crumbling. A middle class group has managed to save itself, but for vast numbers of the unskilled, poorly educated city working class the fabric of conventional social relationships has all but disintegrated. … A national effort is required that will give a unity of purpose to the many activities of the Federal government in this area, directed to a new kind of national goal: the establishment of a stable Negro family structure. This would be a new departure for Federal policy. And a difficult one. But it almost certainly offers the only possibility of resolving in our time what is, after all, the nation's oldest, and most intransigent, and now its most dangerous social problem. What Gunnar Myrdal said in An American Dilemma remains true today: "America is free to choose whether the Negro shall remain her liability or become her opportunity." (Office of Policy and Planning, United States Department of Labor, 1965, preface section, para. 7)

In framing the Negro as the nation’s “liability or her opportunity” in the introduction of *The Negro Family: The Case for National Action* (Office of Policy and Planning, United States Department of Labor, 1965), which came to be popularly known as the Moynihan Report, the Lyndon B. Johnson Administration set a national tone and agenda perpetuating the view of Blacks in the U.S. as both a problem and a commodity. I use the Moynihan Report throughout this chapter to argue, though transformed, the tone and agenda of people of color as a problem and as a commodity currently persists not only in the social thought of many U.S. residents, but has influenced the theoretical and the practical research into the stagnantly and disproportionately low completion rates of students of color pursuing STEM doctorates.
Daniel Moynihan argued due to a remarkable rate of absent Black fathers, the higher fertility rate of Black women, and a higher birth rate in the Black community, the number of poor Black families living in poverty was leading to a “startling increase” in financial dependency on the federal government through welfare programs (Office of Policy and Planning, United States Department of Labor, 1965, p. 12). Given this rapid and undesired population growth, the need to transform Blacks from an economic and social “liability” to an “opportunity” is cast as urgent. Additionally, the Moynihan report attributed part of the “Negro Problem” to the insufficient socialization of poor Black individuals into white middle-class culture. The report portrayed this as a handicap (i.e. a social deficiency) resulting from dysfunctional communities (Frazier, 1960).

Moynihan’s report received much criticism from Black leaders including Martin Luther King Jr., who shifted the “Negro Problem” portrayed in the Moynihan Report to the “Negro’s Problem” (Carlson, 2012). King traced the “Negro’s Problem” back to “a vast breeding program which produced enormous wealth for slave owners;” the Negro’s Problem” is having to work against “a tragedy that utterly defies any attempt to portray it in terms the human mind can comprehend” (Carlson, 2012, p. 38-39). King’s criticism, as well as the criticism of other Black civil rights activists, reframed poverty in Black communities as one attributable to racism rather than familial, economic, and social deficits. This was dismissed by Moynihan as the perspective of a relatively small group of civil-right activists “whose anger and attitude was understandable, but hardly rational or scientific” (Carlson, 2012, p. 39).

In *Blaming The Victim*, Ryan (1971) countered that the Moynihan Report presented a “blaming the victim” discourse that preserved racism by basing the “Negro
problem” not upon a history of slavery, segregation, and racial inequality, but upon Blacks’ apparent social handicap to display White middle-class norms; the Moynihan Report shifted the responsibility of poverty from systematic political, social, and cultural structures to deficiencies in the behavior and the culture of poor Blacks. Ironically, the attack on the cultural deficiency portrayed in the Moynihan Report by the Black community may have implicitly given credence to the idea that the cultural change and greater individual responsibility, advocated in the Moynihan Report, was singularly of more worth in affecting the problem of poverty than changing social and economic inequalities (Bean, Feliciano, Lee, & Van Hook, 2009). The legacy of “blaming the victim” endures decades after the publication of the Moynihan Report, where the burden of responsibility for racial inequality, the social deficiency model of Blacks (and other minority groups) to appropriately socialize into a dominant White, middle-class, heteronormative culture, and using people of color for economic opportunity repeats itself in national reports addressing apparent crises in STEM education and the U.S. economy.

The Rise of STEM in a Nation at Risk

The risk is not only that the Japanese make automobiles more efficiently than Americans and have government subsidies for development and export. It is not just that the South Koreans recently built the world's most efficient steel mill, or that American machine tools, once the pride of the world, are being displaced by German products. It is also that these developments signify a redistribution of trained capability throughout the globe. Knowledge, learning, information, and skilled intelligence are the new raw materials of international commerce and are today spreading throughout the world as vigorously as miracle drugs, synthetic fertilizers, and blue jeans did earlier. If only to keep and improve on the slim competitive edge we still retain in world markets, we must dedicate ourselves to the reform of our educational system for the benefit of all. (National Commission on Excellence in Education [NCEE], 1983, The Risk section, para. 2)
In the late 1970s, imported goods began to compete with U.S manufactured goods, causing a significant decline in employment and wages in many U.S. manufacturing industries (Revenga, 1992). *A Nation at Risk: The Imperative for Education Reform* (NCEE, 1983) offered the “raw materials” of “knowledge, learning, information, and skilled intelligence” as alternative economic resources to manufactured goods (The Risk section, para. 2). More specifically, the U.S. was portrayed as a nation at risk of losing its competitive edge in an increasingly science and technology knowledge-based global economy. Therefore, *A Nation at Risk* placed emphasis on increasing the science and technology literacy of the general U.S. population. The NCEE also strategically gave science, mathematics, and technology a central role in the nation’s education system in their rebuff of criticism from those who pointed out the importance of the humanities. Under the section titled Indicators of Risk, the report’s authors claimed individuals concerned about losing the value of the humanities should be reassured for the “humanities…must be harnessed to science and technology if the latter are to remain creative and humane, just as the humanities need to be informed by science and technology if they are to remain relevant to the human condition.”

*A Nation at Risk* placed STEM on a pedestal and catapulted it to the attention of educators, parents, the public, and the press in an unprecedented manner (Seaborg, 1991). Because of this unprecedented attention, *A Nation at Risk* was influential in laying the foundation for the linking of STEM and education policy to economic prosperity reflecting the specific interests of a few powerful elite rather than widespread public
consensus\textsuperscript{10} (Mitchell, 2010). As with \textit{A Nation at Risk}, committees of powerful elites not only continue to link STEM, education policy, and economic prosperity, but also often justify this link by portraying STEM as a panacea for many of the major societal challenges such as human health, energy, and national security (Augustine, 2005; Committee on Prospering in the Global Economy of the 21\textsuperscript{st} Century et al., 2007). This panacean view of science conflicts with a basic premise of the nature of science that science cannot solve all problems (McComas, 1996). However, this conflict is beyond the scope of this discussion.

Linking STEM and education policy to the global economic dominance of the U.S. has been consistent over the last 30 years by many powerful, politically appointed elites who have continued to perpetuate education policies designed to use education, and public education in particular, as an instrument for competitive profit generation (Scott, 2011). One of the more recent of these reports is \textit{Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future} (Committee on Prospering in the Global Economy of the 21st Century et al., 2007). The authors preface \textit{Rising Above the Gathering Storm} with a discussion that echoes much of the sentiment expressed more than twenty years prior in \textit{A Nation At Risk} with the following assertions:

\begin{quote}
Recently, however, corporate, government, and national scientific and technical leaders have expressed concern that pressures on the science and technology enterprise could seriously erode this past success and jeopardize future US
\end{quote}

prosperity. Reflecting this trend is the movement overseas not only of manufacturing jobs but also of jobs in administration, finance, engineering, and research. The councils of the National Academy of Sciences and the National Academy of Engineering, at their annual joint meeting in February 2005, discussed these tensions and examined the position of the United States in today’s global knowledge-discovery enterprise. Participants expressed concern that a weakening of science and technology in the United States would inevitably degrade its social and economic conditions and in particular erode the ability of its citizens to compete for high-quality jobs. (Committee on Prospering in the Global Economy of the 21st Century et al., 2007, p. ix)

*Rising Above the Gathering Storm* not only mirrors *A Nation at Risk* by linking education policy, STEM, and economic prosperity, but also because many of its proposed solutions remain relatively unchanged from those made by *A Nation at Risk* more than three decades before. However, there are some notable distinctions in *Rising Above the Gathering Storm*, primarily the unabashed call for increasing immigration limits for those who hold doctorates in STEM fields and the loosening of tax and patent regulations for private science and technology industries, along with a focus on doctorate and post-doctorate STEM education and opportunities in the U.S., educational levels unaddressed in *A Nation At Risk*. Additionally:

As minority groups increase as a percentage of the US population, increasing their participation rate in science and engineering is critical if we are just to maintain the overall participation rate in science among the US population. Perhaps even more important, if some groups are underrepresented in science and engineering in our society, we are not attracting as many of the most talented people to an important segment of our knowledge economy. (Committee on Prospering in the Global Economy of the 21st Century et al., 2007, p. 167)

*Rising Above the Gathering Storm* renewed the link the Moynihan Report made between economic well-being and capitalizing on a rapidly growing racial minority population. While *Rising Above the Gathering Storm* reshapes the link to reflect the pedestal upon which STEM has been placed by the current power elite, it keeps intact the Moynihan Report’s insouciance for the historic influences on the lives of people of color by
narrowly focusing on the economic contributions the largest growing segment of the U.S. population can make to the economic interests of private industry and by extension the U.S. economy.

**The Role of People of Color in a Nation Still at Risk**

Hispanics and Asian immigrants account for most of the population growth in the U.S. (U.S. Census Bureau, 2010) with the projection that collectively non-Whites will comprise more than half of the U.S. population by 2050. Asian Americans are overrepresented in STEM fields, earning 6.3% of doctoral degrees in science and engineering in 2010 while representing 4.7% of the U.S. population. In contrast, as shown in Figure 2.1, Blacks, Latinas/os, and American Natives are persistently (racial disparities remain embedded despite decades of interventions) and progressively (as educational level increases, minority representation decreases) underrepresented in STEM (NSF & NCES, 2013).

The trend in underrepresentation means Black, Latinas/o, and American Native participation in STEM is most severe at the doctoral level. Further, the trend of very slow but steady growth in an increase in the percentage of STEM doctoral degrees earned by Blacks, Latinas/os, and American Natives has stalled in the last decade. Despite collectively representing a third of the general U.S. population and accounting for most of the growth in the U.S. population between 2000 and 2010 (U.S. Census Bureau, 2010), and small gains in students who earn undergraduate and master’s science and engineering degrees during this decade, the proportion of doctoral degrees Blacks, Latinas/os, and American Natives have earned remained relatively stagnant (ranging from 6.0% to 7.0%; NSF & NCES, 2013). Further, the proportion of mathematics doctorates earned by
Blacks, Latinas/os, and American Natives has remained flat at approximately 4.0%.

Marked differences are also present in the degree and nature of negative stereotyping by Whites of Asians, Blacks, and Hispanics as people of color in the U.S. (Bean et al., 2009; Bobo & Charles, 2009); the possible implications of these differences will be discussed in a later section.

Figure 2.1. Trends in science and engineering degrees earned by students of color 2001–2010. Adapted from Women, Minorities, and Persons with Disabilities in Science and Engineering, NSF & NCES, 2013.

In identifying Blacks, Latinas/os, and American Natives as an underused resource, *Rising Above the Gathering Storm* was influential in spawning another committee charged with specifically exploring the lower enrollment and higher attrition of Blacks, Latinas/os, and American Natives.
Expanding Underrepresented Minority Participation: America’s Science and Technology

Talent at the Crossroads (The Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline et al., 2011) framed the racial diversity issue in STEM by stating:

The proportion of underrepresented minorities enrolled in public elementary and secondary schools has increased over time…Between 1972 and 2007, the percentage of public school students who were white decreased from 78 to 56 percent, while the percentage of students from other racial/ethnic groups increased from 22 to 44 percent, largely reflecting the growth in the percentage of Hispanic students. Thus, the K-12 pipeline is expected to have an inevitable majority of underrepresented minorities and must be a major focal point of intervention to cultivate the diverse talent pool needed to sustain the nation’s future in STEM. (p. 56)

In Expanding Underrepresented Minority Participation, the direct connections between education policy, STEM, and the economic prosperity of the U.S. made in A Nation At Risk and Rising Above the Gathering Storm (both of which are cited in Expanding Underrepresented Minority Participation introductory paragraphs) are perpetuated with the addition of an explicit focus on how these direct connections pertain to the underrepresentation of people of color in STEM fields. That is, Expanding Underrepresented Minority Participation focused on increasing students of color participation in STEM because they will collectively be a majority of the U.S. population by 2050, and STEM remains the U.S. government’s best hope for economic prosperity while Blacks, Latinas/os, and American Natives remain an underused human resource.

The authors of Expanding Underrepresented Minority Participation (The Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline et al., 2011) implicitly argued that the growth in the population of Blacks, Latinas/os, and American Natives should be used to advance the
economic interest of the U.S. economy, an argument once again bearing a striking resemblance to the argument presented in the Moynihan Report written nearly 50 years earlier. Even further, *Expanding Underrepresented Minority Participation* reignited the Moynihan Report’s strategy for the success of people of color by exclusively using socialization theories and strategies to promote students of colors’ socialization into the White, middle-/upper-class, heteronormative male culture of STEM departments with virtually no attention to addressing the racism students of color are challenged with.

**Theories and Strategies for Expanding Participation in STEM**

*Expanding Underrepresented Minority Participation* (The Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline et al., 2011) represented much of what is known about the progressive and persistent nature of racial inequality in the STEM educational pipeline. Additionally, it specifically addressed how Blacks, Latinas/os, and American Natives, as underrepresented students of color, can be supported to enter and successfully earn STEM degrees. In its summative representation of research on students of color, success in and attrition from the STEM educational pipeline, *Expanding Underrepresented Minority Participation* focused on strategies needed for underrepresented students of color to succeed in STEM from kindergarten to the doctorate. These strategies include increased STEM access and quality of preparation in K-12 and increased access, motivation, affordability, and academic and social support at the undergraduate level and graduate level.
The report does not use theories and strategies exclusive to the undergraduate experience or the graduate experience; rather, it addresses mostly challenges underrepresented students of color face in higher education collectively with the challenges of graduate education (again not delineating differences in the master’s process as opposed to the doctoral process). Although the problem of racial inequality in STEM spans the educational pipeline, as discussed in *Expanding Underrepresented Minority Participation*, the remainder of this discussion will be limited to addressing racial inequality in STEM at the doctoral level, the level where underrepresentation of students of color continues to be most severe and intractable (NSF & NCES, 2013). The STEM doctoral process is profoundly social in its preparation of students to develop the discipline-specific expertise along with learning the explicit and implicit expectations of behavior for the STEM career that follows earning the doctorate (Elliott et al., 2008; Golde, 1998; Rocke, 2003).

This expected social training in behavior is highlighted by a research and development manager at Chevron Phillips Chemical Company’s explanation of his criteria for hiring from groups of applicants, all of whom hold a Ph.D. in chemistry:

> All the candidates the company wants to hire have strong chemistry skills, but the soft skills -- such as communication ability and teamwork -- differentiate between a successful applicant and ones who will not make it past the first round.... We all have to see the objective the same way at the end of the day. (Committee on Challenges in Chemistry Graduate Education et al., 2012, p. 30)

This research and development manager’s weeding out criteria based on soft skills highlights that the STEM doctoral process is more than being trained to possess strong field specific research skills in your discipline. The STEM doctoral journey is also a social process that occurs alongside the development of these strong scientific skills in
anticipation of the socialization required after the journey’s completion and is crucial to
doctoral completion (Nettles & Millet, 2006).

Training to become a scientist, in part, involves being able to perceive evidence of
phenomena or to devise methods to make this evidence observable; such perception or
devising will remain elusive to the untrained individual (Chalmers, 1999). The
predominant contemporary structure for training the scientific eye of individuals within
universities is based on Justus von Liebig’s method for apprenticing his chemistry
students (Elliott et al., 2008; Golde, 1998; Rocke, 2003). Dating back to the 1820s, the
Liebig model moves students from novices to experts through supervised research
activities under more advanced students and the science master (Elliott et al., 2008,
2008).

In Liebig’s model the master (contemporarily referred to as the research advisor)
declares the student an expert once they can independently mimic the scientific skills of
their masters (Committee on Challenges in Chemistry Graduate Education et al., 2012).
Liebig’s model is now used in all modern university research programs (Rocke, 2003).
However, acquiring the necessary scientific skills is only part of the doctoral journey of
progressing from novice to expert, a progression recognized as the core of earning a
Ph.D. (Golde, 1998).

STEM graduate departments, as all graduate programs, train students in field-
specific research skills, as well as socialize students to exhibit behavioral standards and
norms expected of those more advanced in the STEM discipline (Weick & Quinn, 1999).
Therefore, the social relationships established as a doctoral student are crucial to the
success in the STEM field (Gluck, 1987; Slaughter, Campbell, Hollerman, & Morgan,
2005). Forming productive relationships within research groups and with advisors (Mendoza, 2007), and the socialization derived from the obligations of positions such as assistantships that facilitate relationships with faculty and students, are good predictors of STEM doctoral degree completion (Nettles & Millet, 2006).

The relationships formed in doctoral programs represent the anticipatory socialization to the academic profession and is a transmission of values to the next generation of scientific gatekeepers (Tierney & Rhoads, 1993), often through informal codes and expectations (Schutz, 1970). Both formal and informal codes and expectations comprise an organizational culture (Tierney, 1988), which is transmitted through organizational socialization (Tierney, 1997; Tierney & Rhoads, 1993). Tierney and Rhoads (1993) defined organizational socialization as a “ritualized process that involves the transmission of culture” (p. 21) through a reciprocal and adaptive process between the organization and individuals. The primary conduit of transmission of organizational culture is everyday conversations (Ford & Ford, 1995), and STEM departments are no exception to this culture conduit (Holleran, Whitehead, Schmader, & Mehl, 2011).

However, doctoral students can reshape organizational culture via small continuous changes over the long periods of time (Mendoza, 2007). While the organizational culture of the department can hold these changes at bay, deconstructing organizational codes and expectations can cause significant change from within the organization to that culture (Weick & Quinn, 1999). Weick and Quinn (1999) also argued that paradigm shifts in organizational culture can occur through episodic change. Episodic change “refers to changes in cognitive frameworks underlying the organization’s activities, changes in the deep structure or shared schemata that generate
and give meaning to these activities” (Bartunek & Moch, 1994, p. 24), and is due to external pressures and is centrally initiated and controlled by the leaders of that organization.

For the remainder of this study, I argue that episodic change, without monetary implications for STEM gatekeepers, is unlikely to occur, as the external pressure to increase the successful outcomes of students of color seeking a STEM doctorate is low. The dramatic disruptions brought on by episodic change (Mintzberg & Westley, 1992) is unlikely, because the STEM research and development enterprises in the U.S. are not yet at enough of a financial crisis point that would widely force predominant White, middle-/upper-class heteronormative males to break away from a legacy of oppression to accept students who explicitly hold cultural values deviating from their own doctoral enculturation that have allowed them to be declared gatekeepers.

I also argue that continuous change, that is change from within STEM institutions, will also be unlikely without deconstructing socialization theories that attempt to explain the higher rates of attrition of students of color from STEM doctoral programs without explicitly accounting for the influences of racism, classism, sexism, heterosexism, and other forms of oppression. Being viewed as racial and cultural minorities and therefore as problems (Carlson, 2012), racism and other forms of oppression can undermine students of color being accepted (or even the student’s desire to be accepted) within the organizational culture of their departments (Rendón et al., 2000).

If researchers and policymakers continue to centralize socialization (or lack of socialization) while ignoring racism and other forms of oppression, as in Expanding Underrepresented Minority Participation, by erroneously assuming reciprocity between
students of color and their doctoral organizations, then researchers and practitioners of STEM will continue to exist only in the periphery of the problem of higher attrition of students of color in STEM. *Expanding Underrepresented Minority Participation* in part casts academic and social support of students of color at the doctoral level as primarily the burden of the educational institutions with suggestions such as:

- Strong leadership from trustees and regents, the president, provost, deans, and department chairs,
- A campus-wide commitment to inclusiveness,
- A deliberate process of self-appraisal focused on campus climate,
- Development of a plan to implement constructive change, and
- Ongoing evaluation of implementation efforts. (The Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline et al., 2011, p. 138)

While these suggestions hint at institutional and departmental issues with racism and forms of intolerance, issues of intolerance such as racism or any other form of oppression are never explicitly named, much less discussed. Rather, these suggestions were preceded by an argument, which commoditized students of color, as in the Moynihan Report, where the underrepresentation of students of color at the doctoral level is described in terms of an “underproduction” and “underutilization” (p. 38) of a rapidly growing segment of the U.S. population.

Further, the theoretical frameworks of social learning theory (Bandura, 1977; 1985) and more particularly Tinto’s (1987) interactionalist theory used to explain and offer solutions to this severe racial underrepresentation are reminiscent of Moynihan’s
blaming the victim perspective. In using these theories, the authors of *Expanding Underrepresented Minority Participation* (The Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline et al., 2011) link students of colors’ doctoral success to the individual’s social integration into their primarily White doctoral program. The responsibility both of these theories place on the student of color to assimilate into their institutions is at odds with the suggestions that institutions and programs become more inclusive of diverse cultures.

Social learning theory is used to account for the actions of the individual and the socio-environmental influences on the individual (Schunk, 2012), which can include the effects of racism. However, because social learning theory very broadly accounts for environmental factors, the inclusion of racism and other forms of oppression are at the discretion of the researcher. For example, while some of the studies cited (Fries-Britt, 2000; Gándara & Maxwell-Jolly, 1999; Nettles 1988) in *Expanding Underrepresented Minority Participation* as examples of the applicability of social learning theory do incorporate racism to varying degrees, others (see for example Allen, 1992; Bouffard-Bouchard, 1990; Chemers, Hu, L. & Garcia, 2001; Cole & Barber 2003) fail to deeply or even superficially acknowledge racism and other forms of oppression within STEM as root causes to negative stereotypes and higher attrition rates.

The second theory presented in *Expanding Underrepresented Minority Participation*, Tinto’s (1987) interactionalist theory is more problematic than social learning theory, as it does not and cannot account for the effects of racism on an individual who does not belong to the racially dominant culture (Braxton, 2000). Additionally, there is increasing consensus that Tinto’s interactionalist theory is
inadequate or even inappropriate for examining underrepresented students of color persistence/attrition even at the undergraduate level (Rendón et al., 2000). This inadequacy emerges because Tinto’s theory through its phases of separation, transition, and assimilation, assumes that individual seeking entry is trying to assimilate into a welcoming culture. In transferring Tinto’s (1987) theory to the experiences of people of color, the assumption is made that primarily White higher education institutions and departments have cultures that are welcoming to people of color, or that people of color would desire or choose to separate from their racial and cultural identities (Rendón et al., 2000). This assumption is erroneous, because Tinto’s theory ignores the systematic, systemic, and subtly violent nature of racism in the U.S. (Bell, 1995; McIntosh, 1988/2004), which extends into academia (Collins, 2013).

In aggregating the academic and social support underrepresented students of color need for undergraduate and graduate STEM experiences, the authors of *Expanding Underrepresented Minority Participation* (The Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline et al., 2011) obfuscated how essential the intimate and reciprocal nature of the apprentice/master relationship of the Liebig model is for socialization of doctoral students, a model not widespread at the undergraduate level. Additionally, the authors ignored how this intimate and reciprocal socialization can be undermined by using theories that cannot explicitly inform the research community about the role racism (versus social deficits of the minority individual) and other forms of oppression play in the social and cultural challenges unique to the STEM doctoral experience of underrepresented students of color (Hurtado, Cabrera, Lin, Arellano, & Espinosa, 2009; Lewis, 2003).
Multiple Identities

My focus so far has been on racism, because racial identity is integral to the political, social, and cultural structures of the U.S. However, it is not my intention to monolithically represent underrepresented students of colors’ STEM doctoral experience. Class, gender, sexuality, nationality, and language are fluid structures of domination that can intersect and influence how individuals are perceived, and the effects of the intersectionality of these identities also matter to the STEM doctoral experience (Mohanty, 2003). In this study, I explored the effect of identity intersectionality of selected participants’ identities during and after data collection, given the idiosyncratic and complex nature of underrepresented students of color STEM doctoral experience.

This decision was made because underrepresented students of colors’ STEM doctoral experience seem to defy some of the long standing findings about how these identities affect outcomes. For example, although men continue to earn more STEM doctoral degrees than women in the U.S., underrepresented women of color have earned a greater share of STEM doctoral degrees than underrepresented men of color every year for at least the last decade (NSF & NCES, 2013). Additionally, while financial support is important to doctoral success underrepresented students of color supported on fellowships, which separate them from the research or teaching obligations associated with assistantships, are more likely to depart their doctoral program than those supported on assistantships (Nettles & Millet, 2006). Further, among the different groups of underrepresented students of color collective the degree and type of negative stereotyping experienced by people of color vary (Bean et al., 2009). Although students from geographically diverse locations from the Asian continent are generally aggregated under
the Asian label, upon data disaggregation inequalities are revealed based on geographic origin and immigration status of students from Asian nations and their representation in STEM (Leggon, 2010).

Immigrant students from Southeast Asian and Pacific Islanders are underrepresented in STEM compared to immigrant students from Korea, China, Taiwan, and Japan. Further, immigrant students from Korea, China, Taiwan, and Japan schooled in the U.S. outperform Chinese, Japanese, and Vietnamese students schooled in their birth countries (Gándara & Maxwell-Jolly, 1999). A similar geographic inequality exists for Latinas/os, where Mexican Americans and Puerto Ricans are among the least represented Latinas/os in STEM, while Cubans -- who are granted greater access to economic and educational resources-- tend to have more successful educational outcomes (Leggon, 2010). There is also a spectrum of negative stereotyping held by Whites in U.S. society of people of color depending on their socially imposed racial labels.

Half to three quarters of Whites in the U.S. express negative stereotypes of Blacks and Latinas/os based on cultural and social deficiencies (Bobo & Charles, 2009; Hunt, 2007). It is likely that underrepresented students of color will face similar negative stereotypes in their STEM institutions; as institutions of power, they will tend to reflect and reinforce inequities present in U.S. society (Fox, 1999). Social support has been shown to be the most influential factor (Antony 2003; Gardner, 2010; Golde, 1998; Holley & Gardner, 2012; Lovitts, 2001; Nettles & Millet, 2006), more so than increased financial support, to doctoral student success.

Nettles and Millet (2006) found that fellowships, in particular, actually increase underrepresented students of color attrition for STEM doctoral programs because it
results in increased social isolation. Thus, nearly 50 years after the Moynihan Report in *Expanding Underrepresented Minority Participation*, we have returned to the conversation of a rapidly growing population of people of color that can be used as an opportunity to increase the economic prosperity of the U.S. with the supposed deficits of these people of color needing to be addressed to promote their successful assimilation or integration into the White, male, heteronormative, middle-class culture of primarily White institutions. The national reports reviewed in this study never seriously recommend that racism, classism, sexism, heterosexism, and other forms of oppression be openly and consistently deconstructed within STEM organizations to change cultures that implicitly favor White, middle-/upper-class, heteronormative men, despite longstanding theory that this type of open deconstruction through everyday conversations is one of the most effective ways of changing organizational culture that marginalizes minorities (Rhoads, 1994; Tierney & Rhoads, 1993).

**Transcending Racism in STEM?**

In response to the unequal treatment of six black students who retaliated against White students who hung nooses on a tree to warn Blacks not to sit under the “White” tree in Jena, Louisiana, economist and New York Times columnist Paul Krugman (2007) wrote, "The reality is that things haven't changed nearly as much as people think. Racial tension, especially in the South, has never gone away, and has never stopped being important. And race remains one of the defining factors in American politics" (para. 4). Krugman (2007) wrote that these scenes belonged to the 1960s, yet just a few paragraphs later he also wrote, "It would be wrong to suggest that the nation has made no progress.
Racism, though not gone, is greatly diminished: both opinion polls and daily experience suggests that we are becoming a more tolerant, open society” (para. 10).

Both of Krugman’s (2007) statements are true, and this is the contradictory nature of how racial inequality in the U.S. has both made progress yet remains little removed from its historical roots (Bobo & Charles, 2009). Although there has been a decrease in the percentage of Whites expressing negative stereotypes of Blacks and other people of color, all groups have very different views about the persistence and foundations of racial inequality in the U.S. More than half and up to three quarters of Whites in the U.S. continue to negatively stereotype Blacks and Hispanics, with much of the negative stereotyping typically expressed upon Blacks displaying behavior indicative of lack of motivation or having a comparatively deficient culture (Bobo & Charles, 2009).

Between 1977 and 2004, the percentage of Whites, Blacks, and Hispanics assigning lack of motivation for the sole explanation for the disadvantages people of color increased, while those who assign structural origins for inequitable disadvantages decreased across all racial groups (Hunt, 2007). Hispanics are viewed slightly more favorably that Blacks because they are viewed by Whites as valuing the nuclear family and Christianity; however, they are still perceived as unmotivated or lazy (Bobo & Charles, 2009). Variation in stereotypical perception occurs, as previously discussed within groups.

Among Blacks, those of mixed heritage and country of origin and display White norms, like President Barack Obama and Colin Powell, tend to be perceived more positively (Kinder & McConnaughy, 2006). In considering whether STEM gatekeepers, STEM education researchers, and educational policymakers are ready to let go of the
seemingly objective expectation that White, middle-class, heteronormative culture is the standard against which every other culture should be measured (Carlson, 2012), we can consider why people of color of mixed heritage, like President Barack Obama, seem capable of transcending racism.

Barack Obama has twice been elected the President of the United States, but it is argued that he was able to achieve this because he transcends negative stereotyping as he deviates from the Black Prototype, i.e. he is light skinned, biracial with his minority heritage of immigrant origin, speaks “like a white person,” and gained upward mobility while distancing himself from Black institutions and leaders within the Black community (Kinder & McConnaughy, 2006). That is, while President Barack Obama clearly cast himself as a Black candidate, he has also clearly demonstrated an ability to display behavior indicating assimilation into White cultural norms. So, in a national climate that seems to be increasingly regressive toward the social deficit model of people of color portrayed in the Moynihan Report nearly 50 years ago, when the authors of Expanding Underrepresented Minority Participation promoted greater “inclusiveness” as the primary solution for increased participation of people of color, are STEM doctoral programs willing to be more inclusive of those who are the Black/Latina/Latino/American Native Prototype? That is, are the White, middle-/upper-class, heteronormative, males who dominate STEM fields ready to be more inclusive to dark skinned, unmixed people of color who do not speak “like a White person” and who unapologetically display ties to non-White cultural heritage?

Recasting these questions using the underlying separation-transition-assimilation premise of Tinto’s (1987) interactionalist theory, can we transcend race in STEM
doctoral programs by not expecting/pressuring people of color to openly separate from their cultural heritage by transitioning into a hegemonic culture that views “prototypes” from their racial group as socially and culturally deficient? Should students of color be accepted into that hegemonic culture by unfailingly adhering to speaking and acting “like a White person?” Would we have more than half of science and engineering doctoral degrees being earned by white U.S. citizens for decades (NSF & NCES, 2013) if earning that degree required them to display ways of being that require separation from their cultural heritage and align with the cultural heritage of Black or Latina/o communities? These questions are not meant to incite divisions, but rather to provoke doubt about the theories and strategies used in *Expanding Underrepresented Minority Participation* and the vast majority of research on underrepresented students of color in STEM (Antony, 2003) that, perhaps unwittingly, perpetuate Daniel Moynihan’s blaming the victim (Ryan, 1971) model of the Negro Problem.

**“The Master’s Tools Will Never Dismantle the Master’s House”**

In 1983, Black feminist Audre Lorde (1983) asked, “What does it mean when the tools of a racist patriarchy are used to examine the fruits of that same patriarchy?” Her answer: “it means that only the most narrow perimeters of change are possible and allowable” because “the master’s tools will never dismantle the master’s house” (p. 94). I do not dispute STEM doctoral students building of a supportive social network within their program is a key factor to successfully emerging from that program with their doctorate. However, from my own experience and the experiences of other people of color, there are underlying complex racism and classism issues making socialization more challenging for people of color (Bancroft, 2013). I recognize that if we continue to
view the progressive and persistent nature of the underrepresentation of people of color in STEM programs as caused primarily by a socialization problem as is evident by the dominant use of theoretical frameworks whose center is socialization (Antony, 2003; Gardner, 2010; Golde, 1998; 2005; Holley & Gardner, 2012; The Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline et al., 2011), we may continue to enact only the most narrow perimeters of change.

We may already be witnessing the possibility of this limitation of change in the stagnation in the percentage of underrepresented students of color earning STEM doctoral degrees previously described (NSF & NCES, 2013). This stagnation has occurred while national reports for decades have declared and still declare the U.S. as a nation at risk (Committee on Prospering in the Global Economy of the 21st Century et al., 2007; Committee on Challenges in Chemistry Graduate Education et al., 2012) of losing STEM talent as policymakers vigorously suggest ways to ease restrictions for international individuals holding advanced STEM degrees to work in the U.S. (Committee on Prospering in the Global Economy of the 21st Century et al., 2007). Simultaneously, these individuals decry an underutilization of our students of color (Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline, et al., 2011). In continuing to view socialization as the problem rather than a symptom of systematic, systemic, and subtly violent racism (Adams et al., 2007), we continue to use the master’s tool of social integration to describe and dismantle an intransigent problem.
For the remainder of this chapter, I present a theoretical framework comprising three theories that approach the problem of racial/ethnic minority underrepresentation in STEM doctoral programs from a social justice rather than a social integration perspective. I argue it is the presence of a repressive environment, not the student of color’s inability to socially integrate into their doctoral program, that is the underlying problem of racial underrepresentation in STEM doctoral programs. Critical race theory (Bell, 1995; Ladson-Billings, 1998), fictive kinship (Fordham, 1988), and Bourdieu’s (1986/2008) forms of capital provide a theoretical framework that allows the analysis of the experiences of people of color in STEM doctoral programs to move beyond the periphery of the problem; beyond the pedagogy of the oppressed (Freire, 1970/2012).

**A Framework for Social Justice**

Theory, then, is a set of knowledges. Some of these knowledges have been kept from us—entry into some professions and academia denied us. Because we are not allowed to enter discourse, because we are often disqualified and excluded from it, because what passes for theory these days is forbidden territory for us, it is *vital* that we occupy theorizing space, that we not allow white men and women solely to occupy it. By bringing in our own approaches and methodologies, we transform that theorizing space. (Anzaldúa, 1990, p. xxv, emphasis in original)

In *Leaving the ivory tower: The causes and consequences of departure from doctoral study*, Barbara Lovitts (2001) succinctly distilled the core of doctoral student attrition: “The most important reason to be concerned about graduate student attrition is that it can ruin individuals’ lives” (p. 6). Given the higher attrition rates of people of color from STEM doctoral programs (Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline et al., 2011), Black, Latinas/os, and American Natives are disproportionately suffering what can be devastatingly life-altering consequences of doctoral attrition. As a student of color who
departed from a STEM doctoral program, I was not an exception to these consequences.

I am a first-generation, student of color from a low-socio-economic background and a former Ronald E. McNair Postbaccalaurate Achievement Program (McNair Program). The McNair Program prepares low-income or underrepresented students of color for the doctorate with the ultimate goal of increasing the diversity of university faculty (U.S. Department of Education, 2010). I left a chemistry doctoral program after one year of encountering a highly dissonant social and cultural environment in my daily interactions in that program. Three years after this departure, and earning a master’s degree in education elsewhere, I still questioned why as a chemistry doctoral student who got thrills from failures and triumphs of scientific experimentation, answered “no” to the following four quintessential questions graduate students ask themselves (Golde, 1998):

- In terms of intellectual mastery: “Can I do this?”
- In terms of the realities of graduate life: “Do I want to be a graduate student?”
- In terms of determining suitability for the profession, “Do I want to do this work?”
- And the overarching question, “Is this the right choice?”

My reason for answering “no” stemmed from the endless feeling that I was a stranger in my department.

Bauman (as cited in Phelan 2001) defined the stranger as someone who is “physically close while remaining spiritually remote” (p. 29). This juxtaposition of being close, yet far away, was the essence of my sociocultural experiences as a chemistry doctoral student. Despite my passion for chemistry, every second of being around others who overwhelmingly did not look like me, did not speak like me, and were not from
families as poor as mine, caused me to label myself stranger. I had experienced a stunning and inexplicable intellectual and self-efficacy collapse that had not occurred prior to or since that year.

I had friends, I enjoyed my classes, I loved where I lived, I had disposable income for the first time in my life, I was involved in several on-campus organizations, and I had a supportive advisor; but I also had a family who did not understand why I graduated from college yet was still in school, I was self-conscious and tongue tied around faculty and many of my peers, constantly felt stupid; I was miserable. There was something below the surface in the spaces and faces within my institution that I felt, but lacked the objective knowledge and language to transform into conscientization (Freire, 1970/2012). In the end, I decided I was somehow inadequate.

Social integration-based theories do not explain how a look on someone’s face, a tone in someone’s voice (while they smile with you and speak politely), or the body language someone projects reaffirms your strangeness. It was with all of these feelings salient that I decided to pursue a doctorate in education; I needed to know what that something was below the surface. Reading the literature as a doctoral student in science education, I found my STEM doctoral experiences are not unique, but they were complex enough that I needed to intertwine multiple theories to deconstruct and explain the various elements that orchestrated my intellectual and self-efficacy collapse.

For me, early departure from my chemistry doctoral program was both an action of self-preservation and a demoralizing failure, because I left questioning the very core of who I was and who I could become. With such high personal costs, as a research community we cannot continue to trivialize racial underrepresentation in STEM doctoral
programs as a social integration problem. While some attrition is inevitable (Lovitts, 2001), it is dehumanizing (Freire, 1970/2012) to perpetuate the masters’ or oppressors’ “blaming the victim” social integration explanation of racial underrepresentation in STEM doctoral programs in which these oppressors use social integration as a euphemism for racism.

As shown in Figure 2.2, my alternative framework included three distinct theories I argue must be intertwined and centered by racism to have a critical dialogue about racial underrepresentation in STEM doctoral programs.

Figure 2.2. Proposed alternative theoretical framework to critically analyze racial inequality in STEM doctoral programs.
Fictive kinship and forms of capital\(^\text{11}\) gave me the language to explain why (rather than how) socialization into STEM doctoral programs are challenging to students of color in ways they are not to white and Asian students. However, I used critical race theory to undergird fictive kinship and forms of capital in centering racism rather than social deficiencies as the underlying cause of the some of the challenges that account in part for the higher attrition rates of from STEM doctoral programs (Council of Graduate Schools, 2009).

**Race, Capital, and Kinship**

In the remainder of Chapter II, I use the experience of underrepresented students of color in doctoral programs as presented in the literature and my personal experiences to describe how the epistemologies of critical race theory, fictive kinship, and capital can deconstruct and explain aspects of the students of color doctoral experience that are presented across various studies.

**Critical Race Theory**

Values, ethics, politics, ethnicity, gender, and power are intrinsically and inseparably connected to the production of knowledge (Flyvbjerg, 2001 as cited in Pascale, 2011); this basic assumption underlies critical approaches in seeking to access the knowledge of marginalized groups by examining how power functions on a daily basis in the lives of individuals (Hesse-Beiber & Leavy, 2011). The knowledge or reality of

\(^{11}\) I recognize the notion of capital may be associated with capitalism, which is an exploitative system historically used as an oppressive force against people of color (Yosso, 2005). Additionally, I recognize as a White male of European descent who was part of academia, Bourdieu represents one of the power elite. However, Bourdieu’s forms of capital subvert the economic, social, and cultural norms of power elites by identifying and deconstructing “the game” the power elite play to oppress others, and therefore, his forms of capital, can be a transformative tool to underrepresented people of color.
individual lives is changeable, *i.e.* it is an ongoing social construction (Burr, 2003) shaped by the values, ethics, politics, ethnicity, gender, and power factors in society and becomes reified into a virtual reality (Denzin & Lincoln, 1994). Emerging from the intersectionalities of feminism, poststructuralism, the civil rights movement, and critical legal studies (Ritzer, 2008), critical race theory (CRT) falls under the critical strand umbrella and argues that racism is “ordinary, not aberrational” (Delgado & Stefancic, 2012, p. 7), perpetuating a “system of white-over-color ascendancy” (Delgado & Stefancic, 2012, p.7). Taking a critical stance toward STEM doctoral programs means I sought to critique the marginalization of people of color in STEM educational institutions with the aim of transforming dominant structures in these institutions through transformations of the participants in this study (Denzin & Lincoln, 1994). My own experiences, coupled with the following three tenets of CRT, as defined by Delgado and Stefancic (2012), are threaded through my examination of STEM doctoral programs:

- The ordinariness of racism is difficult to cure because racism is not acknowledged primarily through color-blind conceptualizations of equality that inhibit the most blatant forms of inequality, but allow subtler and more complex forms to go unnoticed.

- Racism advances the material interests of white elites and the psychic interests (belief in possessing a normative or even ideal life) of the white working class, therefore, whites have no incentive to eradicate racism.

- Race and races are a production of social thought and relations not tethered to any biological or genetic reality, but are created, altered, or retired when
convenient. A creation, alteration, and retirement of racial categories is a tool of dominant factions and their shifting societal and economic needs.

STEM doctoral programs perpetuate the White-over-color ascendancy by valuing social, cultural, ethnic, and gendered ways of knowing that align with the White, heterosexual, middle-/upper-class, males who dominate STEM fields (Gonzalez, 2006; Stewart & Dottolo, 2005). With nearly all of the growth in science and engineering doctorates earned in the U.S. attributed to international students (NSF & NCES, 2013), and as recommendations to actively recruit people who hold STEM degrees from outside U.S. borders are placed alongside advocating broadening participation of students of color in STEM (Committee on Prospering in the Global Economy of the 21st Century et al., 2007), the U.S. is not yet at a knowledge production and economic crisis to precipitate a paradigm shift to collapse the negative racial stereotyping ascribed to people of color within its own borders. When these factors are viewed through a CRT lens, the materially deterministic nature of racism means that until an economic crisis occurs for White elites, racism in STEM will remain ordinary and inflexibly entrenched in the belief systems of the masters of science.

Further, given the materially deterministic nature of racism and racism’s continued ordinariness and entrenchment in U.S. society, it is not surprising people of color find it more difficult to acquire social, cultural, and symbolic capital, all of which are interchangeable with and for economic capital (Bourdieu, 1986/2008). Bourdieu’s (1986/2008) forms of capital were initially theorized to explain class disparities; it is increasingly used to describe racial disparities (May, 1999). Additionally, given the
intersectionality of race and class in the U.S.-- Blacks and Latinas/os are disproportionately poor in the U.S. (National Poverty Center, 2010)-- Bourdieu’s notions of capital offers a useful framework, in conjunction with CRT, to explain why socialization into doctoral programs is uniquely challenging for people of color.

One of the ways social capital emerges in STEM doctoral programs for students of color is their likely inability to form fictive kinships with peers and faculty in STEM doctoral programs in primarily White institutions. The absence of this fictive kinship offers a framework for the isolation students of color in doctoral programs experience. How racism, a dearth of capital, and an absence of fictive kinship overlap to contribute to higher underrepresented students of color attrition from STEM doctoral programs or the Pyrrhic victory (Fordham, 1988) if they persist is described in detail below.

**Accumulating Capital**

Internally, I am also struggling with wondering if I am smart enough to be here, you know, to run with the more intellectually driven people around me or people I feel that are very intelligent. Just struggling internally with not believing that I belong in this environment and questioning if it is even necessary for me to pursue a Ph.D. in order to have a successful career or to even feel like I am successful. (Gildersleeve et al., 2011, p. 104)

The concept of capital emerges from economics and is a product of human labor, which enables individuals, groups of individuals or organizations to acquire social influence (Bourdieu, 1986/2008). Capital becomes a force making everything unequally possible or impossible, with possibility or impossibility linked to different types of capital that at a particular moment contributes to social structure (Bourdieu, 1986/2008). One of the first additional forms of capital that emerged to assist in explaining societal structures was that of social capital.
Jacobs (1965) used the term *social capital* to describe a vital component to the development of relationships within city neighborhoods ensuring their perpetuation. Further use has included the importance of social capital to the individual (Bourdieu 1986/2008; Loury 1977), the development of human capital (Coleman, 1988; Loury, 1977) and its use in policy making (Putnam, 1993, 2000). Each of these conceptualizations share the common view that social networks possess value derived from reciprocated recognition of membership within those networks (Bourdieu, 1997; Coleman, 1988). Currently, Putnam’s (1993, 2000) and Bourdieu’s (1986/2008) conceptualizations of social capital are the most widely recognized and applied in explaining disparities that emerge within organizations and institutions for those identified as having minority status (Cederberg, 2012; Modood, 2004; Nahapiet & Goshal, 1998).

Putnam’s (1993, 2000) conceptualization of social capital has three components: bonding, bridging, and linking. Individuals will bond with others in a specific group; relationships developed within this group may provide a bridge for forming relationships with others beyond this group, which may eventually lead to development of links to those possessing power resulting in upward mobility (Putnam, 1993; 2000). While Putnam’s concept of social capital works well in explaining many of the social structures within institutions, it fails to include the effects of power and resource disparities on the possibility of achieving mobility (Modood, 2004; Portes, 1998).

Bourdieu (1986/2008) proposed a richer understanding of the social structures surrounding us, three primary forms of capital beyond the economic, must be conceptualized:
• Social capital as the collective real and possible resources connected to institutionalized relationships of mutual acquaintances and recognition, i.e., it is dependent on one’s group membership

• Cultural capital as the characteristics of the mind and body which include cultural values and personal preferences and academic achievements

• Symbolic capital related to how we display our achievements and significance to others.

Capital is temporal in nature and needs time to accumulate, to perpetuate, or to expand and in all its various forms can be converted to economic capital\(^\text{12}\). Correspondingly, the possibility or impossibility of an individual’s success is linked to their ability to acquire capital in all its forms. Therefore, Bourdieu’s conceptualization of capital, unlike Putnam’s, allows a complex interplay of factors to precipitate or enhance understanding of societal patterns.

Although traditionally and originally designed to address these patterns as a consequence of class disparities, Bourdieu’s (1986/2008) conceptualization of capital has been made transferable to addressing differences in educational achievement based on race or ethnicity (May, 1999; Yosso, 2005). Here, we will consider cultural and social capital, as conceptualized by Bourdieu, as they relate to opportunities of students of color to accumulate enough of each to acquire the institutional rites necessary for success within a science doctoral program.

\(^{12}\) This reduction of all exchanges into monetary transactions undergirds CRT’s assertion that marked changes in marginalization of certain racial groups in the U.S. tend to occur when those changes can be tied to economic incentives for white elites.
Cultural capital in its embodied state, which is the enduring characteristics of the mind and body, accounts for most of the attributes of cultural capital. As the embodiment of cultural capital, “it implies a labor of inculcation and assimilation, costs time, time which must be invested personally by the investor” (Bourdieu, 1986/2008, p. 283). It cannot be transmitted vicariously, that is, the embodied cultural capital is an intrinsic sense of wealth that must be intimately experienced to be accumulated. The degree of transmission and therefore accumulation is related to economic capital. Since cultural capital requires time to be accumulated and assimilated, “maximum free time” enables the harnessing of “maximum cultural capital- and then its capacity…to satisfy the specifically cultural demands” (Bourdieu, 1986/2008, p. 284).

Free time is a by-product of economic capital; therefore economic capital is a “pre-condition for the initial accumulation” (Bourdieu, 1986/2008, p. 284). It is unconsciously and at very early stages accumulated. I have lived (and continue to live) this accumulation effect in my academic career. I left my first doctoral program in 2008 and, with much cogitation, restarted a second in 2011. My first experience has deeply informed my second, and while I have lost time and the discipline I had been in love with since high school, I have gained valuable insights.

Three insights gained during this time were crucial to my return to the pursuit of a Ph.D. First, my ideas and approach to problem solving is as valuable as my White and Asian peers. Second, the dissonance and impotence I felt in expressing my ideas in the presence of professors and my White or Asian peers was not a reflection of my academic capability. Third, I still was very driven to earn a Ph.D., and to secure a faculty position in higher education with science as a research focus. It took two years to realize and
internalize these insights and another year to feel enough confidence to implement them through a return to a doctoral work. So while time has been lost, I have come to believe, to trust, and to be confident in my abilities, thereby creating my intrinsic sense of wealth; I have accumulated cultural capital.

The longitudinal analysis of McNair participants may also reflect a similar temporal accumulation effect with a significant increase in doctoral degree completion rate of McNair participants. With time, participants from the early cohort (1989-1993), if given 20 rather than the standard 10 years, have a doctoral degree completion rate that more than doubles from 6% to 14.4% (McCoy, Wilkinson, & Jackson, 2008). This additional time needed to build capital makes sense when placed in context with the historical denial of non-Whites to gain economic capital; the precursor of all other forms. Non-Whites have been systematically denied opportunities for property ownership, the marker of wealth within the U.S. (Heller, 2010). Race, therefore, can be used as “the central construct for understanding inequality” (Ladson-Billings & Tate, 1995, p. 50), as it is continually significant in the U.S. as value is placed on property rights rather than human rights and the intersection of race and property can aid understanding inequity.

Current poverty trends reinforce this, with 27.4% of Blacks and 26.6% of Latinas/os classified as poor, compared with 9.9% of non-Latinas/os Whites (National Poverty Center, 2010). As the U.S. tries to increase its strength as a knowledge-based economy, vertical mobility within academia and the workforce is now a significant barrier for Blacks, Latinas/os, and American Natives to acquire wealth comparable to Whites. Therefore, through denial of past generations to accumulate economic capital, current generations of underrepresented students of color are unable to buy the free-time
necessary for accumulation of cultural capital. While a doctoral candidate’s success in their program requires a reserve of cultural capital, they need to display a social aptitude aligned to the dominant White, middle/upper class male (Gonzalez, 2006; Stewart & Dottolo, 2005).

The Gatekeepers of Science

Much of the research on Blacks in science has neglected the social dimension associated with becoming a scientist, often ignoring “how science career attainment is a social process, and the desire of an aspirant is only one factor in the process. An aspiring scientist relies on the judgment and invitation of practicing scientists throughout every phase of the educational and career process” (Lewis, 2003, p. 371). Bourdieu (1991) offered a similar argument within the capital framework. Within academia, scientific capital is separate from social capital, though the two are inextricably linked. The predominantly White practicing scientists, the gatekeepers of institutional state of cultural capital, will withhold entry to those who they perceive as lacking a social aptitude on par with theirs. Entry becomes a difficult challenge for underrepresented students of color when whites deny or take for granted the unearned rewards of whiteness and assumes superior talent and merit for these unearned rewards (McIntosh, 1988/2004).

McIntosh (1988/2004) asserted that Whites do not recognize these rewards, as they are “made confident, comfortable, and oblivious, while other groups were likely being made unconfident, uncomfortable, and alienated” (p. 191). Instead, the predominantly White gatekeepers account for underrepresented students of colors’
seeming lack of social authority not as a result of structural bias, but rather as a perceived lack of motivation and competency on the part of minority populations (Schumann, Steeh, Bobo, & Krysan, 1997).

It is the “hostility, distress and violence” (McIntosh, 1988/2004, p. 191) that Whites have been subtly trained through social interactions to direct to students of color. The dissonance and isolation experienced in doctoral programs by underrepresented students of color (Anthony, 2003; Gildersleeve et al., 2011) is not alleviated for these students, as it is for their White peers who experience similar socio-economic disadvantages as seen in the significantly higher doctoral degree completion rates of McNair participants, 65% of whom pursue doctoral degrees in the sciences (McCoy et al., 2008, p. 23). White students from low socio-economic backgrounds as those in the McNair program will not have the complications that stem from racial bias and through their whiteness are granted privileges by the gatekeepers of science that underrepresented students of color have to earn. This inequitable challenge to earn what is freely given not because of ability, but rather the color of the doctoral candidate’s skin, can destabilize their self-efficacy, particularly given the lack of time to build cultural capital.

Self-efficacy is tied to a student’s cultural capital and is a term often used as a theme when discussing student attrition and persistence (Antony, 2003; Bandura, 1997). Departure may be representative of a student’s inability to persist due to a lack of self-efficacy. “An efficacy expectation is the conviction that one can successfully execute the behavior required to produce the outcomes,” (Bandura, 1977, p. 193).

Bandura (1977, 1982) argued that this personally perceived degree of expectation of success affects whether a person will choose to engage in an environment, what coping
methods they will use, and how long they persist within the environment. Similarly, Bourdieu (1986/2008) argued that the greater a student’s intrinsic sense of wealth, the greater their belief that they can succeed. Within the academic world, this cultural capital is recognized by the bestowing of academic qualifications. Therefore, the more cultural capital a student accumulates, the more it becomes possible for them to earn the academic qualification pursued.

However, a student’s cultural capital is not only dependent upon their economic capital, but also on the social environment in which they interact. Daily interactions with people in our environment are seminal to our knowledge and understanding of the world (Burr, 2003) and the doctoral student in the environment of a doctoral program is no exception. “As a people we construct our own and each other’s identities through our everyday encounters with each other in social interaction” (Burr, 2003, p. 13). As underrepresented students of color experience distress that is race based in their doctoral programs, these social interactions can overwhelm cultural capital and sense of self-efficacy that probably is, as mine was, fragile.

Making Connections

I haven’t had an opportunity to mingle and make meaningful connections with a lot of the other people. I mean, I know everybody there and they know me, face value of just being in that space, in the proximity. But, the research assistantship hasn’t done much for me in terms of establishing relationships other than with just my singular advisor just because I guess maybe the project I’m working on doesn’t require the others. I don’t do any work that is general to the whole department there, just whatever my professor and I are working on; just that interaction there. But it hasn’t helped integrate me with everyone else there. (Gildersleeve et al., 2011, p. 101)
Social structures within doctoral programs are more crucial to student success than financial support (Carlone & Johnson, 2007; Gardner, 2010; Nettles & Millet, 2006). To understand causations and correlations within these social structures, Bourdieu conceptualized forms of capital beyond that of economic capital as “the social world is accumulated history” (Bourdieu, 1986/2008, p. 280). The strength of an individual’s social capital is a reflection of the strength and volume of the individual’s network of institutionalized relationships, that is the economic, cultural and symbolic capital of the individual and the individual’s group membership. However, the acquisition of a network of connections is not a natural given, or even a social given, constituted once and for all by an initial act of institution, represented, in the case of the family group, by the genealogical definition of kinship relations, which is the characteristic of a social formation. (Bourdieu, 1986/2008, pp. 286-7)

Rather, connections within the individual’s group, their social capital, is a ceaseless “effort at institution, of which institution rites—often wrongly described as rites of passage-mark the essential moments” (Bourdieu, 1986/2008, p. 287), and is a necessity to produce and keep long lasting, useful relationships that lead to economic and symbolic capital.

Bourdieu (1986/2008) purported those individuals with genealogical kinship that have success already hold membership within institutions have a pre-formed social network that facilitates their institutional rites. He later presented a similar argument specific to science. He argued scientists need to recognize that their choices are "shaped by social capital controlled by various positions and stances within the field" (Bourdieu, 1991, p. 3).
Whether conscious or unconscious, scientists regulate the selection of newcomers; entry is strictly reserved for

Those who know and recognize the cognitive and evaluative, or implicit and explicit, presuppositions that institute the fundamental law of the field at the given moment, and who possess the mastery of specific resources necessary for reformulating the questions posed naively by the practical logic of the various social practices, be they scholarly or ordinary. (Bourdieu, 1991, p. 6)

Within science there are two forms of capital, capital of scientific authority and capital of social authority; social capital is independent of scientific knowledge (Bourdieu, 1991). Therefore, despite what may be a significant capital of scientific authority, without sufficient social capital or a "feel for the game" (Bourdieu, 1991, p. 8), an individual may be refused entry into the dominant member’s group, in science which is a White, male, middle/upper class dominated group (Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline et al., 2011). In so doing, dominant members “try to impose the definition of science that best conforms to their specific interest, that is, the one best suited to preserving or increasing their specific capital" (Bourdieu, 1991, p.13).

The prevailing social and cultural capitals that determine the transitory structure of the social world is determined by the dominant group, and the unequal burden of most things being impossible lays with the minority group. Within the U.S., race is intimately linked to social class with Blacks and Latinas/os disproportionately representing the lower-social class (Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline et al., 2011; Ladson-Billings & Tate, 1995). Van Gennep’s rites of passage theory (as cited in Tinto, 1987), where the student must undergo three stages to gain entry into a new organization: separation, transition, and
integration, has been and continues to be used to explain the difficulties students of color face in higher education. However this model, which places the burden of integration on the student, is based on the assumption that the dominant culture within that organization is welcoming of the person seeking entry (Rendón et al., 2000, p. 139).

In the male, White, upper/middle class dominated programs in science, this is a heavy burden is dependent on the student of color ability to display behaviors that are not explicit to the racial, ethnic, or class outsiders; building social capital within their program can therefore be a struggle. In my chemistry doctoral experience, I felt uncomfortable in the department when others were present. At the time, I could not explain why I felt so perpetually unwelcomed during regular hours, but happy and competent in my lab after hours. I became tongue-tied when trying to talk to professors and peers about my research, but especially when trying to find common personal ground. My ability to effectively communicate intellectually and socially bond with others seemed to have inexplicably departed.

I became acutely aware of this loss at large gatherings, when inevitably the other two students of color in my cohort and myself in a program of well over one hundred would always end up together. We found safe harbor with each other, but we never talked about the palpable distress obvious in us. By the two year mark, all three of us had departed the program. After describing this phenomenon to a minority faculty member in my current doctoral program, he forwarded a publication that allowed me to solve the puzzle and distress that was my chemistry doctoral experience. Fordham’s (1988) concept of fictive-kinship allowed me to more deeply explore the role of social capital in the high-achieving students of color academic experience.
Within the fictive-kinship framework, high achieving Blacks become isolated from their minority collective identity and assimilate into the dominant culture, thereby becoming raceless (Fordham, 1988). This assimilation, similar in nature to a rites of passage or racelessness forces, a quest for an often elusive alternative fictive-kinship that can result in cognitive and emotional dissonance having profound effects on the individual personally and professionally. The anthropological concept of fictive kinship, is “a kinship-like connection between and among persons in a society, not related by blood or marriage, who have maintained essential reciprocal social or economic relationships” (Fordham, 1988, p. 56). It extends politically as a collective social identity concept that the collective is "brother" "sister" “and blood” (Fordham, 1988, p. 56). Further it is more than skin color it is a mindset or worldview that is used to determine membership, if it is sought (Fordham, 1988).

The collective ethos of fictive kinship is challenged when children enter school. Schools compete for their group loyalty, it is a group that does not extend membership to those that tend to display attitudes and behaviors that identify their fictive-kinship with the Black community (Fordham, 1988; 2010). To deal with the conflict that results from the competition for loyalty, students of color either create a community within school that reflect the collective minority culture ensuring failure or isolate themselves from the fictive-kinship system assimilating into the majority culture, they adopt, consciously or unconsciously, a "raceless persona" (Fordham, 1988, p. 57). It is the adoption of a raceless persona that can result in internal conflict as the individual strives to achieve upward mobility and is therefore more prevalent in Black Americans who have
successful in the dominant culture. A conflict amplified by the denial of opportunity for underrepresented students of color to accumulate cultural capital.

Within the science doctoral environment, minority students may be unable to form an alternative fictive-kinship given the dominant members’, whether intentional or unintentional, effort to reserve membership only to those that reflect and preserve their specific capital (Aikenhead, 2002; Bourdieu, 1991). Forming a network of peers and mentors in the first year is a strong predictor of a doctoral student’s persistence in their program and eventual degree completion (Nettles & Millet, 2006; Sweitzer, 2008). In other words, the opportunity to build social capital through finding an alternative fictive-kinship is crucial to doctoral education success. However, the underrepresented student of color may find it difficult to build this network in such a short time as they simultaneously struggle with a dearth of capital, an undermining of their self-efficacy, and a lack of peers and faculty with whom an alternative fictive-kinship can easily be formed.

While I found a sense of safety with the two other underrepresented students of color in my chemistry doctoral program, without a mentor we were left to fend for ourselves. Without guidance, we remained stranded unable to navigate the social and cultural environment that caused such conflict and confusion and for all three of us departure was the only resolution. In contrast, guidance via a fictive-kinship with someone who understands the requirements of membership can not only guide a doctoral student to the outer walls of membership, but give them time and share the knowledge needed to build capital and to decolonize the ideas of White privilege allowing a progression through the walls of membership.
The complexity of the requirements of membership as set by the gatekeepers of science can rarely be navigated alone. Minimally, an alternate fictive-kinship within one’s program provides an experienced voice to provide reassurance and encouragement through the process. At its best, it is an experienced voice within the discipline that facilitates a series of intellectual conversations and readings that transforms your view and approach to doctoral education and the discipline in which it is sought.

I have, in my current doctoral program, experienced the latter for the first time. A Black professor in my current Ph.D. program, who like me has an undergraduate degree in chemistry and taught science in the K-12 classroom before pursuing a Ph.D. in education, has been a mentor and his depth and breadth of understanding of students of color experiences in science and society shared through conversations, reading suggestions, including Fordham’s work, and follow-up conversations have been one of my most powerful academic experiences. I initiated a meeting with him after I was struck by the similarities in our academic pursuits, unknown to me prior to entry into the program. I cannot underscore enough that the boldness of this initiation and the content and candor of my questioning would never have occurred without the accumulation of capital, which occurred in my time between doctoral programs.

Situated within fictive-kinship is the individual’s experiences and how those inform whether they choose to undergo separation from their collective community and form new bonds within the dominant culture. More importantly, contextualization of these experiences using academic epistemologies, as the ones offered in this discussion, can offer underrepresented doctoral students of color a deeper understanding of how they can situate themselves within their chosen discipline (Pinar, 1975), thereby experiencing
less internal conflict as they seek vertical mobility through academia. The awareness of
the dissonance and the demands of coping and the “impossibilities that make the system
both open and restricted” and the disclosure of the mechanism that makes it so, “may
become the first condition of finding oneself” (Szkudlarek, 2010, p. 366) closer to
penetrating the membership of the dominant culture.

Moving Beyond the Periphery

Rooted in their disciplines’ origin, STEM doctoral programs have social
constructions disproportionately favoring white males from middle- and upper-class
backgrounds. Without deconstructing how this affects what students of color continue to
experience as they work to gain entry into the academy at its highest level, efforts to
increase the success of people of color will continue to produce unsatisfactory progress
towards equity. The theories of CRT, forms of capital, fictive kinship have offered a lens
to conceptualize how socio-cultural constructs within institutions extend or discourage
opportunity for success or upward mobility based on race, class or ethnicity (Cederberg,
2012; Fordham, 2010; Heller, 2010; Modood, 2004; Nahapiet & Goshal, 1998; Phelan,
2001).

In this study, the theories have been collectively intertwined to offer a framework
to understand the lack of participation of underrepresented students of color in science at
the doctoral level. Fordham’s (1988; 2004; 2010) work was the missing puzzle piece
between the forms of capital and white privilege described in CRT as they manifest in
academia for an underrepresented student of color, revealing a depth and complexity to
the racialization of the experiences of students of color in STEM doctoral programs that I
have not found explored in the literature on the underrepresented student of color STEM doctoral experience.

My framework overlapping CRT, fictive kinship, and forms of capital is conceptualized as a powerful tool understand the academic experiences of students of color, and to open the door to a dialogue between those who hold power in STEM and those who engage in STEM from below this power (Harding, 2008). It is also devised to move us beyond the social integration discourse of “blaming the victim” which exists at the peripherals of racial inequality in STEM towards a social justice dialogue between those who hold the power and the students of color who seek to fully participate and be equitably represented within their STEM doctoral programs allowing them to exercise their capacities and realize their choice in seeking to earn a doctoral degree in a STEM field.

**Summary**

In Chapter II, I critiqued the literature addressing the persistent underrepresentation of Blacks, Latinas/os, and American Indians in STEM doctoral programs and reviewed the research literature on racism in U.S. society and institutions of power. I also described how my experiences as an underrepresented woman of color in a STEM doctoral program shaped my perception, informed by the research literature, that researchers and policymakers interested in the STEM doctoral journey of underrepresented people of color need to shift their theoretical focus from one of social integration to one of forms capital, fictive kinship, and critical race theory. Chapter III describes the critical qualitative methodology that informed this study’s design to collect
and analyze data illuminating the experiences underrepresented people of color who were formerly STEM doctoral students have had within their educational institutions.
CHAPTER III

METHODOLOGY

As a comprehensive look into the academic lives of underrepresented students of color, the overarching purpose of this study was to obtain a rich description of how oppression is reflected in STEM doctoral students’ academic experiences and how oppression influences students’ academic outcomes. Further, this study was developed to explore the potential of intertwining theories of CRT (Bell, 1995), forms of capital (Bourdieu, 1986/2008), fictive kinship (Fordham, 1988) in conjunction methods influenced by currere (Pinar, 2011), and critical race methodologies (Solórzano & Yosso, 2002) to uncover the complex nature of how academic lives influence personal lives and vice versa. With these complexities as a major theme, this study was also developed to explore how racism and other forms of oppression are perceived by selected participants and the possible influences the evidence (or lack of evidence) of these oppressions have on selected participants’ perceptions of educational institutions and their academic persistence.

Much of what is known about the doctoral experience is within the dominant White context (Gildersleeve et al., 2011), leaving the STEM doctoral experience of persons of color little understood (Hurtado et al., 2009). Many of the studies exploring the STEM doctoral experiences specifically of people of color, focus on the problem of
social integration into STEM doctoral institutions, and often the impetus for the study
serves the knowledge-discovery enterprise of the U.S. economy (Griffith, 2010; Herrera
& Hurtado, 2011; Herzig, 2004; Leggon, 2010; Millet & Nettles, 2006; Mwenda, 2010;
Pender, Marcotte, Domingo, & Maton, 2010; Stassun, Burger, & Lange, 2010). Situated
within a critical qualitative framework, and in opposition to social integration being
presented as the barrier to underrepresented students of color STEM doctoral success,
this study proposed to capture the normalness of racism in conjunction with other forms
of oppression, such as sexism and classism, as the barriers which underlie the challenges
students of color face in forming meaningful and supportive social networks in their
doctoral institutions. Further, this study centered on the voices of selected participants,
with my voice as researcher used to deepen the understanding of their academic
experiences.

Theoretical Frame

Critical Qualitative Research

My study to illuminate the academic experiences of students of color in STEM
doctoral programs was anchored in a critical qualitative epistemology. The qualitative
researcher “strives to understand the meaning people have constructed about their world
and their experiences” (Merriam, 2002, p. 4-5). As a qualitative researcher, I became the
primary instrument of collecting and analyzing data representative of the constructed
worlds and experiences of my participants where my immediate processing of data,
clarification and summary of material, and checking with participants for accuracy of
interpretation to explore unusual or unanticipated responses is shaped by my
subjectivities (Merriam, 2002).
Identifying those subjectivities, which I describe later in my reflexive statement, rather than suppressing them in an attempt to eliminate bias is important to transform my biases from a perceived liability to where it “can be seen as virtuous, for it is the basis of researchers making a distinctive contribution, one that results from the unique configuration of their personal qualities joined to the data they have collected” (Peshkin, 1988, p. 18). Some of the personal qualities brought to this research developed from my own experiences as a student of color in a chemistry doctoral program; my struggles with oppression eclipsed the challenges of novel, scientific, skill-related experiences.

In the absence of explicitly theorizing racism and other forms of oppression in relation to the student of color STEM doctoral experience has left a need to build an equity and justice centric theory. Theories which center equity and justice should displace social integration to the periphery of the science education research community’s theoretical understanding of retention and attrition of people of color from STEM doctoral programs. Although people of color have always thought in theoretical terms about their conditions of social, political, and economic subordination in a White supremacist society, racism is yet to be given full explanatory power in the academy (Feagin, 2000 as cited in Parker & Lynn, 2002). As discussed in Chapter II, many researchers who have explored the disproportionate enrollment and attrition of students of color in STEM doctoral programs have failed to acknowledge the full explanatory power of racism to contextualize this problem. Therefore, this study more specifically located itself within a critical qualitative framework where the critical qualitative researcher “uncovers, examines, and critiques the social, cultural, and psychological assumptions that structure and limit our ways of thinking and being in the world.
Further, the ultimate objective of this type of critique was to free researchers and participants from the constraints of these assumptions allowing us to “become empowered to change our social context and ourselves” (Merriam, 2002, p. 9).

Modified analytic induction (Bogdan & Bilen, 1992) was used to advance this study’s goal to examine and further critique the social, cultural, and psychological assumptions made about the STEM doctoral experiences of underrepresented people of color. Modified analytic induction allows the researcher to test predetermined hypotheses and theories while giving the researcher flexibility to explore discoveries that emerge from that deductive research (that is, also engage in induction; Gilgun, 1995). This study used modified analytic induction to test the literature-derived hypothesis that forms of capital, fictive kinship, and critical race theory are more appropriate theories than social integration theories for how and why underrepresented students of color experience their STEM doctoral programs. Testing and retesting hypotheses and theory, is necessary to explore the inadequacies of socialization theories currently dominating research of students of color in STEM and to push “the envelope of the ways in which we talk about race and racism, so that we focus on the intersectionality of subordination” (Solórzano & Yosso, 2000, p. 613). Further, modified analytic induction complemented Peshkin’s (1988) assertion that a researcher’s personal experiences can aid in their making a distinctive contribution to the research community since modified analytic induction allows the researcher to examine “preconceived hypotheses…without the pretense of the mental blank slate” (Patton, 2002, p. 493).

A social justice-centric theory of the underrepresentation of students of color in STEM a critical lens further strengthens the qualitative lens of this study as it brought
focus not only to the worldviews participants express in the data, a primary aim of qualitative epistemology (Merriam, 2002), a critical approach also brought focus to the context in which worldviews are shaped (Lather, 1992). More specifically, this research methodology was shaped by raced-gendered epistemologies, which include critical race theory (CRT) and Latino critical race theory (LatCrit).

Raced-gendered epistemologies in educational research recognize students of color as holders and creators of knowledge who have the power to transform educational research and practice, but whose knowledge and ways of being in the world are often devalued, misinterpreted, or omitted in formal educational settings (Delgado Bernal, 2002). Both CRT and LatCrit emerged from the field of law to explore the seeming neutrality of laws and policies perpetuating and reinforcing racial disparities (Bell, 1987; Delgado & Stefancic, 2012). While “the task for critical race scholars is to uncover and explore the various ways in which racial thinking operates” (Flores, 2000, p. 437) to advance social justice, LatCrit adds the dimensions of language, immigration, ethnicity, culture, phenotype, and sexuality (Espinoza, 1990; Garcia, 1995; Hernández- Johnson, 1997; Martinez, 1994; Montoya, 1994; Truyol, 1997) to represent the multidimensionality of people of color. CRT combined with LatCrit allowed me to analyze how racism influences underrepresented people of colors’ constructed worldviews and the context shaping that construction. CRT combined with LatCrit also allowed me to explore how racism intersects with sexism, classism, heterosexism, and other forms of oppression in their STEM doctoral experiences with sexism and classism as established barriers to entry to the STEM doctorate (Bourdieu, 1991; Harding, 2008; Holleran, et al., 2011).
Raced-gendered epistemologies place an emphasis on experiential knowledge that is “uniquely individual while at the same time both collective and connected” (Dillard, 2000, p. 676) to challenge dominant ideologies through considering how pedagogies of the home are applied to systems outside of the home (Delgado Bernal, 2001) by centering multiple layers of oppression and multiple forms of resistance (Solórzano & Yosso, 2000) with the ultimate goal of social justice by seeking political and social change on behalf of people of color (Delgado Bernal, 2002). To emphasize experiential knowledge, CRT and LatCrit embrace the use of life narratives including counterstories, testimonios, and oral histories, as method and as an analytic framework, to bring the experiences of people of color to the foreground (Delgado Bernal, 2002; Smith & Watson, 2010).

Legal scholar Richard Delgado (1993) pointed out “majoritarians tell stories too. But the ones they tell—about merit, causation, blame, responsibility, and social justice—do not seem to them like stories at all, but the truth” (p. 666).Meritocracy, objectivity, and individualism subconsciously filter majoritarians, or White heteronormative males, interpretation of the world around them (Delgado Bernal, 2002), making White privilege invisible in the white heteronormative male metanarrative (Tatum, 1999) despite the very real effects of racism, sexism, classism and other forms of oppression (Mohanty, 2003).

Counterstories can attack metanarratives “that marginalize others or conceal their humanity” (Delgado & Stefancic, 2012, p. 48) and encourages “learning to listen to other people’s stories and then finding ways to make those stories matter” (Williams, 1997, p. 765). Similarly, learning to listen to counterstories within the STEM doctoral education system can be an important pedagogical practice for students and professors, and an important methodological practice for STEM educational researchers and STEM
education policymakers. Through the collection of written and oral artifacts from underrepresented women of color, counterstories were used to challenge and displace the White, middle-/upper-class, heteronormative male metanarrative of commoditization and social integration of students of color pursuing careers in STEM. Some of the tools of *currere* (Grumet & Pinar, 1976; Pinar, 1975) and narrative analysis (Patton, 2002) were used to inform the collection and analysis of data to elicit and represent the counterstories of this study’s participants.

**Currere Inspired Narrative Analysis**

Schubert (2004) describes *currere* as

A continuous reinterpretation …. of one’s experience in light of excavations of one’s past, multiple narratives of one’s present, and anticipations of one’s possibilities, emphasizing: I choose… who it is I aspire to be, how I wish my life history to read. I determine my social commitments; I devise my strategies: whom I work with, for what, how. (p. 9)

Pinar and Grumet’s (1976) early work on *currere* was decisively situated in a qualitative epistemology and focused on autobiographical understanding (Cary, 2006; Pinar, Reynolds, Slattery, & Taubman, 1995). *Currere* as theory and as method brings to educational research and practice “one of the best hopes for keeping the human factor alive in education, especially at a time of widespread political retrenchment, a global movement whose impetus at present shows few signs of exhaustion” (Graham, 1992, p. 40). Further, Lasch (1978, as cited in Pinar 2011, p. 16,) described *currere* as “cultural criticism” that takes on “a personal and autobiographical character, which at its worst degenerated into self-display but at its best showed that the attempt to understand culture has to include the way it shapes the critic’s own consciousness” (p. 45). With “self-display” in mind, Pinar (2011) recommended the method of *currere* in its four moments.
of the regressive, progressive, analytical, and synthetical, be used as a sensibility rather than an instructional device.

I used *currere* as a sensibility, rather than a prescriptive device, for students of color in STEM to self-excavate personal and academic past, present, and future experiences “to produce different knowledge, to produce knowledge differently as we work for social justice in the human sciences” (St. Pierre, 2000, p. 27) and engage in self-excavation by coming to “practice the autobiographies of self-shattering, revelation, confession, and reconfiguration” (Pinar, 2004, p. 55). Being situated within an interpretive qualitative epistemology, *currere* offered not only the ability to capture the academic worldviews of underrepresented people of color in STEM, but also the temporality of how those worldviews came into being. Additionally, Pinar (2004) called for the expansion of the use of curriculum theory and *currere* as method:

Rejecting colonization by the hegemonic disciplines such as psychology, curriculum theory explores and constructs hybrid interdisciplinary constructions, utilizing fragments from philosophy, history, literary theory, the arts, and from those key interdisciplinary formations already in place: women’s and gender studies, African-American studies, queer theory, studies in popular culture, among others. (p. 33)

Therefore, despite being conceived of by Pinar, a White male in academia (a person of privilege) and developed with Madeleine Grumet, a White female in academia (a person of privilege), *currere*, the autobiographical method emerging from curriculum theory, can be appropriated within a critical epistemology because it brings self-knowledge and collective witnessing to the foreground to socially reconstruct public lives of others (Pinar, 2011). In this study, *currere* was appropriated to specifically aid capturing the temporality of how racism, classism, sexism, heterosexism, and other forms of
oppression manifest, in addition to the temporality of capital accumulation\(^{13}\), in the academic experiences of students of color who have chosen to pursue a doctorate in STEM and to offer them a structure that can both give voice to their subjective academic experiences, but to have them answer the question of what these experiences mean for their present academic, public, and private lives.

More specifically, in this study currere’s sensibility was used to guide the type of interview questions (questions that encourage participants to self-excavate and the researcher to self-excavate alongside participants – See Appendix F). Further, the flow of the interview followed currere’s four moments of regression, progression, analysis, and synthesis. Since the primary data collection instrument was influenced by currere and the data were collected via interviews, participants’ counterstories are represented through texts that are both autobiographical and biographical in nature. Therefore in this study, currere was used as a tool to elicit temporal data; a temporality that is key to effectively applying Bourdieu’s (1986/2008) forms of capital as the accumulation of cultural capital is time dependent. This study did not center my currere, currere as method, or currere as theory.

**Narrative and Autobiographical Discourse**

As far as researchers understand, human beings are the only species on the planet capable of storytelling and we exclusively use storytelling to make sense of the world. The human mind “is a narrative machine” (Wilson, 2005, p. ix) and is a “simulation of experience that has been lived, and recalled, and…that would be possible for the

\(^{13}\) Capturing this temporality is significant to the data collection process since accumulation of capital over a lifetime or even generations is a key dimension Bourdieu’s (1986/2008) forms of capital.
future…. [therefore] storytelling is not just important for the human mind, it is the human mind.” (Wilson, 2014a). Thus, to dismiss an individual’s stories is to dismiss their very existence (Wilson, 2014b), but to acknowledge the stories of others has multiple values. Storytelling and listening creates bonding, builds empathy, enhances our ability to evaluate the stories of others, and sparks creativity (Wilson, 2014a).

Some psychologists also argue that thought, which is the essence of the human mind, is fundamentally narrative in form (Schank & Abelson, 1995). Critical researchers agree with evolutionary biologists and psychologists about the role of storytelling in human lives. Since stories are the most natural and persuasive form of information input to humans (Brock et al., 2013), critical researchers also advance the use of counter-storytelling (similar to what psychologists call counter-arguing) to breach dominant groups’ meta-claims and metanarratives (i.e. their stories) that perpetuate their seemingly natural dominance.

Autobiography is the most common term used for life writing that emerged in the age of Enlightenment and privileges the autonomous individual and the universalizing life story of the Western, White, upper-class male (Smith & Watson, 2010). However, postmodern and postcolonial theorists such as Julie Rak (2004) argued autobiography is inadequate to describe the historical range and diversity of genres of life writing within the West and globally (Smith & Watson, 2010). Rather, Rak argued critical thinking should shift the term autobiography to the term autobiographical discourse to reflect the discursive forms of truth-telling “sustained by the trappings of identification that have underwritten what the self is and how it has been seen in much of the Western World” (p. ix). Rak went on to argue autobiographical discourse, when used by writers or speakers
who do not have access to the privileges of autobiographical identity, unlike the
unchangeable and universal metanarrative of the autobiographies of the privileged,
changes as it is used because it can become appropriated for use by those who are not
powerful or whose version of events cannot be allowed to have validity.

The appropriation of use, and by extension meaning, of autobiographical
discourses means autobiographical truth resides in an intersubjective exchange occurring
within a dialogic exchange among autobiographer, researcher as biographer, researcher as
reader, and other readers outside of the autobiographical writing process (Smith &
Watson, 2010). The intrasubjective nature of writing autobiographical discourses (for
example, Pinar described currere as a conversation with, for, and about oneself), and the
intersubjective nature of reading autobiographical discourses (there are innumerable
separate transactions between readers and text (Rosenblatt, 2004) means autobiographical
discourses are not written or read as an objective truth; that is, the subjective nature of
autobiographical discourses “redefines the terms of what we call “truth”:
autobiographical writing cannot be solely read as either factual truth or simple fact”
Smith & Watson, 2010, p. 17). Therefore, the truth derived from autobiographical
discourse can neither be proven nor falsified.

**Reflexive Statement**

The closeness and distance between a biographer and her subject is
given…perspective by Liz Stanley when she asks “how close are the links
between the experience or lives of autobiographers and…written biographies…?”
This suggests an experiential link between the life of the writer and the way she
expresses her understanding of the life of her subject. (Iles, 1992, p. 2)

“Expressing one’s subjectivity through academic knowledge is how one links the
lived curriculum with the planned one, how one demonstrates to students that scholarship
can speak to them, how in fact scholarship can enable them to speak” (Pinar, 2011, p. xv). This study was not only an academic endeavor; it was a catharsis of my own lived experiences as an English speaking, immigrant woman of color from a third world country who is the first in a poor family to attempt to earn a doctorate in a STEM field. My attempt to earn a doctorate in chemistry failed, and the consequences of this failure vibrantly lives on years later in this dissertation study. Before I attempted a doctorate in chemistry, I was a McNair Scholar who graduated with a Bachelor’s of Science in Chemistry with honors summa cum laude, conducted nearly two years of research in polymer synthesis, presented my research at several local and national academic conferences, and had a publication in the pipeline.

In my chemistry Ph.D. program, I was supported by fellowships that absolved me of teaching obligations and totaled $34,000 annually, a huge leap from making less than $900 monthly as a research aide. Objectively, I was a perfectly positioned student of color to successfully complete a STEM doctoral program of study, yet I departed from my chemistry doctoral program after just one year with 21 credit hours completed and a 3.9 GPA. In my one year as a chemistry doctoral student, everything I knew and understood about how to be academically successful was made impotent, being bright and deeply in love with chemistry was no longer enough. I found myself constantly on edge and often struggling to put a coherent thought (much less an intelligent one) together when having a conversation with anyone affiliated with my institution. I felt insignificant and stupid despite two decades of academic experiences that indicated otherwise. The objective, quantifiable evidence did not support the eventual outcome of departure. These experiences represent the essence of why I chose to illuminate the
academic lives of students of color in STEM. Whether participants’ experiences reflect or clearly depart from my experiences my voice as researcher and the participants’ voices work in solidarity as mutual agents for social change (Tuhiwai Smith, 1999).

**Research Design**

The purpose of this study was to explore the academic experiences of underrepresented students of color in STEM doctoral programs. Through qualitative and critical lenses, the study used *currere* inspired counterstories to focus on how social and cultural experiences influence the STEM doctoral journey of underrepresented students of color. These influences were considered by asking:

1. How do selected underrepresented STEM doctoral students’ of color experience educational institutions?
2. How do the educational experiences of selected underrepresented STEM doctoral students’ of color influence their ability to persist in their STEM field?

**Participant and Site Selection**

Patton (2002) described qualitative studies as focusing “on relatively small samples… selected to permit inquiry into and understanding of a phenomenon in depth” (p. 46). Further, a purposeful selection of a small population “leads to selecting information-rich cases for study in depth” where “one can learn a great deal about issues of central importance to the purpose of the research study” by focusing on the needs, interests, and incentives of a small number of carefully selected individuals than by gathering standardized information from a large statistically significant sample (Patton, 2002, p. 46). More specifically, in this study participants were selected using purposeful
intensity sampling. Intensity sampling allowed me to seek “excellent or rich examples of the phenomenon of interest, but not highly unusual cases” (Patton, 2002, p. 234). Therefore, intensity sampling allowed me to select participants whose experiences with oppression in their academic experiences have been sufficiently intense to illuminate how racism, sexism, classism, heterosexism and other forms of oppression manifest and influence STEM doctoral experiences of students of color.

Participants were purposefully selected with the understanding that “there are no rules for sample size in a qualitative inquiry” (Patton, 2002, p. 244) and on the following criteria:

- An underrepresented person of color who is a U.S. permanent resident or citizen.
- Currently or formerly a doctoral student in a STEM field.
- Experiences with sufficiently intense of oppressive academic events.
- Willingness to being open about oppressive academic events.
- Willingness to communicate, as necessary, on the phone, e-mail, or other participant preferred and feasible method of communication throughout data collection, analysis, and member checking processes (estimated to extend over five consecutive months).

While the three participants in this study met the above criteria and were purposefully selected, each was recruited under different circumstances. I met the first participant, given the pseudonym Avenus, at a conference in 2013. After discussing my dissertation proposal over lunch, she volunteered to be a participant. She is a former McNair Scholar who departed a chemistry Ph.D. program and had recently completed her Ph.D. in
science education. Once I had IRB approval (Appendix K) for this study in January 2014, I used the email address she gave me at the conference asking if she was still willing to be a study participant. Avenus resided in a European country for the duration this study.

I met the second participant, given the pseudonym Soraya in undergraduate studies. She was also chemistry student and we were in contact intermittently over the years, but had not been in contact since 2012. After I began my analysis of Avenus’s interview, I decided the perspective of someone who had completed a Ph.D. in a “hard science” would be valuable, and Soraya quickly came to mind.\(^{14}\) I knew Soraya had completed a Ph.D. in chemistry and the last time we spoke (about two years prior to contact for this study) she was lecturing chemistry at a liberal arts college. After a phone conversation in which I briefly described the study, she agreed to participate. Soraya resided in a Southern U.S. state for the duration this study.

The final participant, given the pseudonym Devina, was recommended after description of my dissertation study with a mutual colleague. Devina and I were introduced via email. Devina agreed to participate after I sent a follow-up email giving her a brief description of the study. Devina resided in a Midwestern U.S. state for the duration of this study.

**Data Collection**

**Identity Protection and Informed Consent**

Given the variation in locations of participants, multiple modes of contact were necessary to accommodate the preferences of each participant and the limitations large

\(^{14}\) Up to this point Soraya was never considered as a possible participant for this study as it was originally designed to focus on former McNair Scholars and she is not a former McNair Scholar. Further detail on how participant selection emerged is discussed in Chapter V.
distances placed on having face-to-face meetings with every participant. Two separate email accounts\textsuperscript{15} were used, in addition to multiple online web-based applications and offline methods, when appropriate, to ensure the confidentiality of selected participants (Eynon, Fry, & Schroeder, 2008). The consent letter was sent as an attachment (Appendices A and B) via email. Each letter contained a link, unique for each participant, which took participants to their individual and anonymous signature page (Appendix C) created in Qualtrics (Qualtrics, LLC.). Qualtrics is a password protected Internet-based survey software. The signature page in Qualtrics informed participants that by clicking on “I consent to participate,” they indicated they read the consent letter and agree to be a participant in the study. Although signature pages were anonymous, the unique links contained in the consent letters were tied alphanumeric codes that were unique to each participant. Therefore, as signature pages became populated I could specifically infer which participants gave consent.

\textbf{Interviews and Demographic Surveys}

We cannot observe the meaningful events, whether in the past or hoped for, in the lives of others, nor can we understand how a person organizes and makes meaning of such events (Merriam, 2002; Patton, 2002). Asking questions provides the researcher an instrument that can reveal the mind of others (Patton, 2002). Further, interviewing assumes that the perspective of others is “meaningful, knowable, and able to be made

\textsuperscript{15} An email account recognized by participants was used for initial contact requesting their interest to participate. A second account was created specifically for this study and was used when data collected from the study was communicated to participants. Separation of personal and experimental data (as well as keeping personal information separate from both the researcher institution email system and potentially Scholars institutions e-mail system) protects the privacy and anonymity of research participants (Kraut et al., 2004).
explicit” (Patton, 2002, p. 341), and allows the interviewer to tell the stories of others (Patton, 2002). In this study, interviews were the primary data collection instrument and were conducted using an interview guide (Appendix F). An interview guide provides the interviewer a list of issues they wish to explore, but gives the researcher flexibility to ask also explore unanticipated topics that facilitates elucidation of a particular subject (Patton, 2002). The interview guide for this study was loosely constructed around Pinar’s (1975) suggested topics to be explored when engaging in currere, and more closely around a validity matrix (Appendix H) I created based on and aligned with the current literature on the doctoral process, racism and sexism and their effects on educational outcomes, and the role of socialization in the doctoral process.

Interview dates and time were arranged via email or phone. I gave participants the schedule I was hoping to follow (I hoped to complete all interviews by the end of April 2014), and they indicated when they were available and what mode of communication they preferred\(^{16}\). Avenus decided to do one-hour sessions over two consecutive days via voice phone call. Soraya agreed to a two-hour session via voice phone call. Devina decided on a face-to-face meeting at her local college campus. Prior to each interview, the demographic survey and the interview guide containing questions that would be explored in interview were emailed to participants. This was done to give participants the option of reflecting on possible answers prior to the interview.

Participants were reminded at the beginning of the interview that they could decline to answer any or all questions asked. Each interview began with the 12-item

\(^{16}\) Phone, Skype, or Google were suggested platforms for Avenus and Soraya. They were also offered just a voice call or a video call for these interviews. Devina also had these options in addition to face-to-face meetings since her location made driving to meet her feasible.
demographic survey (Appendix D) that clarified each participant’s educational background. This was followed by interview, which used a 60-item interview guide (Appendix F). I completed the verbatim transcription of each interview no more than three weeks (two of three were completed within one week) after the interview using Microsoft Word. After the transcription of each interview, I wrote a two to four page reaction to the story that seemed to be emerging from that interview.

**Participants’ Reflection on Sharing Stories**

After initial data analysis of the three transcribed interviews, the following question emerged: How did the act of telling your stories affect participants? An email was sent (Appendix G) to participants explaining how the follow-up question emerged, and asked them to share a reflection, written or otherwise, on their thoughts after the interview was completed. This occurred 45 days after my first interviews with Avenus and 10 days after my final interview with Devina.

**Method Revisions**

I began this study intending to focus on the experiences of students of color who were either formerly or currently enrolled in a STEM doctoral program and were also former participants in a McNair Program. As a former McNair Scholar myself, despite the program’s intention to provide preparation for the doctorate, I went into my chemistry doctoral program astonishingly oblivious of the hegemony practiced and apparently accepted in the STEM culture of that program. My experiences after just one year in my chemistry doctoral program were so deeply affecting that I developed an intense curiosity to find out if other McNair Scholars felt similarly about their STEM doctoral experiences. Additionally, I wondered if they felt, like I did, that the McNair Program prepared them
academically, but utterly failed to prepare them for the sociocultural demands they would have to face as an underrepresented person of color in academia. However, access to former McNair Scholars proved to be a more formidable task than I had foreseen.

I had done a survey of the McNair Scholars from three Midwestern universities in 2013 and planned to return to the contacts to seek participants for my dissertation study. This strategy initially seemed successful. I had one woman (we will call her Fatima) who was a participant in the 2013 survey study who quickly agreed to participate. She went on to quickly complete the online consent form, and we were in the process of arranging data collection. At this point, I had planned to collect data over six weeks, collecting data from each participant through a demographic survey (Appendix C), an online journal guided by prompts (Appendix D), a one-to-one interview, and finally an online focus group. The latter two methods of data collection were to be developed after the survey and journal were complete.

Also, I had serendipitously met Avenus at a conference 2013. We were one of the few people of color and fictive kinship kicked in and we ended spending considerable time together. In a conversation about my dissertation research, I discovered she was also a former McNair Scholar who had been in a STEM doctoral program. She offered to be a participant for my study. Three days after I received IRB approval, I contacted Avenus via email. Two weeks later she replied, agreeing to participate. The plan for data collection remained unchanged from my description above.

However, the plan for data collection quickly changed after renewing contact with two of the McNair directors from 2013. When I informed them of plan for data collection, they both advised that I may want to reduce my demands on Scholars’ time, as
my plan seemed very time intensive. The third director never replied to my e-mail or my two follow-up telephone calls. Further, I was unable to find any more participants from contact with these two McNair directors. I then randomly selected 10 McNair Programs from the 2009-2010 grantee level performance results spreadsheet\(^\text{17}\), which had 200 university grantees listed. I visited the webpages for the 10 randomly selected universities. Three of the universities contained phone numbers listed specifically for the graduate school McNair Program and there was no McNair Director listed or e-mail contact, although information for the McNair Program was on the website. I called the provided phone numbers and had to go through several people to get connected to the McNair Directors, who were out of their office every time I called. I left voice messages, but they never returned my calls. I decided these three McNair Programs were not viable options.

Through e-mail replies from three other McNair Programs, I found out one program had a non-STEM focus and two programs had lost their funding and were defunct. Another two programs had no email contact information and no one answered the phone despite repeated attempts. The remaining three McNair Programs I made contact agreed to help made promises to either contact a few students they could think of or send out a blanket requesting volunteer to their Scholars. However, no participants emerged from their attempts.

Cumulatively, I had spent a month e-mailing, calling, and following up; I grew frustrated. I went back to the grantee spreadsheet and selected three more programs and ended having very similar experiences. Within this month I sent Avenus the material

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necessary to begin six-week data collection; however, she had not yet completed the first part of the data collection. Additionally, Fatima stopped replying to my e-mails and I took this as an indication that she had withdrawn from the study.

Feeling that I was engaging in an exercise in futility, I decided to widen my accessible population by dropping the former McNair Scholar criterion. I also decided that I needed to significantly shorten my data collection to reduce participant attrition. So I reduced my data collection instruments to the demographic survey and the one-to-one interview. I revised the journal prompts so they worked as interview questions. I also decided to administer the survey as the first part of the interview.

Data collection time became reduced from six-weeks to approximately two hours. Avenus seemed much more receptive to two hours versus six-weeks and Soraya and Devina indicated no hesitancy to volunteer two hours of their time. I decided that any additional data collection and my final sample population would be dependent on what emerged as I conducted interviews and started data analysis. An outline of what emerged and when it emerged is provided in Figure 3.1.
Figure 3.1. Timeline of emergence of research design and data collection.

In our one-to-one interviews, I focused on participants’ current recollections of past events and anticipated experiences. I recognize that these recollections and
anticipations and the feelings associated with them were fluid and influenced by participants’ present experiences and the social context of their present. Individuals’ lives are on ongoing social construction (Burr, 2003) and autobiographical truth resides in the intersubjective exchange among the participants’ counterstories, my interpretations of their counterstories, retelling those stories, and the readers outside of the autobiographical process (Smith & Watson, 2010). Therefore, participants’ understanding and expression of their experiences change with time, and readers’ understanding of the text presented in this study will also change with time. Additionally, given the autobiographical underpinnings of this study, I did not intend to portray these counterstories as an objective truth. However, I did intend for these counterstories to tell a truth that is valid.

Data Analysis

Construction of Counterstories Using Narrative Analysis

Within the LatCrit framework, counter-storytelling can be autobiographical, biographical, or composite stories (Solórzano & Yosso, 2002). Rather than using my reflections and conceptualizations to biographically write the stories of individual participants based on their autobiographical discourses or drawing on the autobiographical discourses of all participants to create composite/fictional characters representative of categories derived from coding, I used narrative analysis to connect minimally edited sections of each participants transcribed interview to holistically and separately represent the experiences of each participant. A narrative analysis was then conducted to create a chronological and connected story for each participant.

Some qualitative researchers distinguish between stories and narratives. A story is an original account of specific past events, whereas a narrative is a representation of a
story along a timeline and made up of discrete moments at which events occurred (Polanyi, 1985 as cited in Gall, Gall, & Borg, 2010). That is, a narrative is a reorganization and interpretation of a story. More specifically, within a narrative analysis framework, each participant’s counterstory would be considered a research narrative as I (re)presented each as an organized interpretation of events (Gall et al., 2010).

To create a first draft of each participant’s counterstory, transcribed interviews were read in the order the interviews were conducted, and significant parts of the conversation were noted. A second reading of the interview transcript was done with a new Microsoft Word document open beside the verbatim interview transcript; significant portions identified in the first reading were copied and pasted into the new document. The interview portions pasted into the new document were then rearranged and edited with a conscious attempt to make minimal changes. The first draft of each counterstory was then re-read alongside the verbatim interview transcript to ensure the counterstory preserved the context of the original conversation.

Coding for Oppression, Capital, and Fictive Kinship

After all counterstories were completed, common patterns among all participants’ experiences, in addition to some unique experiences, seemed to be emerging. To further explore these patterns, verbatim interview transcripts were uploaded into Nvivo 10 for Mac to be coded. Using operationalized a priori meta-codes (Hesse-Biber & Leavy, 2011; Appendix I) for the forms of capital, fictive, or alternative fictive kinships, and forms of oppression that connect to critical race theories, each transcribed interview was coded. Over multiple readings, sub-coding was introduced as I cycled through the data and refined and redefined meta-codes until saturation, which is “the point at which you
realize no new information, insights, or understandings are forthcoming” (Merriam, 2009, p. 183). Refined and redefined operationalized codes can be found in Appendix J. The frequency of each code identifying a dimension of capital, kinship, or oppression was then tabulated. Further, the timeline and/or context in which some of common dimensions of capital and oppression emerged for each participant seemed to be strikingly different, therefore the frequency of each code for these dimension was disaggregated and tabulated.

Finally, an editable draft of the counterstories, my interpretation of the counterstories, and my interpretations of the coded data were shared via email with participants for member checking. Within the critical scope, member checking empowers participants to shape how racism, classism, sexism, heterosexism, and other forms of oppression can contextualize the past, present, and future academic experiences of students of color (Solórzano & Yosso, 2002) and moves their voices from the margins to the center of those experiences (Tuhiwai Smith, 1999). The feedback from participants was then used to revise the draft for misinterpretations, omissions, and included data they requested be omitted. In addition to feedback on changes to their counterstories, participants independently chose to take on the role of editor and identified issues with writing style and areas where ideas needed to be expanded and supported with scholarly citations. Each participant was then emailed a copy of a complete draft of the dissertation study for a final member check.

**Data Validation**

Within a qualitative paradigm, Guba and Lincoln (1981) recommended rigor be established through trustworthiness. Trustworthiness comprises of credibility,
transferability, dependability, and confirmability (Lincoln & Guba, 1985). Specific strategies to establish trustworthiness include negative cases, peer debriefing, prolonged engagement and persistent observation, audit trails and member checks (Morse, Barrett, Mayan, Olson, & Spiers, 2008). Additionally, they recommended the researcher be responsive and adaptable to changing circumstances, holistic, having processional immediacy, sensitivity, and ability for clarification and summarization (Guba & Lincoln, 1981). In this study, credibility, transferability, dependability, and confirmability (Lincoln & Guba, 1985), in addition to researcher responsiveness and adaptability, were used to establish trustworthiness. The discussion below details how each of these were addressed in this study.

**Credibility**

Credibility was established through multiple triangulation (Denzin, 1970; Polit & Hungler, 1995) including investigator triangulation and theoretical triangulation. Investigator triangulation lends greater credibility to researcher conceptualizations (Denzin, 1970) and was achieved through member checks of data as described in the previous section. As recommended by Denzin (1970), there was no prior discussion with participants about specific research questions or the theories that were being refuted or supported. Therefore, with participants voluntarily taking on the role of not only examining the accuracy of my interpretations of their story, but also of the scholarly nature of the study their confirmation of my interpretation of the data lends greater credibility to the study.

Theoretical triangulation uses multiple theories or hypotheses to examine a phenomenon with the intention to support or refute findings (Denzin, 1970). This study
theoretically triangulated initially that same data set with the theories of forms of capital (1986/2008), fictive kinship (1988), and critical race theory (Bell, 1995). In keeping with modified analytic induction, space was left to discover previously unconsidered conceptualizations. After data analysis, LatCrit (Solórzano & Yosso, 2000) and care theory (Noddings, 1992) were also considered as theoretical lenses through which the data could be framed.

**Transferability**

Shenton (2004) defined transferability as the “provision of background data to establish context of study and detailed description of phenomenon in question to allow comparisons to be made” (p.73). To provide the necessary contextual background of the study I followed Shenton’s (2004) recommendations, based on the work of Cole and Gardner (1979), Marchionini and Teague (1987) and Pitts (1994) and provided the following information:

- The number of organisations taking part in the study and where they are based,\(^{18}\)
- Any restrictions in the type of people who contributed data,
- The number of participants involved in the fieldwork,
- The data collection methods that were employed,
- The number and length of the data collection sessions, and
- The time period over which the data was collected. (p. 70)

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\(^{18}\) Given that the small sample size, specific organizations and locations will not be indicated to protect their privacy. Instead, where participants are based will be broadly indicated, for example, Public University in the Northeast.
Dependability and Confirmability

Guba and Lincoln (1985) stressed the relationship of credibility and dependability, stressing that demonstrating credibility ensures dependability where the processes within the study should be reported in detail enabling a future researcher to reproduce the study; it is an in-depth coverage that allows the reader a thorough understanding of the methods and their effectiveness (Shenton, 2004). Therefore, I created a theoretical audit trail consisting of a journal cataloging decision-making throughout the data collection process and reasons for these decisions with justifiable and explicit links made to working hypotheses (included in the Method Revisions section of this chapter). Additionally, I created a data oriented audit trail comprising of my codebook with initial and focused codes, operationalization of codes (included in Appendices I and J), and memos written throughout the coding process.

Generalizability

Within a critical framework, the objective is not to generalize findings beyond the study’s population and context; rather, it is to increase consciousness of injustices by identifying the nature and sources of those inequalities (Patton, 2002). Rather than seeking generalizability where my findings can be applied to populations beyond the study’s sample population and context, I sought naturalistic generalization (Stake & Trumbull, 1982). In naturalistic generalization, the “felt” news from one world is communicated to another thereby providing opportunities for the reader to connect their lived experiences with the lived experiences of others shared in the text. That is, I intended for readers to constantly test and find generalizability of this study as they make text-to-self connections (Ellis & Bochner, 2000; Rosenblatt, 2004) with the counterstories
presented. Although each individual’s personal narratives is particular, and because it is constructed from their unique situated location, all our life narratives “are also typical and generalizable, since we all participate in a limited number of cultures and institutions” (Ellis & Bochner, 2000, p. 722). I endeavored for this typicality to convey to readers that the participants are real people sharing very intimate and emotionally intense aspects of their lives. It was hoped this intimacy and intensity evokes robust, generalizable experiences so readers stand in solidarity with the participants and the researcher, thereby orienting their social and political actions toward social justice and against oppression.

**Researcher Responsiveness and Adaptability**

Researcher responsiveness and adaptability through processional immediacy, sensitivity, and clarification can minimize attrition (Symon, 2004). In addressing Guba and Lincoln’s (1985) call for processional immediacy, sensitivity, and ability for clarification and summarization, the use of e-mail, a cloud based word processing based document, and other data sharing capacities allowed me to respond consistently and daily, if necessary, to any concerns or questions participants encountered with engaging in the research process. In every instance a participant initiated communication, I responded, whether by phone or by email, within 24 hours. Additionally, every effort was made to individualize my communication with participants based on their preferences. Early in my attempts to collect data, it became apparent that participants were more comfortable communicating their stories via one-on-one conversations with me over relatively short periods of time (i.e. interviews) rather than communicating their stories via written text, individual voice recordings, or visual art representations.
Trustworthiness

As discussed earlier, Guba and Lincoln (1985) stressed that trustworthiness is established through credibility, transferability, dependability, and confirmability. In this study, trustworthiness was established through triangulation data from interviews, member checks, a data-oriented audit trial, and a theoretical-oriented audit trial. Further, a personal journal of my reflections, which were incorporated throughout Chapter IV on data collection and analysis process, accounted for my own bias in those processes. Personal journaling and memoing throughout the data analysis, which occurred simultaneously with data collection, aided my reflection on my own subjectivity in my methods and analysis (Merriam, 2002).

Conclusion

This chapter drew on qualitative and critical lenses to explicate the research design and validate this qualitative study. This study used purposeful intensity sampling (Patton, 2002) and currere-inspired counterstorytelling to support a critique of the sociocultural assumptions of the structure of STEM institutions through an examination of the academic experiences of underrepresented STEM doctoral students of color. Counterstories were collected via interviews and reorganized and interpreted using narrative analysis. Chapter IV focuses on the analysis of the data collected from interviews and participants’ reflections in an attempt to create a path towards holistic theories and solutions that characterize and interconnect the apparent symptomatic challenge of socialization with the fundamental challenge of a legacy of oppression of people of color in the U.S. underrepresented students of color may face in their STEM doctoral programs.
CHAPTER IV

FINDINGS

_We are all storytellers, and we are the stories we tell._ (McAdams, Josselson, & Lieblich, 2006, p. 3)

This study was a qualitative and critical inquiry into the STEM doctoral experiences of underrepresented people of color. Using counterstorytelling, this study raises concerns around the oppression of underrepresented populations in STEM doctoral programs of study and attempts to socially integrate them into such oppressive cultures by illuminating the educational experiences of selected participants. The questions framing this study were:

1. How do selected underrepresented STEM doctoral students’ of color experience educational institutions?
2. How do the educational experiences of selected underrepresented STEM doctoral students’ of color influence their ability to persist in their STEM field?

This chapter is presented in four main sections. The first three sections present the counterstories of the three participants who were given the pseudonyms of Avenus, Soraya, and Devina. Within each of these three main sections, I describe the context for each counterstory. Data from demographic surveys, my journal notes, and salient details
that emerged during interviews were used to build these descriptions. I then present data collected from interviews to represent each participant’s voice using a chronological counterstory.

Borrowing from the four stages of regression, progression, analysis, and synthesis of currere, each participant’s counterstory was organized around the following themes:

- Past educational experiences ranging from elementary school experiences to their doctoral experiences.
- Anticipated educational and career experiences, both short and long term.
- Present educational and career experiences.
- Influences of racism, sexism, classism, and any other form of oppression on their past, anticipated, and present educational and career experiences particularly within STEM.

Each participant’s counterstory is followed by my reflection on their counterstory and their reflection on sharing those stories. In the fourth section, I summarize the demographic profiles of each participant, discuss how the common experiences among participants support the theories of forms of capital, kinship, critical race theories, and oppression and discuss how the data introduce previously unconsidered dimensions to the STEM experiences of underrepresented people of color.

Avenus

Context

Avenus is a Puerto Rican, Muslim woman in her thirties who has lived and has been educated in a variety of regions in the U.S. through her K-12 years. She grew up in a military home that remained deeply rooted in Puerto Rican culture; however, that
culture was often confined to life at home. Most of her higher education experiences occurred in Midwestern states. Her parents recently earned their undergraduate degrees. Her mother holds an associate’s degree and her father holds a bachelor’s degree. As a chemistry undergraduate student, Avenus participated in the McNair Scholars program. Through the McNair Program and her chemistry department, Avenus engaged in undergraduate research in two separate labs. Her undergraduate research in one of these labs resulted in a peer-reviewed journal publication. Avenus went on to a doctoral program in pharmaceutical chemistry at a public, research-intensive university.

Despite a publication in a premier science journal of her research conducted in her first year within the program, she left this doctoral program at the end of that first year. She immediately entered a social science doctoral program that she left after two years, with a master’s degree, due to discriminatory behavior from faculty. She then taught science in a public K-12 school system and subsequently earned a master’s degree in science education. She recently earned her doctoral degree in science education, which she completed in five years. Throughout her higher education, Avenus was supported by a combination of scholarships, grants, and fellowships. She works, through a non-profit organization, to bring high quality science experiences to underserved populations.

I e-mailed Avenus in mid-January 2014 asking whether she was interested in sharing how racism, sexism, classism, and any other form of oppressions had influenced her educational experiences. In early-March two one-hour phone interviews over two consecutive days were conducted. Prior to each interview session, I e-mailed Avenus the interview prompts (Appendix F). Both interviews were conducted in the early afternoon while I was in my home and Avenus was in a private space. The first interview was 88
minutes long, and the second interview 44 minutes long. At the time of our interview, Avenus was residing in Europe.

In mid-April, I e-mailed asking Avenus to share her reflection on sharing her academic experiences. My reflection on Avenus’s interview was shared as an attachment in this e-mail request. I received her reflection on telling her story as a written text in her reply to my e-mail request.

**Counterstory**

**Early marginalizing patterns.** Avenus received her K-12 education in various U.S. regions, including Puerto Rico, the Southwest, the Northwest, and the Midwest. With the exception of her experiences in the Northwest, Avenus was aware that her schools offered her less enriching experiences because of skin color, including Puerto Rican schools. Patterns of race-based marginalization were obvious to her even as a young child. She explained:

I have a childhood memory of my first grade class in [Southwestern State B] and you know being selected to be the tree for our play. The white student, the traditional white blonde being selected to be the main character you would see that in the pictures. So, there was a stigma there for how dark you were and who your parents were. In the Southwest, I would say that in Puerto Rico it was again… extremely based on color, so then similar things [happened] because I fall in the range of being darker than most Puerto Ricans that were on my mom’s side. And in the Midwest I would say it was a shock because I had never been amongst so many minorities, outside of [Southwestern State A].

In addition to these early experiences of racism, Avenus also encountered oppression based on her Latina heritage.

It wasn’t prized to speak another language. So, let me give you an example. I spoke, I took, I signed up for Latin when I was in high school. And so all things compared (chuckling), I picked the most nonfunctional language. And, whereas my white friends would take German or they would take Spanish. And I was often embarrassed by language differences, especially like Spanish being spoken, in all of my schooling. I didn’t look at language the way I do now
of course. I think there is a social stigma around it. Like if you speak Spanish you would get made fun of. If you know, didn’t eat pizza you would get made fun of.

As a result of her heritage, she also found herself labeled by her peers and teachers with racial stereotypes:

You were considered like illiterate, you couldn’t write. Ironically this still happens. So, um, it’s just the whole perception of being different played out in me wanting to blend in. I had a strong identity situation until I was you know in my first year of college. So even for scholarships I had never thought of going into college on a scholarship based on your color skin identity. Self-identification. At that time there was a lot of discussion around affirmative action. And it was just sort of like you'd only be going to college if you had help by the government, how are you any different from people who are on welfare?

In the excerpt below, she went on to describe high school encounters where both gender and socioeconomic-based stereotypes resulted a dismissal of the probability of her future academic success:

I would say the moment where you visit your counselor to talk about your college readiness. Who’s going to pay for college? I think that’s the moment where she asked, you know, what do your parents? And how can they help you? And it seemed most disingenuous about how she perceived what I was or what I was going to do. I mean the results were just sort of hyped around if you would even make it out of high school without being pregnant. That kind of thing. For Hispanic girls, I remember my white guy friends saying those kinds of things. Like: “Oh, I didn't think you're going to pass chemistry” like “right now you should have a kid.”

**A mother teaches subversion.** Avenus’s mother was aware that there were experiences Avenus would be excluded from because of her heritage, and decided to subvert this institutionalized marginalization by steadfastly becoming a member the Parent Teacher Association of whatever school Avenus attended from K-6. Avenus described her mother’s reasoning and subsequent actions that eventually led to her to become capable of working around marginalizing systems:

My mom was just very influential in ensuring that my progress was aligned with the school actually treating me well and giving me the opportunities to do things.
Like, she realized early on that was really crucial and influenced a lot of it. Like what competitions I could get into. Where the doors would normally have been closed or not shared to someone like myself. And then, um, in high school where you wouldn’t have your parents I think that’s when I saw like being influenced by, um, if you compete for something you can get it. And so, give you an example, like going, pushing the bar. So I was always very notorious for like, like seeing the institution as one that has loopholes. You look for the loopholes to be able to make your progress. Whatever if there was a competition or something I would look for what was really written for the loophole and then would be able to win it and just beat it. So, you know, it’s always my case, I mean which is why I’ve never paid for education. But I think that is the nature of survival like it or not. Trying to be a part of an institution that is inclusive, I’m sorry exclusive, instead of being inclusive. You know, so, I think that was an early on realization. Not everybody gets to be a part of it so, how can I make sure I’ll get a part of it?

This instinct to survive became an instinct to thrive as Avenus moved on to her higher educational experiences.

**The Bachelor’s is golden.** As an undergraduate, although some of her family members had earned degrees in engineering and medicine, neither of her parents had yet earned their undergraduate degrees. Avenus’s family had two deep-rooted perspectives on the purpose of college. First, the college degree earned should enable the family member to give back to their community. This value, to give back to the community, remains prominent in Avenus’s decision-making process throughout her counterstory. Second, women in the family went to college for as long as it took to find a partner and marry. As Avenus put it, “the schooling is sort of secondary.”

This second value was part of her mother’s experience. She became pregnant in her second year of college as a young woman. She left college at that time without a degree. To Avenus’s mother, however, the second value could be flexible. That is, while she desired Avenus to get married during her early twenties, she encouraged Avenus to earn her bachelor’s degree. Therefore, Avenus’s mother was influential in ensuring
college was not a stop-gap to marriage for Avenus. She described her mother’s influence in this way:

Not because she wanted me to finish for the sake of you know education, but because of security. She believed that if you finished a Bachelor’s then you would at least own something. Because she believed that education was the one thing you can own that nobody else could own. And if you for whatever reason didn’t work out with being married you did not have to have dependency on someone. You could live your life, um, in that you know autonomous. But you could actually choose your path and if you chose companionship with someone it was your choice. If you chose to have a family it was your choice. But that Bachelor’s was like absolutely golden to her… She is [influential]. She always has been too. That’s always been the case.

As a freshman at her Midwestern public university, Avenus met a teacher who helped her fall in love with chemistry, leading her to declare a major in chemistry. She also chose to minor in a social science field. She won a fellowship to study abroad early in her undergraduate experience, which led her to spend time at a British university.

Despite these early positive experiences that helped Avenus build cultural capital, in her third year in college when her chemistry peers narrowed to only five female students in the entire chemistry program and her teachers all became White men, Avenus noticed emerging patterns of marginalization stemming from sexism and racism. The following excerpt broadly describes how and why Avenus became deeply affected by marginalization.

I was feeling very disillusioned of what was going to happen. The women who were the TAs, for example, or RAs were going into teaching at the high school level and were, like, “chemistry is not going to take you anywhere”. So, I was very much dissatisfied with what would happen if you had a chem degree. I was also being approached in my third year and fourth year by the military. Because they wanted to, because at that point, that’s when the Iraqi war started. And, they were like you know, you can get funding. You know directly asking if minorities in the major would go into it. So it really bothered me and what they would’ve used you for anyway as a chem major. So at that point in time I wasn’t really sure how having this degree was going to do anything for the influence of community and people like what I was going to give back, which was the whole thing that my
parents had instilled in me. Like, how was I going to give back? It was like there was no way of giving back (laughter). Yeah, so that was a bit of a shock in the third year, the first part of the third year. Then, got back into the chem and started looking at programs for grad school, I was thinking about grad school, and then it started shifting and thinking about pharmaceutical and like, okay, you can give back in that way. And an advanced degree, the degree could be in [a Midwestern, research-intensive public university] so that was another big thing, go to the larger school away from my family. Um, so it started to look at little bit different now, thinking future wise about a Ph.D. program and what that would mean for me. And at that point I think I started the McNair the very last year.

Kinship. The decision to pursue a Ph.D. in chemistry led Avenus to join the McNair Program, where she found a sense of community with other underrepresented students. Avenus described this sense of collectiveness as “novel” to her educational experience and especially important as her minority status in her undergraduate chemistry department became magnified. In addition to the positive experiences gleaned from the McNair Program, Avenus held on to her pursuit of a career in chemistry because of experiences gained from a few department members who perpetuated a more holistic, nurturing, inclusive chemistry perspective. Her experience with a holistic and nurturing view of chemistry is described in the excerpts below.

I started doing physical chem. And then this little chemist was from Germany and the other one was from New Zealand and they were able to sort of look at chemistry from the perspective of an international. Like, an understanding of like the systems that brought meaning to it… So, as a scientist, to hear someone talk about that, from the learning perspective, is really helpful for me because then it didn’t mean that when I was learning chemistry, going through the program, that I was mastering chemistry at every level. I was doing, what I was doing was being a student of chemistry and the mastery of understanding what others have done could then influence the problem-solving that I would use to, like, solve problems within, within chemistry. And I think that was really important to me cause it wasn't about memorizing things to figure out like what the right answer was, but rather to think about what the contribution was currently, what I could see as the gap in really early on research, but thinking of it in a humble way, which, you know, when you going to science department in no way are they ever humble (laughter from both). This is the first time that I had not seen someone wear their intellect on their sleeve, they were like real down-to-earth which made me feel comfortable both as a minority for the confidence for someone who traditionally
would not be in this department. And also being a woman who was constantly being discouraged about when you were going to have kids, again now you know now there’s a different atmosphere of how far you can really get as a woman in this field of science. And so for me that was really important where they, you know, have families. One of the postdoc students, his wife was also a scientist, they had like a baby on the way, it was just a different lense of what it could be.

So, with these experiences in the forefront of her mind, Avenus moved on to a public, Midwestern, research-intensive university for her doctorate in chemistry. She had a publication from her independent study research and was awarded two fellowships that would fully support her doctoral work and removed teaching obligations. However, less than three months into her pharmaceutical chemistry doctoral program, Avenus realized her research skills developed as an undergraduate, her long developed skills to subvert marginalization first taught to her by her mother and later developed on her own, and the preparation received by the McNair Program (preparation, in hindsight, she assesses gave her the misperception of being well prepared for the doctorate), were no match for isolation, tokenism, stereotype threat, and other manifestations of oppression.

**Fighting all the stereotypes.** Avenus summed up her first year as a pharmaceutical chemistry doctoral student as “confusing.” Her financial support from two fellowships removed teaching obligations and allowed her to focus on research in her first year. This research, on which she collaborated with a postdoctoral student in her group, led to a publication in the prestigious journal *Science*. This publication elevated her in the eyes of a previously disinterested advisor who had openly regretted his decision to accept her into his research group when she arrived as a doctoral student who had converted to Islam, wearing a headscarf as part of her faith.

Further, there was overt and threatening pressure for her to curb any desire to marry or to have children. Even the one female faculty member from whom she sought
advice, harshly rebuffed her attempts to find kinship and support within her program. The excerpt below illustrates how pressures threatened Avenus’s identity as a Muslim and as a young woman of color, and eventually led her to seek a way out of the program.

I hadn’t worn my scarves yet and when I appeared on the first day it was almost as if he was defending why I should be on his team. Like, for what reason and what would happen next. So it was outright blatant, like, there was a lot of discrimination going on, internally. …my status as a minority and as a woman and race became what was prized by the department…It wasn’t something that, ahh, wasn’t public. It was shared. Like, the fact that I attended classes and barely put my effort in… there was no value in it and that really scared me. And even when I left the program, when I first tried to consult with my department chair he would say, like, “I think you're just really young and you don't know what you want and so you really don't know why you're leaving or even want to leave; you need to reconsider that. I’m not letting you leave”. And so it was like, I’m crying every night because I can’t stand being in the lab by myself. And they would do little things like say, you know, don't think about getting married and of course I had a significant other at that point. Don't think about getting married, don't think about having children until you finish your Ph.D. program, which is like seven years down the road. And I was feeling very disillusioned by that and the fact that, I felt what I was doing was incorrect, you know, for whatever I was doing. I was very antisocial, I think that first year, technically I was doing well, but emotionally and socially I was not doing well. There was no support there to help me and anytime I went to another woman in the department they would say that is the life. You just have to suck it in and get used to it.

**Awakening of identity.** Ultimately, the decision to leave her doctoral program was made with the realization that those within her department were unwilling to provide her with the guidance and mentorship needed to navigate the doctorate. Avenus recognized that in being labeled the token multidimensional minority, she would be giving everyone in the department who marginalized her evidence to justify that marginalization. However, leaving the oppression of the program became a matter of survival. She described the burden tokenism placed on her representation of her heritage and her decision to leave for her own survival below.

And so like quitting, I was sort of saying you, oh, we quit. I think that, it was only because they had put everything in one basket. You know, and so I felt like I was
proving that it was true that women cannot succeed. And if they want to have children and a family and they can’t really prosper. I was contributing to the belief about being Hispanic; I was contributing to what they believed about being a minority and religion. Like I was adding to their data set and what they believed. All the stereotypes.

Therefore, seeking a way out of this intense and persistent marginalization would have to be done carefully and with political tact, because among faculty in the department “the running joke was if you leave, we will blacklist you in other science fields.” So Avenus turned to the secretary, her only ally in the department, to find a way to leave without becoming blacklisted.

The secretary offered Avenus a way out that would mollify her current department, allow her to keep one of her fellowships, and help her work toward getting the Ph.D. by 30 (a commitment her McNair Program requested and one that Avenus felt obligated to fulfill). The secretary suggested Avenus transfer to another doctoral program at the university. Following the secretary’s advice, Avenus applied and transferred to seek a doctorate in the social science she minored in as an undergraduate. However, her religious identity once again becomes a lightning rod for discriminatory behavior among faculty. This transfer occurred while the U.S. is still engaged in major conflict in the Iraqi war.

A professor within the program who was tasked with translating documents for the U.S. military kicked Avenus out of her classroom on the first day of class on the grounds that Avenus was Puerto Rican and therefore not a native English speaker. It was a misinformed and poorly hidden attempt to remove a Muslim student from her classroom. The excerpt below describes the how religious discrimination awakened Avenus’s a fight for her identity.
I had just converted and put a scarf on, um, the moment I entered she kicked me out of the classroom. So I didn’t even speak. So on the grounds that I was not an English speaker (laughter). Um, at this point I had never had to fight for my identity before. This is the first time. And in high school I didn’t care and I didn’t feel connection to my identity and at this point I have to fight for identity. Um, it turned out that in my request I asked her to be removed from all testing that she could not evaluate my stuff. But it turned out the, they did a blind testing examination for the orals qualifying [comprehensive exams]. And I had the highest score of the department of which then she apologized, and recognized that I was an English speaker, um, and asked for me to continue with the dissertation. At that point though, because of pride [and that similar events had happened to other students in the department] I decided that if this is the type of department that, um, in no way was I going to try to achieve the 30 and under Ph.D. under the circumstances.

These events marked the beginning of a self-awakening that eventually led Avenus back to her family’s tradition of earning a college degree to give back to the community.

**Not in the loop.** As Avenus reflected on her chemistry doctoral experience, and the advisor relationship particularly, she felt like an outsider, and therefore, unable to become part of “the elite circle” in which it was acceptable to engage in discourse about the group’s research. This discourse was unacceptable because any unsolicited, intellectual comments were taken as criticism of her advisor’s research. She asserted that this exclusivity within the group, however, could have easily been mitigated by departmental support.

This insight came from her science education doctoral experience where the social and academic challenges of education in general and education in STEM were openly addressed and studied and diversity in all its forms was nurtured along with high academic achievement. Further, the faculty in her science education doctoral program valued her voice socially and academically. The excerpts below provide greater detail of her view, now as someone who recently earned a science education doctorate where there
was significant support, on department efforts that would have relieved the confusion she experienced in her first year as chemistry doctoral student of color.

I could clearly see that I was so not in the loop. So, like even in the amount of preparation. I was in the pool from my other university I definitely was in the top of you know in that small pool in the top. But in this larger pool I was definitely not in the top, like there were brilliant people in there of which like, like you can very clearly see I was underprepared. For what to do in the sense of, like, not that I could not learn. To a point, a level of coaching would’ve been needed for me to be able to make progress. Which is why the postdoc and I worked well because it was like a very hands-on. But like for a Ph.D. program you, like you skip masters, right? Like you go straight through. I don’t even know how I would’ve become independent. You know, I when I look at the way I was able to navigate science ed[ucation] without a problem through those years which tells you that if I had the coaching at the onset, I would have been able to become independent by the end….I definitely think the transition from the undergrad to the grad should’ve have some type of preparation. So like, instead of starting immediately in the fall, like having something to sort of get to know your research group and sort of their goals and like, understand the relationship you might be having with your lab lead might be different from what you traditionally expected. I think that that would’ve been initially helpful. I also that think, like, just coaching. You’re going straight from Bachelor’s directly into Ph.D. What do students do? Because there isn’t a master level. Getting a master is in itself a filter, right? But, a master’s is a bad thing in a Ph.D. program. So, understanding what is needed to help you develop would have been much more useful. To be able to self assess where I was and being much more transparent about how I was going to achieve that. …So, like when I look back, if I had done all this, that I did for this program [science education Ph.D. program] and the number of years it took, I know I could've gotten a Ph.D. in pharmaceuticals. But, because I was set up in a way that would not allow for that, for this like, straight-line movement. I looked everywhere and got confused. Then...you really don’t know where to go. And you go from being nurtured in your undergrad to complete isolation.

Finally, a place at the table. Avenus’s experience of three distinct doctoral programs, two of which she briefly compared in the excerpts above, allowed her to gain deep insights into how dependent her doctoral success was on prior experiences and the level of inclusiveness and support within departments, and subsequently advisors, choose to offer their students implicitly and explicitly. Although she attempted to return to
science, she found herself drifting instead to fields where her identities were accepted and genuinely valued.

I don't think it [was] the absolute aggression, like obvious aggressions, but I think there were microaggressions, like smaller aggressions occur that have changed my path because of that, like a result of it. Like me going back to a Ph.D. in pharmaceuticals, had it been a cultivating environment, nurturing, I would have never changed I would have stayed with it (laughing), and I think that with each of these particular instances, it’s guided me away from the present moment to something different. And I think because the institution itself was what I was in disagreement with, not the content. So, it seems like with every instance, I've tried to return back to science but, have found myself in different place that is more accepting of me as an individual, of me and my life. And I think that has played a huge part in it, because I have intentionally not chosen universities, I've intentionally not worked at certain places, and I'm trying to like, you know, trying to hold on to what I really want to do.

CRT predicts the oppression of people of color has been transformed from overt and open to subtle acts of violence and exclusion, subtle acts which some research frames as microaggressions (Camacho & Lord, 2011; King et al., 2011; Solórzano, 1998; Solórzano, Ceja, & Yosso, 2000), and have also been documented in previous studies in women of color in STEM (Ong, 2002; Ong, Wright, Espinosa, & Orfield, 2011). While these subtle acts are deeply felt by individuals of color, it is often difficult if not virtually impossible for an individual of color to “prove” oppressive acts within institutions of power dominated by the perspectives of white men (Delgado & Stefancic, 2012). The excerpt above not only exemplifies how the tension between the oppression deeply felt by individuals of color and a tolerance or encouragement of such oppression by STEM institutions can drive people of color to leave science fields, but also exemplifies how the nature of science itself can make STEM fields socioculturally exclusionary.

A sociocultural or social constructivist understanding of how the culture of science can determine who ultimately gets to do science offers an explanation for
Avenus’s search for a science field that accepted her life experiences. Social constructivism opposes a positivist view of how individuals experience the world, that is, understanding the world via traditional science produces a deceptive metanarrative that masks how and why social and cultural divisions, which are seemingly natural, exist (Burr, 2003). More specifically, social constructivism argues “all ways of understanding are historically and culturally specific” (Burr, 2003, p. 4), and this construction is sustained between people through daily interactions.

Within the context of science, a sociocultural perspective identifies learning science as an extension of an individual’s conceptual framework (Fensham, Gunstone, & White, 2013; Gauvain, Beebe, & Zhao, 2011). Therefore, a social constructivist stance would predict that a scientific conceptual framework of underrepresented people of color is shaped by their cultural heritage and the oppression they experience that their White and Asian peers will never experience. This alternate purview of underrepresented people of color often lead to the identification of different social and scientific problems, and therefore also leads to them to ask different research questions and even using different methodologies to answer those questions compared to their non-marginalized peers (Leggon, 2010).

Further when theory cannot offer clear insight into conflicting findings that have equivalently valid and reliable findings, scientists use social or cultural factors such as researchers’ personality and nationality to negotiate scientific fact (Collins, 1992; Latour & Woolgar, 1986). Therefore, social constructions and the inevitable sociocultural negotiations that occur within scientific communities, in conjunction with the presence of oppression of minoritized groups in institutions of power (Blackwell et al., 2009; Fox,
likely lead to STEM environments, whether created deliberately or carelessly, that clearly communicate to students like Avenus, who do not fit the white elitist profile, that the identities and subsequently what they have to offer socioculturally or scholastically to the scientific community has less value than their White elitist peers.

As argued in Chapter II, this exclusionary culture imbued with racism, sexism, classism, and other forms of oppression relegates underrepresented people in STEM fields as strangers and outsiders-within. Further, as Avenus articulated in the excerpt above, such marginalization kept guiding her away from science to academic spaces that affirmed rather than repudiated her life experiences (i.e. affirmed her conceptual framework). Avenus’ articulation underscores the refutation of social integration theories as inadequate or even inappropriate to explain why people of color have lower enrollment rates in and higher attrition rates from STEM doctoral programs (Council of Graduate Schools, 2009). While the doctoral process is inherently a process of socialization (Elliott, Stewart, & Lagowski, 2008), for students such as Avenus, oppression and marginalization within their doctoral program steadfastly undermine their ability or even their desire to integrate into a STEM field. In the excerpt below, Avenus described how her science education doctoral program not only accepted her identities, but also valued her voice as shaped by her cultural heritage.

In the science program I was in you we were required to have a bachelors in science and then grad classes in science, like in chemistry. So, all of a sudden all of my Ph.D. stuff counted towards my science Ph.D. Which was really nice. Like, great I suffered but not really. I do think, though, that having the master’s in the social science did help with the talking, like, with the discourse and being able to share ideas and really think about the social aspect of it and the applied theory which I think for science there is no applied theory. The applied theory is like the product, like you produce some kind of chemical or whatever. Whereas here I was getting to combine social and your research interest does take time. Again, though, I don’t feel like it was an easier discipline, like, I had growing pains there
as well, but, I think it was it was much more open to being able to. If people have strong arguments and you had read up, you had a diverse understanding of what others had written before, you were able to, *you were invited to the table* and I felt like that was very different from being excluded from the table in the hierarchy. Still a lot of nepotism and still a lot of, like, who knows who. I think academia is completely infected by that. Which was very different. I think the other thing that that isn’t in science is that you have to have gone through the profession. You had to have taught in my program. So, I had the status and the credibility because you had to teach to get into the program and that was really powerful. Because like you could say from an anecdote you know from an anecdote I know that that didn’t work, I tried it (laughter). So, whereas in pure science you are dependent on, well, I know from the lab that I may have done that maybe tested correctly because the product was this way. So, I think I have more confidence in my results.

The above excerpt brings into focus how the sociocultural environment of a doctoral program and the field of study itself structured to affirm the life experiences of Avenus, and transformed her desire and ability to integrate into the field of science education¹⁹. Such affirmation, as indicated by Avenus, is supported by the findings of other studies (Sweitzer, 2009; Weidman, Twale, & Stein, 2001) that indicate such identity affirmation enables doctoral students to navigate the staple political challenges of hierarchy and social capital present in academe (Burris, 2004). While such affirmation allowed Avenus to earn her doctoral degree in science education and have led her to a career where such affirmation persists, her battle with institutionalized oppression lingers. **Marginalization persists.** Avenus currently works in an organization that must work with people of color. Her current career path has allowed her to fulfill, on her own terms, the guiding values that led her to a Bachelor’s degree and eventually to a Ph.D.;

¹⁹ Mentor-protégé relationships are key to affirmation of doctoral students’ of color identities and their ability to feel integrated into their doctoral program (Barker, 2012; Willie, Grady, & Hope, 1991). Further, underrepresented doctoral students of color across all disciplines are more likely to choose a mentor and/or advisor of similar race and are more likely to find a same-race mentor/advisor in the social sciences and education versus STEM fields (Nettles & Millet, 2006).
she is now able to give back to her community. She also exceeded her mother’s hope for her to earn her Bachelor’s by earning two master’s degrees and eventually her Ph.D. And although she was older than 30 when she did earn that Ph.D., she still fulfilled that primary objective of all McNair Programs to have more underserved student populations earn their Ph.D. Though she does not seek to become a member of faculty at a university (a secondary goal of the McNair Program) she does work with university faculty. And finally, because she was in a more inclusive doctoral program environment she was able to start a family while pursuing her science education doctoral program. Despite such hard earned triumphs and purposefully working within an inclusive environment, institutional marginalization persists as described in the excerpt below.

It [racial identity] can play both ways. It can be a disadvantage or an advantage. …it's my background has helped contribute to that position, but at the same time, I wouldn’t be I that position if I hadn't, like, followed the culture of the organization either. So, I think it’s probably like middle ground. Umm, you know, I think that in other opportunities, it has like excluded me. Like for example, depending on the sponsorship, because…a lot of money comes for like leadership opportunities for sister groups and because I was Muslim, I was excluded from that [sister] group…. Even though we are…completely secular. So that made it, umm, that's where my own identity, then conflicted with, like, like visually, like appearance conflicted with the ability for me to be selected. Which I have never had that happen before, where you were, excluded from a group based on that. I think in other cases where, there are affinity groups. Where it starts, like being Hispanic and they lump everybody in one group, I felt like I couldn’t contribute to decisions or experience because my experience as a Latina, it was very different from many of those people….Because many people grew up in a community, that have access to other people of their color, and I grew up in an area where it was all white around me (laughing), so I think that in perspective and being able to be included in certain types of affinity groups I’ve been kind of on the outside which has put me in a position where the value of my voice is lessened.

**Resignation.** Decades of varying degrees success and failure to navigate racism, sexism, and classism, and more recently religious based persecution, led to Avenus’s acceptance of a system in which she will always have to work harder and be smarter than her White,
male, Christian peers. She chooses to view her minority status as “a gatekeeper for funding” that has allowed her a debt free higher education. However, despite decades of oppression and acceptance, and a degree of desensitization to such oppression she continues to feel “very guilty” for relentlessly having to find gaps in the system.

She feels similarly about the advantages and disadvantages of being a woman in science and education. Being a woman in science, she chooses to view her male counterparts’ assumptions of her scientific incompetence. For example, at a robotics competition, male counterparts kept singling her out and offering her their tools and/or expertise, as an opportunity to learn. The excerpt below illustrates her acceptance of sexism in science.

If you’re going to be on the shorter end, umm, and there are offers. They would always assume you were outside of the group, you were not part of the club. And, ahh, you know,… the younger woman. And I think in this case gender is probably easier to assign that, like, you can, you get excluded no matter what. You’re going to be excluded in some instance, whether you are pregnant with a kid, or thinking about having a kid, or have them.

In her resignation and subsequent use of sexism to her benefit, she asked, “Why, fight it?”

To briefly summarize, Avenus concluded the desire of doctoral programs to meet their diversity quota combined with a culture that rejects the diverse heritages these diverse students bring ultimately positions many of these students for failure. Avenus asserted that this failure occurs because, while many underrepresented students of color may look as likely to succeed on paper as their White and Asian peers, they have fewer sources of privilege. Greater access to sociocultural, academic, and financial privileges insulate White and Asian students to the isolation and multiple forms of oppression that
are an unrelenting companions to their underrepresented peers of color. It is this inequality, described in the excerpt below, which has motivated her to share her story.

I really think it should be known. I think it is known what people of color may have to work with in the field of science, but I think that it [racism] is sort of like accepted. And I don’t think it should be. I think they are the unwritten laws, of like that’s just what it is… Throughout this entire process of getting a Ph.D., and deciding what to use the Ph.D. my dedication to science has never detoured. It’s just the circumstances and the method in how I was going to be involved in science that have to be shifted because of my given profile. And I just don’t know if it would be the same for a counterpart who is White.

Avenus’s story highlights how departure of underrepresented students of color from science doctoral programs can become an issue of removing oneself from constant operation in survival mode due to oppressive practices rather than an absence of passion for content, academic competency, or social deficiencies.

Reflections

My reflection: Envy. Throughout my time interviewing Avenus, I was stunned by how similar our experiences were. Her experiences with her family’s expectation of marriage and children to be at the forefront of her priorities, to the narrative of how confusion and desperation to find anyone who would guide us through that confusion in the first year of the chemistry Ph.D. journey were mirror images of my own experience. My breath caught when she talked about how she was crying often, about how she would do anything to avoid being there (she threw herself into reading or taking holidays). I remember I would cry as soon as I started to talk about how I felt about staying or leaving my program, and that I suddenly developed an intense interest in daytime talk shows and taking long walks in the garden on campus. Most of all, I was struck by her silence about her struggles to her family and her eventual exit through marriage. Her story in so many, many ways was my story; prior to our interview I was unaware of these striking
similarities between our experiences. However, there was one major experience on which we seemed to diverge, and that was that she had figured out how to exploit the system long before I realized it was even possible.

Although she was Puerto Rican, she mostly grew up in the continental U.S. and understood the educational system through her mother’s support. I was an immigrant more familiar with systems of British colonialism and an education so financially drained that academic scholarships and fellowships were relics of the past. I was so oblivious about how the U.S. education system worked that I did not know you could get money for being bright and even weirder for being a bright person of color until the end of my first year in community college when a White friend mentioned in passing that I should apply for financial aid (I had no idea what a FAFSA was).

I found myself, as she spoke during our interview, deeply envying that she has not had to go deeply in debt to finally get her Ph.D., to find a place where she can continue to be a part of the world of chemistry, and to be happy. I have struggled financially, like no other time in my adult life, for the last three years. I chose to pursue my science Ph.D. and care for a young child at the same time, and I will literally pay the price for wanting and having these two things simultaneously for a significant part of my adult life.

However, the last three years have been the happiest I have had since I immigrated to the U.S. I feel like I have a vocation that makes me deliriously happy and that I have satisfied the cultural and social pressure and my own desire to have a child before my mid-thirties. It took me longer, it cost more both monetarily and emotionally than I know it takes most of my White peers to find this place (at least professionally), but I think I almost there. I think I have a better informed understanding of the system
and how I can make it work for me and for other people of color. Despite clearly seeing how my third world, immigrant, woman of color identities will forever limit my professional opportunities, it feels good to understand why and how those identities limit me and what tools I have available to mitigate these limitations.

**Avenus’s reflection.**

Thanks for sharing and yes the act of telling the story especially as a minority is both empowering and cathartic. I use storytelling as a part of the work I do with teachers and I find it to be one form of expressing freedom of thought. Giving voice to my story with you gave me a position of power but also a sense of responsibility for what comes next.

Sharing my experience helped me with a future story I was asked to share for an organization wide initiative on improving diversity. I felt more confident in telling my education journey because I was validated during our conversation. So I came to my other work with perspective and recognition that what I experienced was for real (not just in my head or a single event only related to me). That was truly inspiring.

Moving forward I would recommend McNair and other programs working with people of color consider voicing these education journeys as we build stronger content knowledge and place in society as future scientists.

**Soraya**

**Context**

Soraya is a Black woman of Caribbean heritage in her thirties. Her parents emigrated from the Caribbean to the Southern U.S. with the specific intention of giving their two children more opportunities. As she grew up in a Southern Metropolis, her parents became economically prosperous, which led to a secure and comfortable home life. She has been primarily educated in various Southern educational institutions. Her mother holds a master’s degree and her father has some high school education. Soraya earned her Bachelor’s degree in chemistry at a private, research-intensive university. While she engaged in lab intensive chemistry courses, she did not engage in
undergraduate research experiences within a research group. In her penultimate undergraduate semester, she abandoned her plan to pursue a law degree and instead chose to pursue a chemistry doctoral degree.

After completion of her Bachelor’s degree in under four years, Soraya entered a chemistry doctoral program of study at another private, research-intensive university. She earned her doctoral degree from this university in six years. Throughout her higher education, she was supported by a combination of scholarships, stipends, fellowships, and personal funds. After completing her dissertation, she lectured chemistry at liberal arts colleges. She has subsequently abandoned academia as well as the field of chemistry. Soraya is now established in a career virtually unrelated to her formal education not only in chemistry, but also unrelated to a STEM field. At the time of our interview, she was living in the South.

I called Soraya on the phone at the end of March and left a brief voice message. She called back two hours later and agreed to a phone interview. The interview prompts, her consent letter, including her unique link to a Qualtrics form to indicate consent, were e-mailed two days after our phone conversation. Seven days after our phone conversation, we had 108 minute long phone interview. This interview was conducted in the early afternoon while both Soraya and I were in our respective homes.

An e-mail was sent 15 days after my interview with her asking for a reflection on sharing her story. My reflection on Soraya’s interview was shared as an attachment in this e-mail request. She called me a few hours after the e-mail was sent and shared her reflection with me on the phone for four minutes; she had not yet read my attached reflection. Her oral reflection was followed-up later that day as a written text in her reply.
to my e-mail request. This second reflection occurred after she had read my attached reflection on her listening to her story.

Counterstory

**Best of the best.** Growing up in Southern Metropolis where most people had immigrant roots, like Soraya’s family, led to school experiences that were culturally inclusive. In particular, Soraya noted there were very few people who identified as White or African American. Such diversity produced a state of comfort throughout her K-12 school experiences, which were exemplary. In third grade, Soraya joined an International Studies program focusing on the Spanish language. She moved through the rest of her primary and secondary education with her mostly Latina/o peers from the third grade.

They moved into what Soraya describes as a public “mega-magnet school” where she continued to participate in the International Studies program, but also went on to take International Baccalaureate and Advanced Placement classes.

In her high school, students tended to socialize along the lines of academic interests (students that they had the same classes with) and similar geographic roots (for example immigrants from the same Caribbean island), rather than racial identity. The school faculty, including the school counselors, consistently cultivated a culture of academic privilege; students were openly being groomed to be the best of the best. This was especially important to Soraya’s higher education path since her parents, who supported her interest in school, had little understanding of the U.S. higher education system. The following excerpt illustrates how her school’s culture of academic privilege shaped her self-directed path to college.

There was this whole expectation of you were the best of the best students because everybody have to go through a whole magnet process and be
interviewed, or you know, have really great grades… Well we had guidance counselors the kind of helped. There were like okay you know there were applications and they always have different people from colleges and universities coming in talking to us. And then also there was the international Baccalaureate Program coordinator [Mrs. Blake] who was kind of. It was very important to them that their students went to certain schools. So, she was like, I had a student who went to Princeton or Harvard or blah blah blah. Ahh, so they gave you that kind of, okay you need to go to college and you’re aware of the different financial aid that was available to you in the state of Florida. I did my applications and there was the common app. It wasn’t like my parents said “oh, you’re going to college” because, you know, they weren’t familiar with American college/universities nor their application process. I think it was helpful because my older sibling have gone through a year before me. I was kind of more aware of, kind of what have to have to do like take your SATs, take your, your ACTs. It was never that someone sat me down and said these are the things that you need to do to achieve this and get done. At least not I can remember… I kind of went to, I applied to schools I look at some of them, I heard of some of them. I don’t even know, like from people coming to the school and then my own research. But no one actually sat me down and said okay what’s closer you’re applying to and comment you know I would tell my parents hey you know I need this check for $65 for the application fee. And that was most of it.

In the ninth grade, Soraya “fell in love with chemistry.” Chemistry made sense to her, her high school chemistry teacher encouraged her interest, and her mother always told her to do what she was good at. She was good at chemistry, so Soraya applied to college with the intent to double major in chemistry and in Spanish. Soraya thrived during her undergraduate studies at a private, Northeastern, research-intensive university. She described her first two years as filled with social learning experiences. She discovered brilliant people, found that some brilliant people lacked social skills, and an awareness of racial identity emerged. Her description of the emergence of her identity is given below.

I want to say not academically, if anything more socially. I realized how different it was to be from a Caribbean background versus, like, African-American. So I called myself Black not African-American. So I have a no link to Africa and I wasn’t born in the United States, so I won’t call myself African-American. I’ll call myself black, so I’m like “yeah I look black, I’m dark” fine.so I realized how different those people were, because growing up in [Southern Metropolis] because most of the people who were black were okay from Caribbean genesis. So I learned that distinction and realized I don’t really. Not like they didn’t fit in
and people were mean to me, but I realize that my experiences were different and that other people have very different experiences than I did. It was never like, any bad thing, just being aware of the differences between, I guess, your own race. Nothing ever really bubbled up, it was just discovering how people are all different and strange.

She cared. Although her college promoted diversity and there were no overt events that led Soraya to feel oppression during her undergraduate studies, as she began to take upper level classes, her professors became exclusively White men and her peers became primarily White, male, and Jewish. Within the chemistry department itself, Soraya noted, “there was no demonstrated diversity.” However, there was one notable exception.

There was a female instructor who taught lower level chemistry classes (she did no research) and who supervised Soraya when she worked as a teaching assistant towards the end of her undergraduate program. Her impressions with this woman who was her instructor and her supervisor is described below.

Well, when I was in her class I don’t think I ever interacted with her much. She would walk around and ask if you’re doing okay or whatever else. Um, so, but when I saw her, she was at the recitation class before labs started. And she actually took action, she cared about what she did and she cared about our success in class. Yeah. You know, when someone actually cares about what they do for a living? That was demonstrated. Also, she was, she was the only professor I worked with that wasn’t doing research. So there were two instructors, there was her and [Dr. Kincade], who were just, who just did lecture and nothing else. Everybody else you know we’re more devoted to their research and didn’t care as much about their class. I guess teaching undergraduates. You know there’re a couple that cared a little bit more than others. I think the reason why it showed that she cared about what she did was because she was actually doing what you wanted to do.

This sense of caring originating solely from a female faculty member recurs in Soraya’s doctoral journey. Further, the end of her undergraduate studies also marked the end of a relative absence of oppression in her educational experiences.
**Frat-tastic.** Soraya dropped her Spanish minor and decided to complete her Bachelor’s in three years. At the last moment, she also changed her graduate plans from applying to law school to applying to chemistry doctoral programs. She described her first year in her doctoral program as a “weird adjustment.” While felt she was being academically challenged, she felt capable of navigating these academic challenges because of her rigorous chemistry education at her undergraduate institution and, more or less, enjoyed her first year or two. However, there were only three people of color in the whole department and Soraya found herself somewhat at a loss on how to fit in to a student culture, where to be accepted you had to embrace drinking, partying, and sports. The excerpt below gives a detailed description of her department’s culture and how she began to come to terms with an absence of fictive kinship in her doctoral program.

It was a weird adjustment because when I entered there was actually another African-American girl. There was, actually, in the whole department they were three of us. One who I actually entered with, there was another one girl who was like four years ahead of us who was about to graduate or just about to finish and just didn’t want to be bothered. So it was weird because *everybody else* was white or straight from China. So the Chinese people, you know, they all have families that came over with them and spoke Chinese to each other. I should probably say Mandarin to each other and not the other. And spoke Mandarin to each other and then there was the whole set of, like, white people. And these were, like, I would say frat-tastic people. You know, people like from the fraternities and loved to party, and drink beer, and hung out and watched football, and were like diehard whatever, fans. And there was a little bit of struggle trying to find myself or how to fit in. Not find myself, just how to fit into that environment because there was really nobody like me. So, what ended up happening, um, I would say my first year there were three other people I hung out with. Two gay guys that were white and the other black girl. But I would go out with the other group of people, you know, because you don’t want to like narrow your group sets or your friendships potential in the beginning. So, I would kind of go out and learn how to drink beer and not have to pay for it. But I definitely have to go out of my comfort zone to fit into what they wanted to do. It was never anything that I wanted to do. Not like me, sitting around drinking for hours at a time. I remember Thursdays were about beer night. What’s 64 ounces? Is that a pint? So, 64. It was a lot of beer! (Laughter from both)….Friday’s you’d do beer pongs and let’s go get sloshed and dance, which wasn’t my thing either.
**Becoming a chameleon.** Whether Soraya drew from instinct or from her previous experiences or both, she understood with great clarity that to succeed in her doctoral program, she was going to have to fit in, or at least give the appearance that she did. She was perceptive in knowing that to acquire enough social capital for success, she needed to expand her social network beyond her gay and racial minority students (she had found several Black friends outside of her department through on campus minority student organizations) and include White students. In the excerpt below, she briefly described her logic on why she went “outside of her comfort zone” and adapted to an undesired culture in order to secure alternative fictive kinship.

Because you realize it [doctoral journey] is not going to be a short period of time. You realize I’m good to be spending the next five or six years of these people so I at least wanted to have some sort of relationship with them. If it’s like hey, I need some help with an assignment research whatever else, I understood that I needed to have some relationship with them and some sort of way in order to, you know, succeed in my career. Or at least in my academics.

This alternative fictive kinship turned out to be important through Soraya’s process of advancing to candidacy around her third year. She turned to her peers to work through challenging coursework, and to a lesser extent practice her preliminary exam presentation. She remembered very little about her preliminary exams, but she recalled being faced with a lot of questions and emerging feeling humbled. However, she recalled the process did not seem to diverge from expectations.

Maybe it’s really bad that I’ve lost my memory of this….I thought it was challenging and fair. It was very transparent except for the whole, like monthly exam business. Trying to like do last minute, I didn’t like that part of it, but you kind of knew what was expected from you. Everyone before you had gone through a similar experience. No one came out of their preliminary exam and said “Oh my God, that they did X, Y, and Z to me” and you said “that didn’t happen to me.” It seems like everyone walked out thinking “oh God, I have a lot to learn.”
It turned out that Soraya’s preliminary exam experience was not like everyone else’s. In her reflection on sharing her story with me, a reflection that follows this main section of Soraya’s counterstory, a friend reminded her that she was kept in for an hour longer than the procedural rules allowed. This first administrative deviation from the rules that made for a more challenging experience was perhaps a harbinger of what was to come for the remainder of her doctoral journey.

**Violence.** Between Soraya’s third and fourth year, an escalation of experiences with oppression, in particular racism, sexism, and even physical harm, began to shape an unappealing impression of the possibilities of her career in chemistry beyond the doctorate. She began to encounter behavior from her advisor, from other students in her research group, and the bureaucracy in her department that left her feeling powerless. In the excerpt below, she described a sexual assault by an older, White, male staff member, the department’s subsequent inaction, and the importance of the comfort and support she was able to seek and receive from the Black network of friends she had built outside of her department.

I remember having a guy, I have no idea what the guy’s role was in the department. He was somebody who worked in the chemistry department, he groped me in the elevator and going and dealing with and telling the higher-ups and nothing being done. And you’re like, “okay, there is old dude he’s probably like 65, 70, who groped me in the elevator and you guys are like, “oh well, you’re going to force him to retire in two years.” One or two years! So, like this is how this is resolved! Oh yeah, and he has to stay away from you. And you’re like but he works in the same building with me, thank you guys. So I think that was probably like one of my: Really?! Really?! Is this really what I have to deal with? I think I did a good job of getting out of my department as much as possible and getting involved in other things. So I was involved in [a Black students’ organization], I was involved with the regular student council, and I was involved in [Black organization for STEM students], so if ever I had like a thing or two, I could tell these people. I had them to lean on.
Felson (2002) argued that sexual violence⁰⁰ against women, perpetuated by men, is rarely the result of sexism or hatred of women. Rather, sexual violence against women is used to gain control, retribution, or defend self-image (Felson, 2002). Further, the perpetrators of sexual violence often have had early experiences of being socialized into patriarchal societies and are able to enact this behavior as adults when functioning in cultures where there is gender imbalance and male peer support for such behavior (Scully, 1994; DeKeseredy & Schwartz, 1997).

Tolerance of such behavior within Soraya’s chemistry department indicates that she was functioning within an organizational culture that supported male dominance. Male dominance was also a department-wide known characteristic of her research advisor. Subsequently, her relationship with him was a persistent source of oppression she was compelled to handle for years, including through the dissertation defense process.

**Passive aggressive advisor.** In addition to sexual violence that went unpunished, Soraya found herself having to handle an uncommunicative, passive aggressive advisor who openly discriminated against the women in his group. In fact, he was infamous for treating his female students badly, an infamy the department chose to tolerate. Soraya’s advisor made it increasingly difficult for her to navigate the politics of her lab and department and to succeed academically. Almost five years into her doctoral program, Soraya’s doctoral advisor almost sabotaged her progress toward her doctorate by giving her research project to a less experienced, male group member. This project handover

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⁰⁰ The World Health Organization (2014) defines violence as “the intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community, that either results in or has a high likelihood of resulting in injury, death, psychological harm, maldevelopment, or deprivation.”
was done without prior discussion between Soraya and her advisor, or between Soraya and the male group member who took over her project. A detailed description of how these patterns of discrimination unfolded is provided in the excerpts below.

My advisor he did not ever deal well with women. When I joined the lab people told me that. There were, at that point in time, I was the only woman in his research group. They were only maybe one or two other women that had ever worked for him and got a Ph.D. from him. So he was notoriously horrible, you know, dealing with women. So he always went to a male to talk to. You walk into the group, come into the office, he wouldn’t even say hello, he would go straight to some dude, tell him something and then walk away. And it took some time to get used to that and in time you have to get used to that. But that was just his personality type. So, there was this, there was this guy was his favorite, he left he graduated and there was this guy named [Harry] who was older. Really cool guy, but I think my advisor had a really difficult time dealing with him because of the age. I think the age disparity, because technically he was more senior. It was always insane seeing that. And then there was a new breed of crop that came in. So after I came in, the year after he had one girl join the lab, and then the year after that another girl join the lab. So there was lots and lots of women but my advisor always feel went to that one dude. So I basically reached my breaking point when we had like weekly meetings as a group and we kind of went up to the blackboard and talked about what experiments we did and what went wrong, what didn’t and we shared stuff. And I remember one day, I was, we’re doing a presentation, I did my presentation and stuff, I sat down and then this guy got up, put his stuff on the board, and low and behold I realize he took over my project and my advisor didn’t even have the balls to tell me. And I was pissed. I was really, really upset. Because, you know he was younger in the lab than me, and I, I was the person that showed him how the lab ran and how to do things and it was like, I was betrayed.

….This was probably my fourth. Probably my fourth year. Somewhere between my fourth and fifth year, most of it. So I honestly didn’t talk to him for months. Like, I told him one day, like “you know what,” because he sat right next to me, “I can’t believe you would do this to me,” and he was like you know, “well [our advisor] came in and told me to do it.” And I’m like “yeah, that’s nice. If that’s what happened that’s what happened, but I deserve at least to be pulled aside and say hey this is what’s going on. You sit next to me in the research room, you work next to, you’re working my old hood, you know you work right next to me in the lab.” Like there’s only two hoods on one side and he was literally right next me. I have to pass him to get my hood everyday. And then going past my desk I would have to pass them. And I’m like “you never found the right time to tell me?” And I’m like “you have no time? I don’t trust you, I don’t respect you.” And I stopped talking to him.
A culture of male dominance both within her research group and within her department was compounded by a culture that also tolerated overt acts of racism.

**Nigger.** The discriminatory behavior by Soraya’s advisor allowed a permissive culture where the male members of the research group were free to openly discriminate against the women in the group. Soraya described another violent incident, this time race-based, that occurred in her lab as an example of how not only sexism and sexual violence were permissible in her group and her department, but racism accompanied by physical violence. She described the incident below, which in conjunction with the incidents described above, show a clear pattern of how males fostered a culture of dominance over women colleagues.

There was this Chinese guy was one year ahead of me who I loathed. He actually called me a nigger and threw glassware at me. Well not at me but in my direction. And in my world, that’s at me. So, I’m in the room as you’re yelling at me, It’s at me. And nothing was done in that situation either. He was like “oh I didn’t call her nigger” and I was like “sure you did, I know the word.” Nothing else sounds like it, nothing else in the lab sounds like it. So, unless you just yelled things and throw things, you know, [it was] another day that nothing happened. So, I have a little faith in the chemistry department and I was nearing in trying to be done.

In keeping with the male dominance in Soraya’s research group and her department, at the time there were only two female faculty members, one of whom was openly ostracized by the department and who turned out to be the only faculty member that Soraya felt cared enough that she could seek emotional support from her. In the excerpt below, she briefly described her relationship with the one person she felt was a mentor to her within the department.

She was a wonderful person. Her name was [Dr. Blethyn] I did a class with her. She was ostracized by the department… But you know she was always a good person to talk to. If I was ever feel frustrated or that I wanted to talk to a faculty member about something. I never really spoke to her about chemistry… So I didn’t get to pick my committee members, the chemistry department policy I
believe was your advisor had to be your committee chair, because I would not have picked him to be my committee chair. I would’ve picked [Dr. Blethyn].

Soraya’s doctoral program was housed in a Southern university and the U.S. South is steeped in a legacy of sexualized racism and gendered violence (Cardyn, 2002); this legacy endures in Southern society at large and within Southern educational institutions. So, Soraya as a Black woman in a Southern university STEM doctoral program dominated by White, middle/upper-class, heteronormative men found herself besieged by several iterations of oppression and violence because of her racial and gender identities. Even after she was physically removed from her department during the dissertation writing process, Soraya found herself subject to oppression from her advisor and the organizational culture of her education institution.

**Balls to the wall.** Soraya’s preference for [Dr. Blethyn] became evident as she went on to describe how difficult her advisor made the final part of the journey between writing the dissertation and the oral defense. At every step in the process where his input was required to move to the next step, he ignored her. He presented her with a wall of silence so impermeable that it took more than a year between completion of the written dissertation to her official receipt of her doctoral degree. During this time, Soraya pushed him, as much as she dared, directly and indirectly. She even tried to find administrative ways to work around his reticence by approaching the dean of the college.

However, her doctoral institution gave her advisor near total control over whether or not she would ever defend. The situation was so frustrating that even Soraya’s mother, who had remained supportive but relatively removed from her academics, decided to get involved and called the university’s president. The excerpts below illustrates how
powerless Soraya was left, despite her completion of all requirements of her doctoral program.

He clearly was part of it because I never would’ve get gotten it without him, without him signing off on it. But the reason it took me six years and not five was mostly his fault. Because he would not get back to me on, you know, I would give them copies of a chapter to edit, he wouldn’t respond. But he wouldn’t respond, it would take him like a month to get back to me. So if you give somebody a chapter, a chapter to look at, it takes them a month, you do the edits for a week, you give it back to them and then it takes another month. It’s really frustrating. I remember at one point in time I set a date to defend and, you know, I was getting very little feedback from him. I very much think it’s balls to the wall, you know, we had a time, we had a date. And I remember saying okay, I made the last set of edits, I sent it to him he ignored me...And just when he wasn’t responding to me, there was nothing I could do but sit around and wait and wait and wait. And even when, and even when he was giving away my research stuff it was technically all his research, but there was no recourse. There was too much autonomy or, not really autonomy, but dictatorship of him throughout the process. ....I spoke to, you know different people within, the dean of the graduate school. You know, just kind of asking for advice and everyone just kind of told me “well, you know, there’s nothing we can really do. We feel for you, but the policy was at the end of the day he have to sign off on it.” And if you weren’t making him happy or if you weren’t too much around him, he was not been sign off on it.

Through this difficult time, Soraya once again pulled support from the social network she had built. She stubbornly pursued her dissertation defense because, in addition to seeking alternative paths from her university’s administration, she sought advice from those that were ahead of her. The advice, which assured her that perseverance was key to success, contributed to her cultural capital and fortified her resolve to not let her advisor drive her out without her getting her degree.

**Fighting the stereotype.** Toward the end of her program of study, Soraya was keenly aware that she was the only minority left from the group of people who she had befriended at the beginning of the program. Through the sexual assault, sexism, racism, and “blackballing,” Soraya consciously fought the stereotypes she knew were attached to her as a Black woman. Stereotypes that the discriminatory culture of the department
seemed to force minorities (whether racially, gender, or sexual orientation based) to become susceptible. Her keen awareness of conditions ripe for this susceptibility and her self-described stubbornness, bolstered by a lifetime of her parents telling her she could do whatever she set her mind to, to not give those who cultivate the discriminatory culture is described in the excerpts below.

I thought maybe in my lab group I have to not be sensitive because the last girl that was in the lab she would cry for anything. And that’s why the boss just learned to ignore her. So you know, I have to at least, I didn’t want him to actually develop this stereotype that all women cry and are feeble and he can’t talk to you. I remember one story they told me that he was, that they were in the office and she cried and he got up and walked off. And left her crying in the office. I didn’t want that to be me, I didn’t want that to be perpetuated in his little mind.

…You know when you feel frustrated and you realize that there’s nothing you can do, the whole like powerless cry. I wasn’t like sad and suicidal but it was very much like there’s nothing I can do this situation. I felt very powerless. Only in the last two years, it was kind like well, I got to do whatever I can to move on.

Oh wait, and to answer the part about people of color. I feel, because the other girl that started with me she had dropped out. She left, I would say my second year. She left with her masters. She got that at least she left with something. The gay guy that was a year older than me, he left with his masters. And the gay guy that was in my year, he left he didn’t get a master’s, I think sometime in his third year. My favorite core people, that like, but I hung out with they were gone. You know, it was sad. And you realize like, (sighs), as much as you want to pretend that it’s not something, you realize that anybody that was any sort of minority was gone. So what is it? Is it something that is damaged? Is it something that was in them? You wonder.

As someone who does not like to leave anything unfinished, Soraya worked around or broke through every barrier thrown at her; she persevered and went on to explore a career in academia. Unfortunately, faculty life once again presented her with barriers that solidified the unappealing nature of a career in academia and chemistry that began to form around her third year.

**Tokenism.** The first year as a chemistry lecturer in a non-tenured position at a private, elite liberal arts college was fun. Soraya found her students’ learning to be the
most rewarding part of the experience. She enjoyed seeing them grow academically as well as personally. However, toward the end of the first year, two events within her new chemistry department’s culture started to solidify her perspective as an outsider in her academic career. First, a White female colleague berated her for daring to make an input about her teaching style (a student they both had in common had approached Soraya about an issue he was having in her colleague’s class) based on a student’s perspective. Her colleague also berated the student. Soraya was mortified because she realized that she had misperceived what she thought was a good and equitable relationship with her colleague.

A second event with racist overtones occurred later at a departmental level. A tenured faculty position had opened up in the department for the next academic year and Soraya was enthusiastically encouraged by the department’s faculty to apply for the position. With the encouragement of her colleagues she applied for the position. Soraya did not foresee that she would not even be considered for the first round of interviews; nor did she anticipate how undiplomatic her colleagues would be following the decision not to consider her for the position. She described the events and their subsequent impact on her in the excerpt below.

And on top of that [event with her White female colleague] they were looking for an assistant professor in the year I was finishing for the following year. And they were like ‘you should apply, you should apply, you would be great, the students love you, Blah blah blah.” So I put together like my whole little package and I don’t even make the shortlist. And it’s a really small school so maybe there were five or six people in the department. So it’s like, you guys told me to apply I don’t make the shortlist, you know, and the chair doesn’t tell me. One day, we have a peer mentor, you know a person you’ve been kind of contact. And she was like hey I’m just calling to let you know, I was on the panel and hear some feedback about your application and here’s what you can do in the future to make yourself more competitive person. Which, I really appreciated and valued her input for. So like if you cannot encourage someone to apply and not have them make the
shortlist, you’re thinking, were you just saying that because you wanted to say you had so many diverse candidates apply. There was a Black woman, blah blah. You know? So I was very, very happy to leave them.

**Super educated. Super talented.** Soraya moved on to lecture chemistry at another liberal arts college, but her first experience as college faculty had skewed her view of a career in chemistry. She had grown bored and wanted to try something else. She does not regret getting her Ph.D., but she has moved on to a non-science related career for which she is overqualified and affords her a high degree of respect, especially because both of her degrees are from prestigious private universities. This respect mitigates any racism and sexism present in what is still a male dominated field. The organization she works for has less than 1% of Black women in their employ; in fact, Soraya noted that with a staff of around 700, she is the only Black woman in attendance on a daily basis. However, as in her doctoral program, she feels pressured to drink beer and watch sports to secure alternative fictive kinship in the absence of other racial minorities.

**Resignation.** Career experiences have brought Soraya to a point of acceptance of the oppression that she will inevitably encounter, to varying degrees, no matter what she does and where she does it. However, with this acceptance comes a calm and smartly designed strategy to work around systems of marginalization described in the excerpt below.

I think the matter where I’m going to be I’m going to be one of the few I think I’ve accepted that. There’s never been a time like I when I was one of the masses, Besides when I was teaching at the [second liberal arts college]. Still being in [a liberal arts college where] there were Black professors, but then I could still sit there and think yeah they’re black professors but not all of them came from as prestigious schools as I did, you know. There’s a pedigree. Or just the amount of them, you think it would be more but there wasn’t as much as I would think or I thought should be. So I think that was very interesting. But, I’m okay with it. I
know that I’m not going to always fit in and I’ve learned how to play the game a little bit. Go out and have a beer with my coworkers even though it’s not what I would rather do, what I do it just because I want them to feel comfortable and think “oh, where is Soraya? She’s a cool girl” I don’t want the thinking anything about my ability to work. You’re just thinking over what I go have a beer with her? And would I enjoy working with her? …I think it [being a well-educated Black woman] gives me an opportunity so when they’re looking for diversity to look for me and I would be more able to get a job and still be overqualified. So, I never have to worry about I got a position because I’m a Black woman, it’s like I got a position because I’m a Black woman who is super educated and talented.

Accompanying this resignation to marginalization is the cynical realization that as a Black woman, although brilliant with the credentials to support that assertion, she will have to inevitably be an outsider in whatever organization she chooses to work. In the excerpt, below she projected, based on previous experiences, how and why her identities lead others to view her as an outsider.

I think it would be more challenging because I have learned most of the job opportunities, you know, by the time they’re advertised they already have somebody to know if you want for it other only advertising it because they’re obligated to. So, I think that will end up having a bigger influence on how you get to a certain job or position. You know, I’m in the fact that if you want someone to refer you or to get a leg up in someone else you need to be in-the-know and since it’s such a small population you’re never really going to be in the know. You’re always going to be an outsider. And I think that’s the hardest reality of it. I remember when they got more than one female professor in my chemistry department and I thought all we’re really inclusive, we’ve got two!” And then I’m like yeah you’ve got two out of like 300 men and like how is that being inclusive. You’re just being stupid. It was my thought of it all so. I think that’s my biggest problem. So race ends up being part of it, yeah, you may get a leg up because they’re looking for diversity, but half the time they say they’re looking for diversity they do nothing to keep it. They do nothing to promote it, and they have blatantly ignorant, belligerent, retarded people in their community who can say and do whatever they want and have no repercussions. So even the environment itself doesn’t breed the inclusiveness that you want. And that’s the problem.

Her cultural heritage, despite her chameleon-like ability to adapt to her sociocultural environment, continues to heavily influence her perseverance and strategies to succeed in institutions whether they are marginalizing or not. She is grateful for the undeviating
belief of her future success her parents expected and supported and their sheltering of her early in her education. While she knows money makes a difference in educational opportunities and choices, she is unwavering in her conviction that her parents’ belief in her was the factor vital to her educational successes. The importance of her heritage and parents’ support is illustrated in the excerpt below.

I think I was very lucky in [Southern Metropolis] because it was so culturally diverse I wasn’t really aware of my race and what limitations that brought. I really do think it is perceived with inherent limitations. So by the time they actually started to happen to me I would sit there and think like oh, is it because I’m Black? And I would think oh yeah, that’s the reason. And thankfully, you know, my parents were there for me before all that happened that I didn’t have that experience. But I definitely see it, I saw with my students name was at the HBCU. And I see the detriment, what hurts it can do. When someone tells you that you can’t do something, you believe that you can’t do it. You believe that you can’t do it… I think, you know, my parents came here when I was really young and they always told me we came here for you to have a better education, to have more opportunity. So when you’re told that we came here you can have opportunities, you can have successes, you don’t squander it. You think about this other life that they had that was perfectly fine for me, so you always want to do whatever you can to not disappoint them….I think another part of it is women being told I can do this because if I wasn’t being told all the time [by her parents]: you can do this, you can do this, I don’t think I wouldn’t have been able to do it. I don’t think I would’ve had the mindset to say “I can overcome all these challenges, I can overcome all these crazy people, I can overcome being insulted, and you know, fondled, if, you know, that wasn’t the case.

**Power shift.** Ultimately, Soraya recognizes the power earning her doctoral degree in chemistry has imparted to her career opportunities. In numerous ways, her degree has enabled her to consciously choose the environment in which she works and shapes her future career opportunities to fit who she is and who she will eventually become (although she has no expectations for who she will become). The ramifications of the power derived from her completion of her doctorate have had ripple effects on her past. As illustrated in the excerpt below, through it all Soraya has found power, empowerment, and happiness.
So, I think I’ve had enough time to get over my hate for my advisor. You know, I’ll tell you this. Last year last year I was at Mulder University and chitchatted with my advisor. And we had a lovely old time. This man who ignored me, but you know what, I’m over this, I’m happy. I can do is say hi to you and ask you about your wife and kids.

I think, it wasn’t even how he received me, it was how I portrayed myself. I think the power was no longer there. There was a shift in the power dynamic, I could be like how was this? How was that? What’s going on with that? And not really fear: what is you say? What do you think? How do I know if I’m supposed to know this? And that way, since I didn’t care, I was happy, there was nothing he could tell me. It’s not like he could tell me you suck on a daily basis forever, there was never any, I couldn’t disappoint him and there wasn’t a level of expectation that he had of me. I already said I wasn’t going to do academia at year three, which is when he stopped talking to me, but I think he had accepted it by now and realized I’ve got a career and I’m happy. Or maybe that’s what I portrayed and he went with it.

Reflections

My reflection: Immigrant. My initial reaction to Soraya’s story was similar to my reaction to Avenus’ story; I reacted with jealousy. I felt jealous that they both came to recognize, understand, and manipulate the marginalization inherent in U.S. educational institutions system. My follow up reaction was the dawning of a new revelation; for the very first time, I felt the deeper ramifications of immigrant identity. Although both Avenus and Soraya have roots outside of the continental U.S., they both essentially grew up and were educated in the U.S. educational system. In contrast, my entry into the U.S. educational system was as a newly divorced 21-year-old, part-time student in a community college. I was so naïve, it took a White friend at the same community college to inform me colleges gave money to smart minorities.

At the start of my doctoral program I had been in the U.S. for five years. Up to that point, I believed the metanarrative of the hope of the “American Dream”: work hard, work smart and you will achieve your goal. The color of your skin, your gender, your heritage, your religion, and your sexuality did not matter. Now, as a 33-year-old woman
on her second try for Ph.D., I am stunned and angered by my naiveté, which caused me to be oblivious of how the American Dream is very much dependent on socially imposed identities.

I also found myself envying that Soraya had parents who not only encouraged her through her K-12 years, but also encouraged her through her higher education. While my parents encouraged me very strongly and supported me incredibly through my K-12 years, once I finished it was expected that I would marry at 18 (I was married off at 19) and have children soon after. Primarily for financial reasons, in my parents’ plan, higher education was an unfeasible expectation. When I hear that Soraya’s parents were unfailingly supportive despite that they, just as my parents, did not fully grasp the higher education process, I cannot help but wonder what my path would have been if my parents were as supportive.

Rather my parents, my mother in particular, who was so supportive of me in my K-12 years, started to hound me to get married, to have children the moment I graduated from high school. Interestingly, this was not the case for my other brothers and sisters, who were all encouraged to seek postsecondary training, primarily vocational training. What my mother called my “bookishness” was such an anomaly for a girl in my family, no one had any idea what to do with me beyond marrying me off. My family still finds my academic interests mystifying. Accompanying this envy of Soraya is enormous admiration.

I am amazed at Soraya’s chameleon-like ability to blend in socially. She deftly both recognizes the importance of blending in and navigates her behavior according to the social expectations. Her high level of know-how is breathtaking. I was in a similar
“frat-tastic” environment where my peers’ idea of a good time was drinking, partying, and whenever possible, combining drinking and partying with a sporting event. None of these activities has ever appealed to me.

Her discussion of this triggered a memory for me that is reminiscent of Avenus, also classified as Hispanic, and her recollection of the expectation by her high school teachers and peers that she would likely become pregnant before she graduated. My refusal to drink alcohol at social gatherings led to a rumor among the cohort that I was pregnant! Not that I was perhaps conservative in my views on drinking alcohol, but that I was pregnant! I now wonder if I was like the pretty White girl next door, rather than the Hispanic immigrant, if my peers would have jumped to my fecundity as the only rational explanation for my refusal to drink.

So at the time, I was between a rock and hard place when it came to having children. It seemed everyone whether with good intentions in my parents’ case, or negatively stereotypical perspectives as in my peers’ case, it seemed I was expected to have a child. Even in hindsight, even if I could do it again, I know that I could not compromise and vacillate identities, even superficially. The asking price (high economic gain, high emotional loss) for this compromise was not only too high for me, a prerequisite cost of success that my white peers seemed to not have to incur, but it was also clearly an injustice.

In the end, I chose a more palatable compromise to getting the Ph.D. by seeking it in the more socioculturally welcoming field of education. This compromise has had an initially high economic loss, but very low emotional loss. However, as amazed as I am at her ability to fit in, I am more amazed that after overcoming being called a nigger, being
sexually assaulted with no repercussions for the perpetrators, and the odds against a passive aggressive advisor, she has walked away from chemistry. After everything she persevered through to earn her Ph.D., she was still perceived as an outsider; she was still being asked to continue to compromise.

When she shares her recognition that the elite, private, liberal arts college knew who they wanted to hire (not her) despite encouraging her to apply for the open tenure track position, I think back of a conversation I had with a full professor. As I discussed with him my desire and worry about securing a tenure track position, he interjected that departments write their job descriptions with a very specific type in mind and if that type includes someone who is an underrepresented person of color, they will write a job description that leads the committee to hire an underrepresented person of color. More recently, I had a conversation with another professor who basically indicated when I was ready to look for a tenure track position, a position would be created for me in their department if I desired it; I simultaneously felt flattered and cynical.

Soraya was so insightful in understanding that in academia whether or not you get interviewed, much less hired, is predetermined. So, whether you choose to use Avenus’ term of being “out-of-the-loop” or Soraya’s term of “not-in-the-know,” you will continue to be at a disadvantage as a person of color, despite having competitive qualifications. Avenus, Soraya, and myself found that despite recruitment, fellowships, scholarships, and numerous platitudes, at the end of the road we are still not wanted, we will never really belong.

The more I think through and write this reflection, an increasing sense of sadness has crept in. I fear success (success defined as identity affirming experiences within
doctoral program and equitable distribution of all forms of resources within doctoral programs) in STEM will almost invariably be dependent on having to negotiate some variation of a culture that resembles Soraya’s frat-tastic Thursday and Friday nights. In Avenus’ and Soraya’s stories, I feel I have found evidence that supports my hypothesis of capital, kinship, and oppression as key players in academic success as the doctoral level and I realize that I find no joy in this evidence.

Part 1 of Soraya’s reflection: Time filters out the horrible things.

So, I guess what I realized with all the things that went on [in doctoral program], I was like, wow, that was really, really crappy. And you kind of tend to forget all the bad stuff and focus on the better memories of it. I actually talked to one of my girlfriends; I’m like, you know, I have no idea what my preliminary exam was like. And she was, like, it was absolutely horrible; do you not remember? They kept you in an extra hour, it was supposed to be two hours and I ended up being in there for three hours because they sat there giving me an extra problem to solve on the board. It reminded me of all the horrible things you have to go through to get to where you are and you just remember the good stuff. I didn’t go into, like you know, any emotional distress from it, but it was kind of crappy that you had to go through all of that without support and without really anybody to talk to about it because no one really truly understands.

Part 2 of Soraya’s reflection: My true personality.

Just read your reflection. It was beautiful. Something you'll never know without me saying. I try so hard to fit in that I wonder what my true personality is. It drastically changes depending on who it is. Other comments, during grad school my mother started to tell me I didn't need to be married, to have kids, and continues to this day to set me up with Mr. Right. You were never alone. We had each other.

Devina

Context

Devina is a multiracial, Episcopalian woman in her thirties whose mother holds a Bachelor’s degree and her father has some high school education. Her parents divorced when Devina was around four and half, and she was raised in a house with her mom, great grandmother, and sister. Her father remained a constant and supportive presence in
her life. Devina started her undergraduate education in a joint Bachelor of Science/Medical Doctor (BS/MD) program at a public university. She decided against pursuing her medical degree and earned a Bachelor’s in general sciences. She went on to earn a master’s degree in biology from a public university and then went on to a neuroscience doctoral program at a research-intensive, private university.

Devina left her neuroscience doctoral program after six years without a degree. She is currently pursuing a master’s degree in education from a public university concurrent with alternative teaching licensure. Her higher education has been supported by a combination of scholarships, assistantships, fellowships, and loans. Devina now teaches middle school science at a public school. At the time of our interview, she was living in the Midwest.

I was introduced to Devina via an e-mail by a mutual acquaintance. After several subsequent e-mails, Devina and I settled on a mid-April interview date. A week prior to our interview, an e-mail was sent to Devina with the interview prompts attached. As scheduled, I conducted a 138 minute long face-to-face interview with Devina in mid-April. This interview was conducted early in the morning in a private room in Devina’s college student union. An e-mail was sent 10 days after our interview asking her to share her reflection on telling her story. Devina chose not to share her reflection.

**Counterstory**

**Kids with horses and working around a marginalizing system.** Devina’s K-12 experiences were filled with transitions. Her mother earned her Bachelor’s degree while Devina was in elementary school; Devina accompanied her mother to her college math classes during this time. Devina was very good at math and thrived in her mom’s math
class. Additionally, when Devina was in fourth grade, her mother transferred her from a public to a private school. Devina went from always being one of many students of color at her public school to where she was one of two students of color. In this school, for the first time Devina felt her minority status, despite her family having a strong and constant presence, throughout Devina’s life so far, in an all White Episcopalian church.

Additionally, although Devina’s family was financially comfortable, the families at her private elementary school were part of an “incredibly high socioeconomic group.” So, as she socialized with students who had their own horses and vacationed in Aspen, Devina gained her first awareness of class. Devina transferred into a private, all-girls Catholic middle school where she was once again a racial minority. However, the school lacked challenging academic opportunities for the young girl who did college level math in the third grade to help her mom who was “really, really, really, bad at math.”

Academically unchallenged, Devina convinced her mother to transfer her into an affluent, public high school, which would give Devina more options for her academic program of study.

As expected, she loved her high school because it gave her access to so many academic opportunities. However, her racial and gender identity led her school counselors to advise Devina into less rigorous courses. However, Devina, an extremely shy child, was driven to satisfy her need for being academically challenged. While she was grateful she was not initially placed in lower track math like her other minority peers, in another first, she learned how to work around a system that attempted to marginalize her by refusing to put her in honors math. The excerpt below illustrates the
marginalization Devina encountered in her affluent high school and how she worked around these attempts.

So, you know, some of it was me having to jockey and make things happen that wasn’t supposed to happen. For instance, they really, they didn’t want me in the higher math. When you register, they’re like “what did you take before? Well, we’re not sure if we can put you in honors track math” there’s no testing or anything, it’s just that we don’t think this is where you need to go. I don’t know where the “this is where you need to go” came from, but, at least it wasn’t low track math. So, at least I got that. So that meant I took regular algebra my first year, which means I was not going to be on track for taking calculus. So, what that meant for me, because you know that’s not something my mom, that’s not a battle my mom would even understand or try and fight. Math is not her thing anyways, she doesn’t understand me being bored and I was not going to spend another four years being bored at math. So I took Algebra I that year and then when I went to take Algebra II, I wanted to take Algebra II and Geometry the same year, so that would put me on track for calc[ulus]. And my advisor was not going to sign off on my schedule with two Maths on it, at all, that was, like, not an option, you can’t do that. You’re going into Algebra II. So I went to. The good thing about having over 300 students in your class is this, I can go to him with the format saying I’m taking Algebra II one week if I waited two weeks later and went with the form that said Geometry, he also signed that one. So when my schedule came through, I have both Maths on it. He actually didn’t realize what had happened until the end of my sophomore year went I told him I was signing up for functions and he was like “you can’t take functions, you have to take Geometry” “I did” “I thought you were taking Algebra II/Trig” “I am” “you can’t take two Maths” “But, I just did and I got A’s in both of them, So…”

This attempt to deny Devina access to higher-level courses was her only systematic encounter with oppression in her high school. And despite some isolated incidents with a White, male peer, and a White female English teacher (who seemed equally horrible to everyone), Devina’s high school experience gave her enough opportunities to indulge her love of learning, which she continued to pursue as an undergraduate.

**What else do you do with science?** Despite Devina eventually indulging herself in academically rigorous course work, the marginalization encountered with her school system via its counselors, in combination with parents who had limited experience with higher education and more specifically the field of science, affected her ability to make a
well-informed decision about her long term career opportunities. In the excerpt below, Devina explained how a lack of social capital led her to her initial decision to pursue a medical degree at a public university and her early realization that she was in the wrong program of study.

I knew and I knew that I loved science. I loved English and I loved science and, you know, if you love English you don’t love science. I loved them both and when you’re 16 looking at what colleges to apply to everybody always tells you if you’re good at science you should be a doctor. And, it’s like, I didn’t have any plans, what else do you do with science? Because nobody ever talks about that at school, right? I don’t know what you can be with science? You could be a doctor? Or a vet? Or something? Because that’s what you do. So, I said alright, I guess that’s what I’ll do. And I applied to the BS/MD program and I got in. I loved the classes. It was actually a nice program, I think for me, because it fit my personality because it was such a small program and because you have to take so many credits. There’s only so many ways you can fit the puzzle piece, which means for the most part you going to class to class to class with the BS/MDs. But for the most part you’re not doing science, You’re not doing science. And I don’t really want to be a doctor, because I don’t think I have the personality to keep looking at the same person, going “I told you to stop smoking, What’s your problem?!”(both laugh) because my brain, if something is bad for you then you stop! And so I don’t have a lot of patience (laughs) for self-inflicted misery. And so I was worried that I would always end up making people mad.

**Less surprised that I knew things.** Despite realizing her error in pursuing a medical degree, Devina relished the freedom to take any class she wanted simply because she was interested in the topic. She also enjoyed interacting with teachers who were less surprised that she was a bright woman of color; however, she never felt she connected with any of her professors who, with the exception of one woman, were old, White men. After leaving the BS/MD program, Devina worked her way through her undergraduate and in her fifth year gave into pleas from her friends and family to finally stop taking classes and graduate.

**Teachers before researchers.** Devina worked full-time as a regional sales manager for six years at the company she was employed as an undergraduate. In this job,
where she trained others, she discovered a talent for teaching adults. She decided she wanted to pursue a career that would allow her to combine her love of biology and love for teaching adults. She decided she wanted to be a biology college professor. With this decision made, Devina thought it was prudent to test this decision by first earning her master’s degree in biology because she had had no prior research experience. She found the research aspect of her master’s experience allowed her to exercise her love for puzzle solving.

So, despite working full-time and carrying and eventually having a second child during her master’s work, Devina successfully completed her master’s course and thesis requirements in two years. The excerpt below illustrates how her success at the master’s level gave her the confidence to take the next step of pursuing a doctorate in neuroscience to achieve her ultimate career goal of becoming a biology college professor.

So that first summer after I had her I got a summer fellowship, so, I was taking a DNA molecule and I was substituting part of the molecule with something that I could identify, but was not functional. So that I could stain it and find it later. I’m so I was taking that piece of DNA actually cutting that out and replacing it with something else to make a construct so that I can inject that into embryos later. So, my advisor is like, this is what you’ll work on this summer, here’s our plan, but you know, it’s a difficult thing to do. We tried it once before and we have not done it successfully yet, but we got a new way, I’ve got a new way to try and get it done. So don’t get upset if it doesn’t work. So, that was my plan and I got lucky and it worked the first time I try to do it. But now, the weird part was the control because that was supposed to be the thoroughly, the gimme one, that I had trouble with, making the control. I had to do several tries before we finally got it done. I got it done early enough in the summer, I was actually able to do the entire assay experiment. I started at the beginning of the summer, I did all my injections and cryosectioning and all I have to do, I was finishing the analysis of the cellular impact during that first Fall. So, when I actually had my proposal meeting with my committee my project was almost completely done. I was just finishing the stats on it when I had my proposal meeting. So, it was nice because I felt like, I’m actually doing this. It’s actually working and maybe I’m not such an, you know, making terrible decisions just chuck everything (raising voice high) so I can go into academia (laughs).
Although she encountered one White, male professor who forced her to take a make-up class because she took a week off after giving birth, Devina found her master’s program nurturing because students’ learning was valued more than research and publications. The culture of her doctoral program, however, was the antithesis of such a nurturing environment.

**Don’t have kids and learn to drink beer.** Devina’s first year in her doctoral program, as expected, required adjustment. Most stunningly, she immediately encountered repeated verbal harassment, in the guise of advice, from multiple faculty members, including the sole female member, about reproductive choices. She kept being told to not have children. Devina looks younger than her actual age. Therefore, her retort that she was already a mother of two took many by surprise and inspired some to respond that she should safeguard against having anymore.

When Devina became pregnant with her third child just after she completed her preliminary exams, she began to be at the receiving end of significant gender-based pushback from faculty, including her advisor. Her additional caregiver role for her ailing great-grandmother was also used by her advisor as a source of derision against her. The duty of caring for family members, a duty U.S. society at large singularly thrusts upon women, was openly viewed as a weakness and irresponsible behavior within Devina’s private, research-intensive university. The excerpt below illustrates how sexism permeated Devina’s doctoral experience.

So I don’t know if that was really an issue for the other girls, but, a lot of pushback. Actually my youngest son was born during my Ph.D. work. And when I told my advisor I was pregnant, he just looked at me and didn’t say anything for a minute and then he says does knows the graduate program coordinator know? And I said yes. And he said, and what did he say about it? (Laughing) those were his first two sentences. And I said, he said congratulations and if there was any
time to have, you know, in terms of having a baby during your graduate work. I told him right after I finished my qualifiers, he goes being done with your coursework and after qualifiers is the best time for you to have one. And he goes well I guess that’s one person’s opinion and he walked away. (Laughing) and that was it. You never said congratulations, not at that moment, not when I had the baby, never. I mean, it was always I’m sure you always have kids stuff to do. So there was a lot of that though. And, you know, they’d say things. Even the department chair, she had one son, who was grown because she’s an older lady. She is the talk about all the time how she would bring him into the lab when she had work to do and everything else. And other male faculty members would say stuff all the time. She shows you those pictures and tell you those things all the time, so you understand there are sacrifices that need to be made and that, you know, being a mom has to come after research type things. So, there was always a lot of pushback.

Adding to this culture of sexism was a culture of drinking and partying among the nearly all White, male doctoral student body. Friday night was beer night, and acceptance into the social network required heavy drinking. Devina, still shy and not a drinker, found the behavior required to earn an alternative fictive kinship within a clearly male culture to be too much. The brief excerpt below illustrates the lengths to which new students were required to go to gain entrance into the social network.

Gender was definitely a disadvantage. The people that seemed to get along best (chuckles) were the good old boys who liked to sit and drink with the guys. I am not a drinker, I have never been a drinker….We had a weekend retreat where one guy got completely wasted. He was a total train wreck in terms of what was going on, But you know that was his initiation into the club and he was golden from then on. He made a complete jerk of himself. He was falling down drunk. It wasn’t just, like, tipsy happy. I know, I was in a sorority in undergrad…So, it’s a large group, I think part of the issue with me in groups is I think that there’s a social contract where you’re supposed to be witty, you’re supposed to be engaging, you’re supposed to be these things and it’s just too much pressure for me. I just, I really don’t…The Filipino boy and I would make an appearance and try and drink a soda and we would sneak out. Staying there was just. The only time we couldn’t sneak out is if we were hosting because it was bad form to not be there.

**Petulant micromanager.** Devina had a very difficult experience with her first neuroscience doctoral advisor. He was a younger, White male who had just begun his
tenure track position at the university. At that time, his only two doctoral students happened to be two of the three minorities in the entire department, Devina and a Filipino male student. Included in the research group was an Indian lab technician. In addition to the derision he directed at Devina for being a mother and caregiver for her very ill great-grandmother, he enforced a rule of Devina being in charge of cleaning duties in the lab, even if on paper that duty was assigned to one of her male lab mates. Devina’s breaking point came when he kept forcing her to make obviously unwise research strategies, and then blamed her for poor decision making. The excerpt below illustrates how Devina’s advisor’s maltreatment suffocated and undermined her scientific capital through racism and sexism.

It wasn’t just me because we had a lab aid in there that was, a lab tech that was in there that he would just berate and humiliate in front of people. And I have nothing to back this up, but it always seemed to me that it was a racial thing. My PI was British citizen, he had moved here from England and his lab tech was an Indian gentleman. I just really seemed like it was, I don’t know, but he was just terrible. And in front of everybody he would just start screaming at him and he was just a hard person to be around. And that always made the Filipino boy and I uncomfortable. We were trying to sneak out and not make it any worse for the lab tech have to sit in front of everybody and take it…. At the time my great grandma was living with me because her health has declined and she couldn’t on her own. And “how would you like it if your great grandma was living in conditions like this and was about to die.” I mean it was those sorts of things, like everything is my fault. And then he was very, for researcher to me, he seemed really non-focused. Like he would get fixated on an idea that would be the flavor of the month type thing… So now, I switch everything and do the eye and he would tell me to do things and I would do them and he would say but that’s not what I said for you to do…He wanted to have a meeting (banging hand) every week about everything you were doing and how you’re doing it. There was no, like, I couldn’t think on my own apparently. I got to the point where he would set up a crossing scheme and I’m like just write down what you want me to do. I remember him coming in one day and just like where we are we on this cross? Well there on this generation before I can across these guys here. Why would you do that? That’s not the most efficient way to cross them. So, I’m like I understand that. That’s not how I wanted to cross them, but that’s how you told me to cross them. I would have never told you to do with that way because that’s a stupid way to do it. And then I just looked at him and opened up my drawer, went into my file and said
that’s your handwriting, not mine. To which he just turned around and stormed off and slammed his door. So it was that kind of thing all the time, so it got to the point where I’m just like, is this even worth it being here? So I ended up talking to the graduate program director of the department and talked to him about switching labs.

Removing herself from his lab group did not completely insulate Devina from the “bizarre” behavior of her first advisor. He became a “like a stalker boyfriend” for months after she left his lab. He found excuses to lure her back into his lab space and would openly beg her, against her clear indications that this behavior made her uncomfortable, to come back to him. Interestingly, Devina moved from having an overbearing, micromanager for an advisor to someone with whom she had no regular contact. This lack of advisor involvement proved to be just as damaging.

**Sabotage.** Although her relationship with her new advisor was less mercurial, his numerous administrative duties as dean left him very complacent in how he ran his lab. Although he said all the right things, he rarely followed through unless a student was having “very cool results.” Her new advisor’s penchant for showing favoritism based on success in the lab led to a culture of sabotage in the research group. Her lab mates were not just unsupportive, they purposefully sabotaged each other’s work in a manner that would prove detrimental to their research. Acts of sabotage, seemingly confined to her research group rather than departmental culture, were compounded when her advisor gave away her research project to someone else, without telling her. He justified this transfer of her project to a peer because he believed Devina lacked the skills to produce his desired experimental outcome.

Once again, Devina had tried to convince an advisor that an experimental strategy would not work, but once again she was ignored. Although she was later vindicated,
circumstances, both at home and at school frustrated Devina so much, she eventually decided to leave without a degree. She described these circumstances and her frustration in the excerpt below.

So I changed to another project that he wanted me to do and it wasn’t working and I didn’t think it was doing what he thought it should do. And I think he was convinced it was something that I was screwing up and at the time my grandma got really sick and so that’s what took my first leave of absence. I had my son already and my grandma was getting really sick and actually she died and my ex had some depressive episode after that. And it just was too much. He was actually in the hospital for his depression for a couple of weeks and then he was in intensive counseling and so I took a leave of absence for the rest of that semester and then that summer afterwards. During that time he had a summer intern that came in, research intern, who he gave my project to because he thought apparently it was something I was screwing up and when I got back, he just said yeah, it wasn’t you. It does not do what I thought it was doing and that’s what I’d been telling you. That’s what I’d been telling you! Started with a new project and it still wasn’t working the way he thought it should be working and I was getting really frustrated, because I kept thinking I just want to teach.

Despite the validation wrought from a male student’s failure with the research project, Devina, now six years into her doctoral journey, was unable to move on to the dissertation stage because her program required her to be published before she could graduate. However, she needed successful results to get a publication. Devina’s advisor, who had led an obscenely privileged life, refused to help her navigate the necessary politicking required to work around the system. Since her institution lay nearly all of the power to grant a student a Ph.D. with their advisor, Devina lost hope and decided for her own wellbeing that departure was necessary. The excerpts below illustrate why Devina felt deprived of any support.

That’s exactly what I wanted to do [teach at a student focused college) but I was at every turn told her that was not a worthy pursuit. And if that’s what you wanted to do anyways, then there’s no reason for you to be here. That was actually said to me. Well if that’s what you want to do then why are you here. You don’t even have any reason to be here.
…And I don’t know if it was because I really didn’t want to talk to anybody, but my great grandma was really sick, my ex was having all kinds of problems with his mental state, so it wasn’t like that was a (scoffs) supportive situation. I didn’t want to put more in there. My sister, my oldest young sister, the one right underneath me, she’s two years younger than I. You know, I talked to her about it a little bit, but she’s got no frame of reference for it…My mom when I told her, “but you’ve already done so much.” You’ve been doing it for so long you might as well finish. And actually a lot of people told me that, just the get out and finish. Why would you walk away now? Because here’s the thing, that’s the thought that’s been keeping me from leaving. I’ve done this much, it’s been this much hassle I might as well complete, I might as well complete it. I didn’t like the idea of giving up or leaving something undone, so it was hard for me to see that’s it I’m leaving, I’m walking away. I kept feeling like I was just giving up and leaving something undone. So it took me a year, I think I decided quite clearly that this is really what I should be doing before I actually ended up leaving. But, it was, finally you have to be realistic. What was your goal coming here? Because you are no closer to that goal now than when you started. You are not moving towards teaching, that’s the only reason why you went back to school in the first place. So, why are you hitting your head against the wall and trying to make it work when you’re not heading towards the goal. You’re just heading further away from it…. Because there’s only so much, feeling when you’re on your own, there’s only so much you can put up with before the mental beat down starts to take its toll.

In addition to not wanting to leave something unfinished, Devina felt she could not leave her program because she did not want “to give anybody any more evidence to use against the people that they see me represent.” However, with so much time invested and no hope to successfully defend in sight, Devina finally “stopped being stubborn,” and decided if she could not teach science to adults full-time, she could teach children instead.

**Where I am supposed to be.** Devina is grateful that she finally found the courage to quit her doctoral program and seek a career in which her identities and scientific talent are welcomes. Now, at her public elementary school, Devina and her principal are the only two faculty of color, but her racial identity is valued and her gender
is not an issue as female colleagues surround her. Her joy at finally finding a place where
she wants to be and accepts her is illustrated below.

I’m so grateful. I’m so grateful. Not just that, like, I really feel, part of it’s
teaching, part of it’s the school I landed. I really feel like it’s where I’m supposed
to be. I feel it’s the first time in a long time; actually it’s the first time ever in
terms of professionally. Because before I was doing things because it was a
challenge or because it was something new. But I also just, I have never felt this
satisfied, I guess, with the job. It’s one thing, yeah it was great money and I got to
learn new things at [the Company], but it wasn’t fulfilling, fulfilling in terms of
really feeling. I know it sounds so hokey and stupid, but. Everyday, even on my
worst days, I walk out of there with a smile. Like, on days where kids are just off
the chain and just being completely goofballs and having to drop the hammer on
them and fuss at them. I still walk out everyday, even on stupid PLC paperwork
days where I had all these hoops to jump through, which are meaningless to the
teaching to begin with, that I’m where I’m supposed to be. And I’m just grateful
for having found that place and going: see, this is what you could have had years
ago had you not been so stubborn.

**Expectations matter.** Racism and classism have been secondary sources of
oppression in Devina’s educational journey. Racism gave rise to lower academic
expectations by her teachers and advisors. These lower expectations pushed Devina to
independently design strategies that allowed her to acquire academic capital that would
otherwise have been denied her. Despite the success of her strategies to subvert
marginalization, a lack of social capital, specifically related to access to guidance on
higher education and subsequent career choices, led to delays in her discovery of a career
that suited her talents. Classism has also been a background influence, Devina noted, “I
mean, even then [working as a regional manager at Company #2], even then, I always
had to worry about money. And that’s an interesting undercurrent to have going through
life. I think it changes how you see the world. There’s never peace there, which I think
not everybody realizes.”
However, sexism has been the dominant force denying her successful achievement the career she knew suited her talents best. Her doctoral education institution persistently ostracized her for being a caregiver to her young children and ailing great-grandmother. Further, her conceptual understanding of neuroscience and experimental skills were repeatedly dismissed by her advisors who both were only convinced about her assertions after a male peers also failed to produce her advisors’ expected results. Devina’s career was stymied by being ostracized by the gatekeepers in her doctoral program because of her role as a caregiver for her children and great-grandmother along with skepticism about her scientific ability because of her gender. Ultimately, Devina felt that sexism in her doctoral program proved to be too formidable even for her and decided that departure was, for her, the most practical recourse.

Reflections

My reflection: A measure of peace. A week after Soraya’s interview, I sat in front of Devina and continued to carry the despair I felt after reflecting on Soraya’s stories. So, it was with great surprise that I felt catharsis as I listened to Devina’s story. While Devina did not complete her Ph.D. program, her gratefulness and joy with teaching K-12 that she has found, strangely gave me peace. Suddenly, I saw my own joy at finding the discipline of education reflected in her joy.

I also realized as I reflected on her stories through the transcription of our interview that through pursuing a Ph.D. in science education, specifically focusing on the doctoral experiences of underrepresented black and brown men and women, I have found my own way to work around the system and with the future intent to help others do the same. My intense feelings of jealously that others have seen the system with its inherent
oppression before I did evaporated with this realization. Like Avenus, while I acknowledge all the faults of the McNair Program and similarly I have never lost my love for chemistry, and despite negative encounters with the gatekeepers of the discipline, I have never let go of the goal to earn a Ph.D. and enter the ranks of the faculty with the primary aim to help others thrive. I am now in sight of this outcome, but only because I have (somehow without my knowing until the end of Devina’s interview) over the years built a social network connected enough to help me earn a Ph.D. in three years.

I was momentarily dumbstruck when Devina, in reply to my question of “Why did you choose to speak with me?,” responded “you asked.” Soraya also gave an almost verbatim reply to this same question. It seems like such a simple answer, but the undercurrent of this answer runs deep. The moment Devina uttered “you asked,” I instantly connected with Fordham’s notion of fictive-kinship and with more time it dawned on me that I had built a social network over the last seven years of people who are willing to cheer me on through my academic journey. Social, cultural, and academic capital that will lead to me earning a Ph.D. almost from scratch in three years! The reality that I have a group of people I can reach out to and without hesitation they will agree to help, simply because I asked is in such stark contrast to my first Ph.D. experience I remain dazzled and awed by this new reality.
I feel overwhelming humility as I come to terms with the wealth these three women have selflessly given to me by telling me their stories. While I expected intellectual catharsis, I never anticipated a personal catharsis of the anger and pain would emerge alongside my first tangible sense of unadulterated empowerment from simply listening to the experiences of these women.

**Devina’s reflection.** Devina chose to not share a reflection.

**Coalescence**

Counterstories combat the majoritarian narrative by correcting our “system of beliefs and categories by calling attention to neglected evidence and reminding readers of our common humanity” (Delgado & Stefancic, 2012, p. 49). A counterstory’s power to evoke a common humanity stems from its use of language, bridging gaps between our imagination and conception of oppression (Delgado & Stefancic, 2012). These bridges subsequently reduce the isolation of groups marginalized by the majority (Freire, 1970/2012). Further, in the telling of their stories, groups marginalized by the majority offer the opportunity for members of the majority group to shrug off their epistemological ignorance. Often, marginalized individuals are compelled to navigate both their home worlds and the worlds of their oppressors by constantly being aware of and enacting multiple identities, whereas oppressors often fail to see their own multiplicity of identities because they exclusively move in spaces where they are at ease; their identities appear unified, and this unity provokes a constant sense of security (Sullivan & Tuana, 2007).

Therefore, I feel the power of each woman’s story to counter the STEM metanarrative, dominated by White, middle-/upper-class, heteronormative male
experiences, can only be preserved by keeping each participant’s story relatively intact and separate, because each in their detailed and unique unfolding reveals the constant tension in which they exist whenever they navigate worlds that marginalize them and force them to exist as outsiders-within. I continue to firmly stand by my decision against amalgamating stories via coding for common themes. Yet, after immersion in the data that shared profound experiences among participants, stories began to emerge and reverberate with the theories of forms of capital, kinship, critical race, and oppression.

Given this study’s methodology use of intensity sampling (Patton, 2002) that aided the researcher in gathering “excellent or rich examples of the phenomenon of interest, but not highly unusual cases” (p. 234) it was expected that rich data about the doctoral experience would be illuminated. It was also expected that because participants were selected based on common criteria, common experiences were to be expected. However, there were no specific expectations on what those commonalities would be beyond encountering oppression such as racism, sexism, and racism (with no preconception of how many forms would be encountered, the frequency and intensity of encounters, or how encounters would specifically manifest). Further, it was expected that there would be similar procedural experiences common to doctoral students, such as comprehensive exams, working with an advisor, writing for publication, and writing and defending a dissertation.

Therefore, after shared profound experiences emerged during narrative analysis of the interview data to create counterstories, a second method of data analysis was sought to allow me to overlay and deepen my understanding of these shared experiences and how these shared experiences support using the theories of forms of capital, kinship,
critical race to explain how and why underrepresented people of color remain have been and continue to be persistently excluded from the STEM doctorate.

Therefore, as a complement to each woman’s counterstory and in support of an alternative theoretical framework to understand the lack of equitable racial representation in the STEM doctorate, I have coalesced common experiences with the theories that predict and explain these commonalties. This fourth section presents the results of coding (Appendix J) interview data for dimensions of forms of capital, fictive kinship, and oppression and sub-coding (Bieber-Hesse & Leavy, 2011) for important contexts from each woman’s experience. In keeping with the qualitative lens of this study, this analysis presented through narrative and tabulation was intended to deepen our understanding of the data and centralize the purpose of the study (Merriam, 2009; Patton, 2002) to obtain a rich description of how oppression is reflected in STEM doctoral students’ academic experiences and how that oppression influences these students’ academic and career outcomes.

Table 4.1. represents the first step in overlaying the data from this study which included the tabulation of the demographic information obtained from the demographic survey each participant completed before the interview. Additionally, a statement obtained from the interview data was included in Table 4.1 as a representation of each participant’s synthesis of how their minority identities relate to their career path. The first pattern that emerged from overlaying demographic information related to the educational experience of the participants’ parents. Soraya’s and Devina’s mothers had more educational experiences than their fathers. Avenus’s mother also possessed more formal higher
education than her father for many years, until just recently when he retired from his previous career and returned to school.

Table 4.1

Summary of Participant Profiles

<table>
<thead>
<tr>
<th>Participant</th>
<th>Demographics</th>
<th>Representative Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avenus, Ph.D.</td>
<td>Science education</td>
<td>And I think because, like, the institution itself was what I was in disagreement with, not the content. So, like, it seems like with every instance, I’ve tried to return back to science but, like have found myself in different place that is more accepting of me as an individual, of me and my life.</td>
</tr>
<tr>
<td></td>
<td>Muslim, Puerto Rican woman, 30s</td>
<td></td>
</tr>
<tr>
<td></td>
<td>K-12: multiple states; Higher education: Midwest</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mother has Associate’s</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Father has Bachelor’s</td>
<td></td>
</tr>
<tr>
<td>Soraya, Ph.D.</td>
<td>Chemistry</td>
<td>So, I never have to worry about I got a position because I’m a Black woman, it’s like I got a position because I’m a Black woman who is super educated and talented.</td>
</tr>
<tr>
<td></td>
<td>Black Caribbean woman, 30s</td>
<td></td>
</tr>
<tr>
<td></td>
<td>K-12: South; Higher education: Northeast and Midwest</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mother has Master’s</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Father has some high school</td>
<td></td>
</tr>
<tr>
<td>Devina, M.S.</td>
<td>Biology</td>
<td>I’m grateful that… I have enough grit not to, not to let expectations define me [as a woman and a minority] because I think I see that far too often.</td>
</tr>
<tr>
<td></td>
<td>Episcopalian, multiracial woman, 30s</td>
<td></td>
</tr>
<tr>
<td></td>
<td>K-12 and Higher education: Midwest</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mother has Bachelor’s</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Father has some high school</td>
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</tbody>
</table>

This pattern of women of color being more willing to participate or persist in formal education settings than men of color aligns with a national legacy of underrepresented men of color being the least successful academically of all demographically tracked groups. Nationally, while the historical gap between graduation rates of Black, Latina/o, and American Natives males to White, non-Hispanic males has narrowed, males of color continue to have the highest high school dropout rate than any other group of students in the U.S. (NCES, 2013). Additionally, girls of color are about a third more likely to graduate in four years from high school (National Women’s Law Center, 2007) and a fifth more likely to earn their high school diploma than their male counterparts of color (Greene & Winters, 2006).
While Soraya and Avenus never specifically cited any academic influence from their fathers, Devina spoke of her father as a constant and supportive presence through her educational journey. However, all three women spoke, in some way, of the considerable influence their mothers had on their lives. Avenus mother’s subversion prevented her from being excluded from opportunities of privilege in her K-12 journey and pushed her, against family tradition, to earn her bachelor’s degree and delay marriage. During her doctoral journey, Soraya’s mother began to reassure her that it was acceptable to delay marriage and children and pursue her career goals. Devina’s mother seemed to be her advocate early-on by ensuring she could have the best education possible by securing higher quality educational experiences whether through private or public school choices. She not only went back to school as an adult learner to earn her undergraduate degree, she also took Devina to her college math classes, which resulted in a formative educational experience for Devina.

This conscious allocation of economic and cultural capital from well-educated mothers to their daughters is not surprising. Duncan (1994), in exploring the relationships between same parent and child gender and life outcomes of children in the U.S., Brazil, and Ghana found that Black and Hispanic mothers tend to allocate more resources to their daughters compared to their sons. Further, the attitudes of mothers with more formal education toward their daughters’ pursuit of a higher education is predominantly positive, while mothers with less formal education have predominantly negative attitudes (Suitor, 1987). Further, Lareau and Horvat (1999) found that parents’ possession of cultural capital associated with White cultural displays, cultural displays that U.S. schools tend to

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21 It is not being inferred that their fathers had no involvement or influence.
value over others, and more importantly, their activation of that cultural capital (knowing when and how to use cultural capital\textsuperscript{22}), resulted in their children being more successful at school.

Therefore, their mothers’ decisions to pass on their knowledge and use of the type of cultural capital valued in U.S. schools, whether directly (as with Avenus’s mother teaching her to find opportunities of privilege in her school) or indirectly (for example, Devina’s mother enrolling her in private schools) facilitated their eventual academic successes. So, for these three women, some credit must be given to how their mother’s educational experiences and perceptions of the value of formal education shaped their academic successes and eventual aspirations for a doctorate. This credit has to be given, because it is very likely that without their mothers’ influence, their high academic self-efficacy, a form of cultural capital, would have been lessened. In addition to having high academic self-efficacy, all participants had a high sense of self-worth, another dimension of cultural capital.

Streaks of stubbornness and pride mark the self-worth possessed by each of participants’ representative statements in Table 4.2. This tone of stubbornness and pride, which recurred throughout their synthesis of their educational experiences comes, in part, from their years of battling, with varying degrees of success, racism, sexism, classism, and religious intolerance.

\textsuperscript{22} For example, regular contact with the school and understanding that concerns voiced using calm, polite debate are seen as more legitimate than those communicated with open conflict and anger (Lareau & Horvat, 1999).
Table 4.2. provides examples of their feelings and battles with racism, sexism, and classism\(^{23}\) which are filled with struggle that have been marked by successes, but required sacrifices and compromises that white and Asians were never exposed.

Table 4.2

Characteristics Common to Oppression in Relation to STEM Doctoral Experiences

<table>
<thead>
<tr>
<th>Dimensions of oppression</th>
<th>Feelings associated with being subjected to oppression</th>
<th>Representative Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Racism</td>
<td>Exploited, powerless, isolated, stereotyped, resigned</td>
<td>My status as a minority and as a woman and race became what was prized by the department. (Avenus) He actually called me a nigger and threw glassware at me… And nothing was done in that situation either. (So ray) Not wanting to give anybody any more evidence to use against the people that they see me represent… I feel like when I walk away, everyone’s like there’s another minority girl, you see this is why. (Devina)</td>
</tr>
<tr>
<td>Sexism</td>
<td>Harassed, frustrated, uncared for, stereotyped</td>
<td>…I was the only woman in his research group. They were only maybe one or two other women that had ever…got a Ph.D. from him. So he was notoriously horrible, you know, dealing with women. So he always went to male to talk to. You walk into the group meeting, come into the office, he wouldn’t even say hello, He would go straight to some dude, tell him something and then walk away. (Soraya) I remember a conversation with one of my advisors who said, “well I have just one piece of advice to you, don’t have kids” and I said, “it’s too late”. To which he just said “then you shouldn’t have anymore.” (Devina)</td>
</tr>
<tr>
<td>Classism</td>
<td>Excluded</td>
<td>I think that there isn’t a time when I can have everything, right? I think about class being where you have the opportunity to have multiple things, not necessarily one. (Avenus) He’s [doctoral advisor] lived a privileged life his whole life and it’s hard being a grad student. It’s not a high-paying position and I had kids and I was commuting because I didn’t want to buy a new house. (Devina)</td>
</tr>
</tbody>
</table>

---

\(^{23}\) Violence and religious intolerance are not included in Table 2, because they were dimensions of oppression specific to Soraya’s and Avenus’s experience respectively.
Notably and as expected, stereotype threat, which features prominently in the literature on underrepresented people of color and women in STEM, was also a prominent concern for this study’s participants. Particularly, each participant cited issues connected to stereotype threat, which this study’s data links back to racism and sexism, as significant when they considered departure from their doctoral program. Therefore, this study’s findings support decentering stereotype threat when exploring the problem of racial and gender underrepresentation in STEM by identifying it as a symptom of racism and sexism. Constantly feeling under threat from racism and sexism, each participant became resigned to a reality of having to battle with overt and subtle oppression in their doctoral programs. However, how each participant chose to respond to these threats varied widely, and can be connected to previously accumulated capital and opportunities to activate that previously acquired capital.

The struggles noted in Table 4.2. are marked by a difficulty in building social capital through exclusion based on identity differences and isolation, as shown in Table 4.3. Further, as shown in Table 4.3, while participants perceived and personally experienced how the possession (or lack of possession) of economic, social, and cultural capital challenged their goal of earning a Ph.D., none of the participants doubted their scientific capital. All three participants expressed confidence in their laboratory skills, conceptual scientific knowledge, and their ability to effectively acquire new skills and knowledge as needed.
Table 4.3
Characteristics Common to Forms of Capital in Relation to STEM Doctoral Experiences

<table>
<thead>
<tr>
<th>Dimensions of capital</th>
<th>Feelings associated with various forms of capital</th>
<th>Representative Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic</td>
<td>Important</td>
<td>Your family cannot be dependent on you for money. Because if you need money, then you can’t really sit there and say “hey, I’m going to go to school for six years and make peanuts” (Soraya). I always had to worry about money. And that’s an interesting undercurrent to have going through life. I think it changes how you see the world. There’s never peace there, which I think not everybody realizes (Devina).</td>
</tr>
<tr>
<td>Social</td>
<td>Excluded, different, isolated</td>
<td>…there was really nobody like me. So, I would kind of go out and learn how to drink beer…But I definitely have to go out of my comfort zone to fit into what they wanted to do (Soraya). You’re supposed to be these things and it’s just too much pressure for me… So the Filipino boy…, he and I would go together and make an appearance and try and drink a soda and we would sneak out. (Devina).</td>
</tr>
<tr>
<td>Cultural</td>
<td>Stubborn, family</td>
<td>Traditionally, you know, our family tends to get married during Bachelor’s. The schooling is sort of secondary… (Avenus). I’m stubborn. You know, that’s really what it was. When I start something I’m going to finish it (Soraya).</td>
</tr>
<tr>
<td>Scientific</td>
<td>Confident</td>
<td>Which is why the postdoc and I worked well because it was like a very hands-on (Avenus). So, it wasn’t like if someone said “oh go do distillation”, I said” oh what’s that? Or what equipment do I need? ” No. I knew exactly what I needed and how to do it (Soraya). That’s not how I wanted to cross them, that’s how you told me to cross them. I would have never told you to do with that way because that’s a stupid way to do it (Devina).</td>
</tr>
</tbody>
</table>

Despite high scientific capital and varying degrees of possession of cultural capital, all three participants struggled with a lack of alternative fictive kinship. In their first year, each participant felt socially off-keel because they were the only student in their cohort, or at certain points in time the whole program, who represented their cultural heritage. Also, the dominance of White peers did not go unnoticed for any of the participants in that first year. An absence of both peers and faculty who shared similar a cultural heritage left participants without a community they could inherently feel a sense of belonging.
As noted in Chapter II, race and ethnicity are the strongest predictors of social networks (McPherson et al., 2001), therefore, finding themselves virtually exclusively surrounded by White and Asian peers and faculty, all three women felt like outsiders and subsequently isolated. This isolation, coupled with cultures perpetuating various forms of oppression, left all three feeling uncared for. Avenus noticed this absence of care immediately after she began her chemistry doctoral program stating, “You go from being nurtured in your undergrad to complete isolation.” Soraya’s despair with an absence of care was exemplified in her disbelieving statement of “Really?! Really?! Is this really what I have to deal with?” in reference her department’s leadership essentially dismissing her report of a sexual assault by a staff member of the department. Her explanation of the assault indicated that she was more disturbed by the lack of care from leaders in the department than she was with the assault itself. Devina’s frustration with the absence of care was magnified in her department’s constant pushback against her decision to be a mother and a doctoral student simultaneously, and by a continual rejection of her aspirations to pursue a teaching focused rather than a research focus faculty position. She explains her frustration in the excerpt below:

That’s exactly what I wanted [a career at a teaching focused college] but I was at every turn told her that was not a worthy pursuit. And if that’s what you wanted to do anyways, then there’s no reason for you to be here. That was actually said to me. Well if that’s what you want to do then why are you here. You don’t even have any reason to be here.

This specific perception of a lack or care was an unexpected finding, but is tangential to the dimensions of fictive kinship and advisor relationship that shaped the interview guide questions (Appendix F) created to probe departmental and advisor support in
participants’ doctoral experiences. The more holistic inference of students not just needing support, but needing care, I found intriguing. Tronto and Fisher (as cited in Tronto, 1993) defined caring at its most basic can be viewed as a species activity that includes everything that we do to maintain, continue, and repair our ‘world' so that we can live in it as well as possible. That world includes our bodies, our selves, and our environment, all of which we seek to interweave in a complex, life-sustaining web. (p.103)

None of the participants felt that they were supported, much less cared for, by their advisor or by their department. Given that each participant’s doctoral program culture perpetuated cultures of oppression, creating environments that relentlessly damaged their world rather than seeking to maintain or repair their world to allow them to thrive; rather, this feeling of an absence of care became an understandable outcome. In spite of such relentless damage, no participant indicated feeling their doctoral journey has, at the time of interviews, left them feeling like the cost of their doctoral journey (whether finished or unfinished) was too high; that is, none felt they have had a Pyrrhic victory.

Table 4.4 presents an excerpt from each participant’s response to the interview item that probed the dimensions of fictive kinship, including Pyrrhic victory. Participants’ responses indicated their doctoral journey did not provoke, at least at the time of the interview, dimensions of a Pyrrhic victory. Fordham (1988) argued that often minority students have to give up their racial identity, that is, become raceless to succeed in educational institutions. This loss of identity often produces a feeling of a Pyrrhic victory where the educational and career successes have come at the cost of a loss of fictive kinship from one’s racial community without gaining an alternative fictive kinship within primarily individuals in their academic or career institutions. For Avenus and Devina, once in their doctoral programs they chose not to relinquish their identities and
force an alternative fictive kinship within hegemonic cultures. Instead, they departed with
a stronger sense of their own identity and have found that the field of education allows
them to keep their identities and remain connected to their love of science.

Table 4.4

<table>
<thead>
<tr>
<th>Dimensions of kinship</th>
<th>Feelings associated with needing kinship</th>
<th>Representative Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peers of similar race or heritage</td>
<td>Absent or limited</td>
<td>Everybody was either from an Asian country. So, like Japan or China. Or they were white… (Avenus). So it was weird because everybody else was white or straight from China (Soraya). We did have more female students than I would have thought…. But it was mostly boys, mostly white. There was one African-American boy who was not there at the end of the first year. There were two Filipinos that were there (chuckles). That might be it (Devina).</td>
</tr>
<tr>
<td>Sense of belonging</td>
<td>Outsider</td>
<td>I've tried to return back to science but, like have found myself in different place that is more accepting of me as an individual, of me and my life (Avenus). But I definitely have to go out of my comfort zone to fit into what they wanted to do. It was never anything that I wanted to do. Not like me, sitting around drinking for hours at a time (Soraya). The people that seemed to get along best (chuckles) were the good old boys who liked to sit and drink with the guys. I am not a drinker, I have never been a drinker (Devina).</td>
</tr>
<tr>
<td>Pyrrhic victory</td>
<td>No regrets</td>
<td>Not just that, like, I really feel, part of it’s teaching, part of it’s the school I landed. I really feel like it’s where I’m supposed to be. I feel it’s …actually it’s the first time ever in terms of professionally (Devina).</td>
</tr>
<tr>
<td>Support</td>
<td>Absent, vital</td>
<td>It [being cared for] would’ve helped a lot. Because there’s only so much, feeling when you’re on your own, there’s only so much you can put up with before the mental beat down starts to take its toll (Devina).</td>
</tr>
</tbody>
</table>

Soraya, in contrast and with great sacrifice, was able to adapt to the hegemonic
culture of her department and form an alternative fictive kinship with people who she felt
no deep or real connection. While Soraya expressed in her reflection that she has been
compelled to adapt socioculturally so often, her conceptualization of her “true”
personality is nebulous, she ultimately has no regrets and strategically plans to continue
to benefit from her doctoral experience. Also, unlike Fordham’s (1988, 2010) prediction of stark isolation from the family and friends with shared cultural heritage, Soraya has consciously nurtured enduring bonds with her family and friends.

When these findings are interpolated with forms of capital, it becomes noteworthy that Soraya was the only participant who completed her STEM Ph.D. This is noteworthy because Soraya, who from an early age was cultivated as “the best of the best” and her parents eventually became economically prosperous while she was still young, would most likely have had the most opportunities to access cultural and academic capital from the earliest age based on having more access to economic capital derived from her family’s wealth earlier in her life in her formal educational compared to the other two participants.

Additionally, as shown in Table 4.5., coding patterns that aligned with forms of capital in the interview data of indicated that not only did Soraya’s counterstory have the most occurrences indicating the presence of economic capital, opportunities to accumulate cultural capital, and opportunities to form social networks, but her counterstory revealed that her pre-doctoral experiences were virtually free of oppression^24. Further, disaggregation of the dimensions of cultural capital revealed that not only did Soraya have the most opportunities to accumulate cultural capital in her pre-doctoral experiences (48 in total) compared to Devina (36 in total) and Avenus (22 in total), the context of the primary source her cultural capital was also different.

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^24 While her pre-doctoral experiences were virtually oppression free, there was an explosion of occurrences (with similar frequency seen in Avenus and Devina) with oppression once she entered her chemistry doctoral program.
Table 4.5

Thematic Categories Developed from Modified Analytic Induction

<table>
<thead>
<tr>
<th>Participant‡</th>
<th>Dimensions of Oppression</th>
<th>Dimensions of Capital</th>
<th>Dimensions of Kinship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avenus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-doc</td>
<td>10 9 5</td>
<td>2 3 12 5 2</td>
<td>11 3 4 8 3</td>
</tr>
<tr>
<td>Doc</td>
<td>10 10 11</td>
<td>1 4 0 5 1</td>
<td>6 2 1 2 15</td>
</tr>
<tr>
<td>Post-doc</td>
<td>4 2 1</td>
<td>1 1 8 1 1</td>
<td>0 0 5 2 0</td>
</tr>
<tr>
<td>Total</td>
<td>24 21 17</td>
<td>4 8 24 11 4</td>
<td>17 5 10 12 18</td>
</tr>
<tr>
<td>Soraya</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-doc</td>
<td>1 0 0</td>
<td>6 16 21 5 0</td>
<td>4 9 4 10 1</td>
</tr>
<tr>
<td>Doc</td>
<td>5 11 1</td>
<td>1 10 7 3 11</td>
<td>4 5 2 8 8</td>
</tr>
<tr>
<td>Post-doc</td>
<td>6 4 0</td>
<td>2 1 5 0 1</td>
<td>3 1 2 0 4</td>
</tr>
<tr>
<td>Total</td>
<td>12 15 1</td>
<td>9 27 32 8 12</td>
<td>11 15 8 18 13</td>
</tr>
<tr>
<td>Devina</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-doc</td>
<td>5 6 5</td>
<td>3 1 22 10 2</td>
<td>6 5 2 4 5</td>
</tr>
<tr>
<td>Doc</td>
<td>5 15 5</td>
<td>0 2 5 8 7</td>
<td>3 1 0 5 13</td>
</tr>
<tr>
<td>Post-doc</td>
<td>1 4 1</td>
<td>0 1 4 0 0</td>
<td>3 1 4 0 2</td>
</tr>
<tr>
<td>Total</td>
<td>11 25 11</td>
<td>3 4 31 18 7</td>
<td>12 7 6 9 20</td>
</tr>
</tbody>
</table>

† A = racism; B = sexism; C = classism; D = presence of economic; E = presence of positive social network; F = opportunities to accumulate cultural capital; G = opportunities to build scientific capital; H = activation of social/cultural capital; I = absence of peers; J = presence of peers; K = sense of belonging; L = support; M = feelings of isolation or outsider-within.
‡ pre-doc = time prior to entering STEM doctoral program including K-12, undergraduate, and master’s experiences; doc = time spent in STEM doctoral program; post-doc = time after departure or graduation from STEM doctoral program.

As shown in Table 4.6, Soraya’s primary source of opportunities to accumulate cultural in her pre-doctoral years was from her educational institutions, (which again were mostly free of oppressive acts), while Avenus and Devina had to navigate oppression early in their academic lives and mostly derived their capital from experiences gleaned from home or personal intuition.
Table 4.6

Context in and Timeline along Which Cultural Capital was Accumulated

<table>
<thead>
<tr>
<th>Participant</th>
<th>Undergraduate</th>
<th>Master's</th>
<th>Total</th>
<th>Representative Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Home</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avenus</td>
<td>4</td>
<td>2</td>
<td>N/A</td>
<td>6</td>
</tr>
<tr>
<td>Soraya</td>
<td>6</td>
<td>0</td>
<td>N/A</td>
<td>6</td>
</tr>
<tr>
<td>Devina</td>
<td>9</td>
<td>6</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td><strong>School</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avenus</td>
<td>0</td>
<td>6</td>
<td>N/A</td>
<td>6</td>
</tr>
<tr>
<td>Soraya</td>
<td>9</td>
<td>7</td>
<td>N/A</td>
<td>16</td>
</tr>
<tr>
<td>Devina</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>6</td>
</tr>
</tbody>
</table>

The context of where and how capital was accumulated (also known as the field of interaction) is important, since this context shapes what Bourdieu (1984) called an individual’s habitus. Habitus is “a system of lasting, transposable dispositions which… functions at every moment as a matrix of perceptions, appreciations, and actions” (Bourdieu, 1977, p.82-83, italics in original) and just as there exists variation with how common forms of oppression are manifested differently for different
individuals, there is variation in individuals’ ability to transposing or activating capital depending on the habitus from which the capital was accumulated.

Additionally, while Avenus and Devina needed to activate some of their cultural capital, mainly through finding and exploiting loopholes to access high quality experiences in their high school institution, Soraya never needed to engage in this subversion because of the absence of any form of oppression in her K-12 institutions. For these three participants, the amount of cultural capital correlated with their ability to persist in STEM doctoral programs. Additionally, participants’ ability to persist in STEM doctoral programs also related to the source and timing of that cultural capital.

The data indicates that an early start to accumulation of cultural capital that is then continued within high quality educational institutions are influential in whether or not students are able to appropriately pull from a reserve of cultural capital and activate the social capital needed to create the vital social networks required to overcome oppressive STEM cultures. This pattern was unanticipated because a substantial quantity of the existing literature (Antony, 2003; Barker, 2011; 2012; Gardner, 2007, 2010; Gildersleeve et al., 2011; Golde, 1998, 2005; Gonzalez, 2006; Holley & Gardner, 2012; Millet & Nettles, 2006; Sweitzer, 2009; Mwenda, 2010; Weidman et al., 2001; Zhao, Golde, & McCormick, 2005) on the doctoral journey, STEM or otherwise, primarily limit research questions and methodologies to experiences occurring during the years individuals spend in their doctoral program. This temporal limitation therefore limits researchers’ ability to extrapolate doctoral outcomes beyond the experiences students have during their doctoral years.
In contrast, Bourdieu’s (1977; 1984) framework of capital does account for why and how one’s formative educational experiences can heavily influence future academic achievement. While this connection between past educational experiences and future educational outcomes within the forms of capital framework was explored in Chapter II\textsuperscript{25}, the relationships emerging from the data demand that I revisit Bourdieu’s (1986/2008) “rules of the game” and also describe habitus and field of interaction, two dimensions of capital not previously discussed.

Lareau and Horvat (1999) used the analogy of a card game to explain the nuances of how the “rules of the game” (Bourdieu, 1986/2008) being played, an individual’s habitus, and an individual’s ability to activate previously accumulated capital, interact in a new field of interaction (i.e. a new card game):

In a card game (the field of interaction), the players (individuals) are all dealt cards (capital). However, each card and each hand have different values. Moreover, the value of each hand shifts according to the explicit rules of the game (the field of interaction) that is being played (as well as the way the game is being enacted). In other words, a good hand for blackjack maybe a less valuable hand for gin rummy. In addition to having a different set of cards (capital), each player relies on a different set of skills (habitus) to play the cards (activate the capital). By folding the hand, a player may not activate his or her capital only play the cards (at the capital) expertly according to the rules of the given game. In another game, the same player may be dealt the same hand, yet because of a lack of knowledge of the rules of the game play the hand poorly. Thus, in analyzing social settings, researchers must attend to the capital each individual in a given field has as well as each individual ability and skill in activating the capital. (p. 39)

In the context of the findings of this study, habitus would include the dispositions learned from home and from interactions in K-12, undergraduate, and master’s educational

\textsuperscript{25} This temporal connection underpinned the use of \textit{currere} (Pinar, 1975; Pinar & Grumet, 1976) to shape the interview guide. Complementary relationship between Bourdieu’s (1986/2008) forms of capital and the use of \textit{currere} to guide research methods is discussed further in Chapter V.
institutions, the field of interaction would be the STEM doctoral program. Activating capital includes building appropriate and large social networks in their STEM doctoral program, maintaining self-worth and self-efficacy despite oppression in their STEM doctoral program. So, while all three participants were playing the same game (STEM doctoral program) and were dealt similar cards (oppression\textsuperscript{26}), they all emerged from different habitus (pre-doctoral opportunities to accumulate various forms of capital) and resultantly they played the same game differently with different outcomes. That is, as shown in Table 4.7., because there was variation in habitus, there was variation in participants’ ability to activate the social and cultural capital needed to successfully navigate the oppression that confronted them in their STEM doctoral programs.

The interplay of time and economic capital (Bourdieu, 1986/2008) is central to accumulating cultural capital. Therefore, a combination of economic wealth derived from her parents\textsuperscript{27} and a supply of cultural capital built from privileged and virtually oppression free K-12 and undergraduate experiences may have given Soraya “maximum cultural capital…to satisfy the specifically cultural demands” (Bourdieu, 1986/2008, p. 284), of a chemistry doctoral program.

\textsuperscript{26} However, the primary type of oppression varied, for example, Avenus seemed similarly exposed to racism and sexism, while Soraya and Devina seemed to encounter more sexism related oppression. Further, as discussed in the counterstory narratives the nature of common sources of oppression varied and some participants had forms of oppression that were unique to their experience. For example, while Soraya’s encounter with sexism indicated no issues with her reproductive choices, Devina’s primary encounters with sexism focused on reproduction. So, each participant was playing the same game, but with different rules.

\textsuperscript{27} Family wealth being a “pre-condition for the initial accumulation” (Bourdieu, 1986/2008, p. 284) of cultural capital as it lengthens the time for a child’s acquisition of cultural capital. Additionally, for those that lack a prolonged acquisition time “can be evaluated as [having] a handicap to be made up” (Bourdieu, 1986/2008, p. 284).
Table 4.7

Occurrences in Participant’s Activation of Capital in Educational Institutions

<table>
<thead>
<tr>
<th>Participant</th>
<th>K-12</th>
<th>Undergraduate</th>
<th>Doctorate</th>
<th>Total</th>
<th>Representative Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avenus</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>…I make friends with the secretary at all times.</td>
</tr>
<tr>
<td>Soraya</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>11</td>
<td>You realize I’m good to be spending the next five or six years of these people so I at least wanted to have some sort of relationship with them....in order to, you know, succeed in my career.</td>
</tr>
<tr>
<td>Devina</td>
<td>2</td>
<td>0</td>
<td>7</td>
<td>9</td>
<td>The Filipino boy...he and I would go together and make an appearance and try and drink a soda and we would sneak out.</td>
</tr>
</tbody>
</table>

Additionally, she was the only one who was able to form an alternative fictive kinship (though she disliked the culture of the community in which she sought that kinship) and consequently built a diverse social network. Just as the other participants she experienced racism, sexism, and had an unproductive advisor relationship. However, in facing similarly toxic STEM doctoral experiences she was able to pull on well-established and diverse forms of capital, kinship, and privilege, i.e. habitus, which moderated the toxicity of that environment.

Summary

This chapter described experiences relevant to the educational outcomes of three underrepresented women of color who are former STEM doctoral students. These experiences are presented as counterstories to illuminate how oppression can heavily influence the academic and career outcomes of underrepresented people of color.
Additionally and secondary to this illumination, participants’ counterstories were used to challenge the White, middle-/upper-class, heteronormative male conceptualizations of the STEM experience. These counterstories also help us to contextualize how pre-doctoral opportunities to build capital indelibly influence STEM educational outcomes and subsequent career paths of individuals who are presented with persistent patterns of oppression within educational institutions, oppression that seems to amplify in STEM doctoral programs.

A poignant and unanimous outcome for these women is resignation to institutionalized oppression. They have all accepted that they never were completely “in-the-loop” academically, particularly during the STEM doctoral years. Their experiences with exclusionary environments left participants constantly seeking ways to subvert marginalization to find academic and career success in STEM. This relentless seeking has resulted in all three women, in varying degrees, now pursuing careers removed from the STEM field in which they pursued their doctorate.

The study indicates that manifestations of oppression such as sexual assaults, systematic sexist verbal harassment (perpetuated by both male and female faculty), isolation of students of color, tokenistic recruitment, religious intolerance, passive aggressive advisors occurring between the walls of STEM departments, are tolerated by the department leaders and by default encouraged. Additionally, this study indicates that bright students of color leave STEM not because they have not developed strong scientific identities from successful socialization experiences (Carlone & Johnson, 2007; Hurtado et al., 2009; The Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline et al., 2011) or inadequate financial
support and early access to STEM experiences (Augustine, 2005; Committee on Challenges in Chemistry Graduate Education et al., 2012), but from oppression in their daily social interactions with peers and faculty in their STEM departments.

Further, the findings of this study indicate that to independently and successfully rebuff oppressive encounters in STEM doctoral program, underrepresented students of color need to bring with them high quantities of economic, cultural, academic, and social capital consistently accumulated over their lifetime (that is, they need to have access to privilege comparative to their white peers) rather than from isolated opportunities of accumulation such as undergraduate research experiences and doctoral fellowships.

Finally, sharing their stories brought varying levels of introspection for participants. Whether it was the realization that time had helped filter out some of the horror and isolation of their doctoral experience or that sharing helped to affirm that that horror and isolation was not a singular experience, counterstory telling revealed how each participant has eventually found academic success, career success, inner peace, and empowerment that institutionalized oppression persistently thwarted.

Chapter V answers the research questions that framed the study and discusses recommendations for underrepresented students of color in STEM and STEM programs and policy.
CHAPTER V

CONCLUSION

Necesitamos teorías [we need theories] that will rewrite history using race, class, gender, and ethnicity as categories of analysis, theories that cross borders, that blur boundaries—new kinds of theories with new theorizing methods . . . We are articulating new positions in the “in-between,” Borderland worlds of ethnic communities and academies . . . social issues such as race, class, and sexual difference are intertwined with the narrative and poetic elements of a text, elements in which theory is embedded. In our mestizaje [miscegenation] theories we create new categories for those of us left out or pushed out of existing ones. Anzaldúa (1990, pp. xxv-xxvi)

This study used critical qualitative epistemology, with methods informed by currere and narrative analysis, to present counterstories that illuminate how racism, sexism, classism, and other forms of oppression are manifested in educational institutions and how these manifestations of oppression influence the educational experiences and outcomes for people of color. Further, in light of a national legacy of exploitation and oppression, people of color in U.S. society and the likely contemporary oppression people of color in STEM institutions, this study challenged the economic, military, and security justifications for increasing the participation of Blacks, Latinas/os, and American Natives in STEM. Given this legacy of exploitation and oppression, this study also challenged the value of social integration theories, which often make White, middle-class social and cultural values normative and assign intrinsic deficiencies to people of color in
relation to such norms, to solve the progressive and persistent underrepresentation of people of color in STEM.

Therefore, I framed the problem of inequitable representation of underrepresentation of people of color in the STEM doctorate as one of social justice rather than as a problem of economic and military dominance. In framing this problem as one of social justice, I proposed the alternative framework of forms of capital (Bourdieu, 1986/2008), critical race theory (Bell, 1995), and fictive kinship (Fordham, 1988) to explain how and why racial underrepresentation persists in the STEM doctorate. I start this chapter by answering the research questions used to guide this study. Next, I discuss the implications for research. I then consider the social integration theories that currently dominate explanations of why underrepresented students of color have high attrition rates from STEM doctoral programs in relation to the study’s findings. I also consider how a theoretical framework intertwining forms of capital (Bourdieu, 1986/2008), critical race theory (Bell, 1995), and fictive kinship (Fordham, 1988) can deepen our understanding of how and why underrepresented STEM doctoral students of color experience their STEM doctoral program. Finally, I discuss implications for STEM doctoral education and policy.

**Research Questions**

**How do selected underrepresented STEM doctoral students’ of color experience educational institutions?**

This study primarily used counterstorytelling to share the experiences of people who exist at the periphery of STEM institutions to build social, political, and cultural resistance against the exploitation and the oppression of underrepresentation people of
color to advance the economic and military interests of the U.S. government. Secondary to this primary use, the counterstories presented in this study were used as a tool to challenge majoritarian STEM stories, defined by racial privilege, which are perpetuated as universal truths. I strove for naturalistic generalizability (Stake & Trumbull, 1982) that builds intrapersonal and interpersonal connections between readers’ personal narratives and the counterstories of participants. In building such connections, I sought to convey to readers how the educational experiences, and particularly the doctoral experiences of women of color, are drastically shaped by a culture of oppression.

Each participant had several encounters with racism and sexism their STEM doctoral program. Racism was manifested primarily as tokenism, isolation, powerlessness, and stereotype threat. Sexism was manifested primarily as sexual harassment (directed mainly around reproductive and marital choices) and stereotype threat. There were also notable variations in the degree to which participants felt each of these two forms of oppression affected their lives.

For example, as shown in Table 4.5, while Avenus seemed to be nearly equally influenced by racism and sexism, Soraya’s and Devina’s doctoral experiences seemed predominantly influenced by sexism. Further, while Soraya perceived the effects of classism on the doctoral experiences of others. i.e. money matters, she seemed relatively insulated from the effects of classism, which was present in her doctoral experience. However, Avenus and Devina were not as insulated against classism’s effects as Soraya. Where Avenus navigated her doctoral experiences understanding that “there isn’t a time
when you can have everything, right?” and Devina’s was “never at peace” because of financial limitations. Furthermore, there were forms of oppression that were unique to participants.

Avenus, who grew up as a Catholic and converted to Islam just prior to entering her STEM doctoral program shortly after September 11th 2001, became a target for religious intolerance. Her religious choice had a striking effect on her relationship with her advisor, as her advisor seemed to welcome her into his research group initially, though it should be noted that this was offered prior to her donning the headscarf. While Devina, who is a practicing Episcopalian and identifies strongly with her Episcopalian roots, seemed to encounter no prejudice as a result of her religion throughout her educational experiences. Soraya gave no indication of religious influences on her academic experiences. However, Soraya was the only participant who reported doctoral experiences that included overt acts of violence. The perpetrators, one a White male staff member and the other an Asian, male peer, were not subjected to any punishment for their act of violence by her department’s leadership. This impunity for acts of violence left Soraya in disbelief and with feelings of anger and powerlessness.

Finally, the variations in the degree to which each participant was exposed to common forms of oppression, the influence of common forms of oppression on the educational experiences and outcomes of each participant, and exposure to unique forms of oppression indicate that oppression and its influences are idiosyncratic. While these idiosyncrasies were expected, I did not expect that racism, as contextualized by CRT, would not definitively be at the forefront of participants’ perceptions and reactions to
oppression in their STEM doctoral experiences. Rather, the findings of this study indicate that other forms of non-majoritarian identities need to be centered alongside racial classification.

Resultantly, as shown in Figure 4.1, the proposed alternative theoretical framework has been revised to include LatCrit discussed in Chapter III, which folds in virtually all possible forms of identities such as religion, language, and nationality, to undergird how CRT’s prediction and explanation of systemic and systematic oppression of non-majoritarian in U.S. institutions.

Figure 4.1. Revised theoretical framework. Proposed model of the theories of fictive kinship, and forms of capital are overlapped and centered with critical race theories, which includes CRT and LatCrit, as a framework to critically analyze racial inequality in STEM doctoral programs.
How do the educational experiences of selected underrepresented STEM doctoral students’ of color influence their ability to persist in their STEM field?

This study confirmed that the presence/absence of fictive kinship (or alternative fictive kinship) and the accumulation of various forms of capital by people of color are influential in students’ of color ability to persist in STEM doctoral programs. Soraya had the most instances of fictive kinships and alternative fictive kinships from elementary school to the doctorate. Her ability to consciously shape an alternative fictive kinship to create a diverse social network was instrumental in her rebuffing oppression and eventually enabling her to earn her doctorate. She also seemed to have the most access to economic capital as her parents gained economic prosperity while she was a young child. Further, Soraya had the greatest reserves of cultural capital resulting from high quality K-12 and undergraduate experiences that were virtually oppression free enabling her to activate the required social and cultural capital to respond to intense oppression in her chemistry doctoral program.

Avenus had the fewest opportunities to build fictive kinships. She moved several times as a child in a military family, and in every instance she felt that she was an outsider. This was a pattern that continued through her first two doctoral experiences, with the exception the time spent interacting with individuals in her McNair Program during her senior undergraduate year. Conversely, Avenus had the most direct access to cultural capital in her home life through her mother, who explicitly found ways to support Avenus’s academic goals. Further, since her family was unable to pay for her higher education, she was sharply aware of her economic disadvantage and strategically sought out opportunities such as scholarships and fellowships to support her academic goals.
Researchers and particularly policymakers imply that the problem of racial underrepresentation in the STEM doctorate can be solved primarily by generous financial support to students through fellowships (Committee on Prospering in the Global Economy of the 21st Century et al., 2007; The Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline et al., 2011). I agree that financial support is a piece of the retention puzzle, because as Soraya stated, “your family cannot be dependent on you for money. Because if you need money, then you can’t really sit there and say, “Hey, I’m going to go to school for six years and make peanuts.” However, as Avenus demonstrated, self-preservation of identity was worth significantly more than generous funding, which obligated her to continually function in an environment that never affirmed her experiences and therefore her identities.

Devina’s possession and use of fictive kinship and forms of capital diverged from Avenus’s and Soraya’s, because she seemed to build fictive kinships and accumulate capital independent of guidance from her home life or her school culture. Devina felt like an outsider in her elementary and middle private schools because, while her mother was able to give her a relatively comfortable life, her mother did not have the wealth of the families of Devina’s school peers. Despite divisions of class, Devina managed to make some lifelong friendships with peers at her Catholic middle school. She also seemed to have created an alternative fictive kinship with her undergraduate sorority sisters and then with the professors in her master’s degree program. However, her opportunities for fictive kinships became limited in her doctoral program. Devina appeared to intuitively build cultural capital from elementary school through her master’s experience. She activated this capital during her isolation in her doctoral program allowing her to persist.
for six years in the program, but she became overwhelmed by the rules of the game and she eventually departed without her doctoral degree.

All three participants found the culture of their doctoral program unappealing for similar reasons, including having no peers or faculty who shared their cultural heritage, and persistent encounters with oppression because of that heritage. Soraya, who was the only participant that formed (out of necessity rather than an authentic sense of belonging) an alternative fictive kinship and affected social integration into a culture of oppression, was also the only participant to earn a STEM doctorate. However, ultimately faced with continued encounters with oppression as a chemistry faculty member, Soraya is no longer pursuing a career in chemistry.

**Implications for Research**

Given that socialization into one’s discipline and department is fundamental to the doctoral process, understanding socialization’s role in the contemporary STEM doctoral experience remains important in STEM education research. Researchers interested in how socialization influences students’ doctoral experiences, including underrepresented students of color in STEM, often focus on the role of advisor relationship (Lovitts, 2001; Zhao et al., 2005) and mentorship\(^\text{28}\) (Leggon, 2010; Millet & Nettles, 2006). It is commonly accepted among researchers that successful socialization, which often takes the form of mentorship, requires that either the student adopt the normative expectations of their discipline or learn to navigate the discipline’s norms without co-opting their own values (Antony, 2003).

\(^{28}\)Mentors, unlike advisors, cannot be assigned to specific students. Advisors may be mentors, but many advisor-advisee relationships never evolve to the mentor-protégé relationship. (Willie et al., 1991, p. 72)
However, as presented in Chapter IV, the participants in this study found the norms of their department and discipline laced with prejudice against their identities. Resultantly, none of them ultimately chose to continue to practice science within their chosen field, fields they were scientifically competent in and passionate about. All participants cited a culture, both at departmental and interpersonal levels, that continually undermined their identities and career goal, playing a major role in their decision to leave their field of study. Therefore, continuing to promote social integration without genuine attempts to address the oppression underrepresented students of color face in their STEM doctoral programs will fail to address a core part of why these students ultimately, whether early in their doctoral journey or after they have earned the doctorate, chose to leave their STEM field.

There have been approaches suggested for socializing students into their STEM doctoral programs that recognize the role race and gender (as opposed to racism and sexism) play in students’ leaving. Two of these strategies include focusing on destigmatizing race for STEM underrepresented students of color through authentic apprenticeships in advisor/advisee or mentor/mentee pairings (Hurtado et al., 2009) or helping these students to develop stable and confident scientific identities (Carlone & Johnson, 2007). In these two strategies, as in many others, the strategies for success often lie in developing students’ identities by building their self-efficacy, or their cultural capital.

While the findings of this study support students’ development of cultural capital in relation to their academic identities, the findings do not support tasking students with accumulating enough cultural capital to survive adoption of beliefs and behaviors that
undermine their identities or learning to cope with being “outsiders-within” the academy (Collins, 2000, p. 12). From a critical perspective, the solution to the underrepresentation of Blacks, Latinas/os, and American Natives in STEM is not to integrate them into a system that oppresses them, but rather to change the system (Freire 1970/2012).

While strategically creating STEM experiences that build students’ cultural capital can be a useful part of the solution, it cannot be the sole or primary strategy for the long-term academic and/or career success of underrepresented students of color in STEM. Further, as this study found, learning to cope with an oppressive environment is not only unhelpful for the wellbeing of individuals’ lives, but in many ways it is harmful. The racial inequality in the STEM doctorate is therefore not a problem that can be conceptualized independent of the harmful influences of oppression on underrepresented students of colors’ lives, harm to which underrepresented students of color are uniquely subjected (Barker, 2011). Further, oppression, and by extension the solution to oppression, remains relatively trivial without considering the long-term and holistic wellbeing (Delgado & Stefancic, 2012) of underrepresented students of color.

Further, research that is premised on increasing racial diversity for the economic wellbeing of the nation rather than the wellbeing of the Black, Latina/a, and American Native students devalues and demoralizes the very individuals they seek to recruit and retain. It is common to find terms normally associated with economic trade of goods to describe the underrepresentation of Black, Latina/o, and American Native students in STEM. For example, well recognized researchers use terms such as “supply,” “scarcity” (Millet & Nettles, 2006 p. 282), “critical to the nation’s interest (Hurtado et al., 2009), and important to “ the country’s scientific ambitions and economic security” (Holley &
Gardner, 2012), to frame the problem and purpose of their studies into the underrepresentation of Black, Latina/o, and American Native students in STEM.

Many researchers, I think, fail to understand the moral ramifications of their choice to frame their research problem and purpose in terms of the economic security of a nation dominated by White men of European descent when referring to individuals who carry with them the bone memory29 (Fordham, 2010) of slavery (Bell, 1988), colonialism (Zavala, 1992), and genocide (Porter, 1999) inflicted by White men of European descent on their ancestors for their economic prosperity.

So, when we use social integration theories, the question tends to focus on how it is possible to facilitate Blacks’, Latinas/os’, and American Natives’ integration into the culture of their departments and disciplines for the purpose of securing the nation’s economic security. However, if we take up Gloria Anzaldúa’s (1990) challenge, stated in this chapter’s epigraph, to intertwine narrative with new theories and open up unexplored spaces, we begin to ask different questions. Instead, we begin to ask questions that are defined by the purpose to understand why and how people of color in STEM are continually being relegated to “outsiders-within” (Collins, 2000, p. 12).

**A Critical Framework for Promoting Racial Diversity**

Researchers who centralize social integration theories as a theoretical framework for understanding the doctoral experience of underrepresented students emphasize the symptoms of racism and other forms of oppression rather the oppression itself. Centralization of such theories presumes that it is primarily the student’s role, with the support of their advisor or mentor, to adopt or navigate the oppressive culture of their

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29 An individual’s ability to embody the pain of their ancestors (Fordham, 2010).
department and discipline. However, using a framework that examines the problem of underrepresentation of Blacks, Latinas/os, and American Natives in STEM through the frameworks of capital, fictive kinship, critical race methodology guides researchers to change the purpose for their research and how their research problems are chosen and explored.

This change arises because capital, fictive kinship, critical race methodology are crucial and complementary lenses for understanding the STEM doctoral experience. These lenses are crucial, because each reveals a unique perspective of why, how, and what type of social conventions and cultural attributes are valued in Western institutions of power and institutions of education. More importantly, these lenses connect these valued social conventions and cultural attributes explicitly and with various forms of oppression; connections absent from social integration theories most commonly used. Further, these lenses are complementary to each other, because each adds a depth of understanding of why and how socialization functions within institutions of power and institutions of education that the other lacks. The unique and complementary contribution of each theory is discussed below.

The framework of capital foregrounds how “the immanent structure of the social world” distributes “the set of constraints, inscribed in the very reality of that world, which govern its functioning in a durable way, determining the chances of success” for those who live in the world (Bourdieu, 1986/2008, p. 280). While Bourdieu outlined social capital in his theory, he also intricately described how cultural capital (or self-efficacy and self-worth) is inextricable with the constraints of the social structure. He further linked social and cultural capital with economic capital where economic capital, which
people of color in the U.S. have had lawfully granted denial to (Heller, 2010), facilitates an individual’s access to all other forms of capital.

Bourdieu’s (1986/2008) intricate web detailing how social, cultural, and economic capital play off of each other makes this theory crucial to understanding the experiences of underrepresented people of color in STEM. The findings of this study indicate, as have other studies (Mohanty, 2003) that identities such as race, gender, class, sexuality, and other constructs of identity are neither additive nor linear; therefore, we cannot assume common identities and subsequently common forms of oppression experienced by one individual, male or female, will influence other individuals of color in STEM similarly. Currently, social integration theories can tell us what is necessary for success, that is social integration and a strong sense of scientific identity, but it cannot fully explain why and how these attributes connect both in micro-social contexts such as advisor/advisee relationships or on a macro-social contexts such as in STEM departments, the STEM discipline, and academia in general. What Bourdieu’s intricate web uniquely offers is insight into how and why intersecting identities are neither additive nor linear and therefore how and why we can never assume common identities equate to similar reactions to similar forms of oppression.

Further, embedding the sensibility of currere (Pinar, 2012) into data collection instruments provided an important tool for tracing when students began accumulating cultural capital that would be necessary to navigate the oppression in their STEM doctoral journey. Additionally, embedding the sensibility of currere allowed contextualization of how and why participants were able or unable to accumulate the necessary cultural capital. The important role of this contextualized timeline becomes
clear when we juxtapose Soraya’s counterstory and her subsequent accumulation of
enough cultural capital to rebuff oppression with Avenus’s and Devina’s counterstories
and accumulation of cultural capital. Bourdieu’s (1986/2008) framework of capital was
made more powerful by incorporating a temporal academic autobiographical data
collection method shaped by currere. However, the inclusion of participants’ experiential
knowledge of both academia and oppression via autobiography would have been unlikely
without the inclusion of critical race theories in the study’s theoretical framework.

Critical race theories and methods also complement the framework of capital by
bringing a historical and legal perspective in why and how people who are not White,
middle/upper-class, and heteronormative males are subjected to the constraints of
oppression. This is a perspective Bourdieu’s (1986/2008, 1991) capital does not offer,
because while it is situated within Western and capitalistic contexts, it does not bring to
bear the history of oppression unique to the U.S. experience. Critical race methodology
contextualizes the oppression that often ascribes “ethnic” people to be outsiders-within
U.S. institutions of power and institutions of education. Therefore, unlike Bourdieu’s
notion of capital, critical race methodology forefronts the social construction of race and
how it is used, revised, and retired to economically benefit the White elite (Delgado &
Stefancic, 2012) rather than the social structure itself.
Critical race theory, situated with critical race methodology, helps to define how oppression in the U.S. is legally and historically unique in shaping the Black experience, which has contributed to shaping other ethnic populations’ experience in the U.S., with the following question:

And what makes you think that the Constitutions Framers who saw us as slaves, and use that lowly status to convince themselves that we were an inferior race, would have been more likely to recognize our humanity than are the country’ contemporary leaders, having every reason to know that we are not inferior, seem determined to maintain racial dominance even if that even destroys us and the country? (Bell, 1987, p. 49-50)

This historical and legal perspective also make critical race methodology unique in this intertwining framework. In framing what Bourdieu (1986/2008) called “constraints” by U.S. history, law, and thereby political stance on “ethnic” people, critical race methodology forces the researcher to adopt epistemologies and methods that challenge traditional positivistic research paradigms (Solórzano & Yosso, 2002). In challenging traditional research paradigms, critical race methodology also compels the researcher to regard the wellbeing of people of color and the collective memory of the communities in which they received their induction into the social structure of the world (Solórzano & Yosso, 2002). Critical race methodology offers a way to peel away Eurocentric and seemingly “objective” versions of U.S. history to reveal the socially constructed racial dominance (Banks, 1993); that is, it reveals oppression in all of its manifestations within the U.S.

In this study, critical race methodology gave me a scholarly and moralistic rationale to value the ways of knowing and being in the world of the individuals that are excluded by the gatekeepers and refute the overwhelming use of social integration theories that instead validate White, middle/upper-class, and heteronormative
gatekeepers. Further, critical race methodology enabled me to propose solutions that advocate for and potentially liberate the study’s participants and myself and for us to transform the lives of others; a proposition that traditional positivistic research paradigms would exclude. Fictive kinship complements forms of capital and critical race methodology by narrowing down specifically into an educational context to understand how the role of race plays in informing people of colors’ choice to make the social connections that will allow them to succeed in school, but likely produce conflict within their family and community.

Fordham (1988) explained that students of color have “to "choose" between the individualistic ethos of the school, which generally reflects the ethos of the dominant society, and the collective ethos of their community” (p. 54). Of course, as critical race theory explains (Bell, 1995), the dominant society in U.S. is fundamentally a racial dominance of Whites over Blacks. This racial dominance also extends to Latina/o and American Native students (Marable, 1992; Solórzano & Yosso, 2002). In this study, fictive kinship was useful in explaining, in part, why Avenus, Soraya, and Devina all had an identity crisis in their first one to two years of their STEM doctoral programs. They each gave a variation of the following statement: there was nobody who looked like me or had similar experiences. For Soraya (who is so deft at adapting to her behavior to fit in she is still not sure what her real personality is) and Devina (who resisted adapting) that identity crisis never fully resolved throughout the six years they both spent in their respective doctoral program. Of course, capital was useful in explicating why Soraya earned her doctorate and Devina did not. Additionally, critical race methodology was
useful in explaining why, to begin with, there was nobody who looked like them or had shared their lived experiences.

Capital, fictive kinship, and critical race theories intertwined into one framework opens new spaces for exploring how and why underrepresented students of color face challenges their white and Asian peers do not. Thus, collectively they also open new spaces to explore how these challenging experiences lead to underrepresented students of color lower rates of pursuing a STEM doctorate and higher rates of leaving their STEM doctoral programs. Each theory addresses the inherently social process of the doctoral process, as well as describes how and why some successfully navigate socialization while others struggle. Collectively, they offer researchers, as well as their participants, the opportunity to be decolonized of dominant ways of knowing. So, decolonization moves researchers away from asking what strategies can be used to socially integrate students into the existing sociocultural structure of STEM disciplines. Rather, they become empowered to instead begin to ask how we can transform the current structure into one in which all individuals within the structure thrive.

Finally, in placing value on individuals’ common humanity rather than the nation’s economic well-being, this framework opens space for research methodology that gets at how the structure dominates students’ lives, rather than how students can adapt to the domination of the system. Although statistics has its place in identifying where problems exist, qualitative and critical methods such as semi-structured and open-ended interviews and autobiographies recordings (written, oral, visual, etc.), which facilitate counterstorytelling, can help researchers map the conventions and human cost of the sociocultural structures in STEM dominate various students’ lives. Such methods of
mapping can provide a more vivid and in-depth understanding of underrepresentation in STEM than statistical analyses and surveys.

**Recommendations for Future Research**

The findings of this study support MacLachlan’s (2006) argument that in trying to reshape the discourse and logic behind diversity in academia, one size does not fit all. The counterstories presented in this study illuminate the intricate and deeply human nature of a problem that too often STEM education researchers sterilize. While racism is at the forefront of the experiences of some people of color, this study, like others, revealed the constructs of sex and class intersect to shape their educational outcomes. This study also found factors that can influence the lives of individuals in STEM that is worth further exploration.

**Retesting**

This study tested the preconceived hypothesis that capital, fictive kinship, and critical race methodology are more appropriate theories than social integration theories for explaining how and why underrepresented students of color have lower enrollment rates in STEM doctoral programs and higher attrition rates than their white and Asian peers. While the results of this study supported the preconceived hypothesis stated above, the relatively small sample size urges retesting of the hypothesis. The study’s methodology will continue to confine the sample population to relatively small sizes.

However, each replication will have individuals that have common identities, that is, underrepresented students of color who are currently or were formerly in a STEM doctoral program. The assumption that oppression will be part of their doctoral experience is expected to hold given this study’s findings and racism’s systemic and
systematic presence in U.S. society and institutions of power. However, how that oppression is manifested and how they influence STEM educational experiences and outcomes remain idiosyncratic and mostly unexplored. In particular, given that the most successful group of underrepresented students of color in the STEM doctorate earned their undergraduate degree at an HBCU (NSF & NCES, 2013), a replication of this study with underrepresented students of color who are currently or were formerly in a STEM doctoral program and who graduated from an HBCU has the potential to document how an HBCU experience allows these students to apparently have meaningfully divergent educational outcomes from students of color who received their undergraduate at a primarily white institution. Therefore, replications of this study can detail commonalities and idiosyncrasies within an intricate theoretical framework and give the research community, educators, and policymakers new perspectives on understanding and solving a little understood problem (The Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline et al., 2011).

Furthermore, in using modified analytic induction (Bogdan & Biklen, 1992), this study also left the potential to discover new concepts and hypotheses unaccounted for in the original hypothesis and that potential was realized. The concept of being cared for in the STEM doctoral process emerged, and care theory may bring an additional layer of understanding to the problem stated in this study.

**Care Theory and the STEM Doctorate**

An unexpected concept that emerged from this study was that none of participants felt cared for by their STEM doctoral advisors or by their STEM departments. This concept emerged after my first interview with Avenus. This absence of care was
explicitly expressed when each participant was asked if they felt emotionally supported by their advisors and how, overall, their department supported them. However, it was also implicitly stated in a recurring tone in the voices of all participants as they moved away from talking about their pre-doctoral experiences and began to talk about their doctoral experiences. Their tone, moving through cycles of anger, frustration, disbelief, and sadness, made the absence of care not only notable, but also palpable.

Another aspect of care in these stories was care within families, with participants having to care for family and/or being cared for by their family. Therefore, framing this research problem within care theory would reveal another layer of how of the underrepresentation of Blacks, Latinas/os, and American Natives experience the dominating structure of their STEM doctoral programs. Care theory asserts that:

Caring practices are essential for the survival, development, and social functioning human beings, but until recently have generally been overlooked as a moral grounding for theory of justice…. Because human beings universally depend upon one another for care, we all have more obligations to care for others in need. While we can fulfill some of our obligations to others to personal caring relationships, we can fulfill many others only through collective caring institutions and policies. Our moral obligations to care for others thus generate collective responsibilities to organize our political, economic, international, and cultural institutions at least in part to support caring practices and care for the individuals in need. (Engster, 2007, p. 1-2)

This study was motivated, in part, by a need for social justice within STEM. Care theory places justice at its core via caring for others through personal relationships, institutions, and policy. Therefore, the core purpose of care theory aligns well with the goal of beginning to find social justice for underrepresented people in STEM, but also makes care and love its foundation. This study used oppression and social justice as part of the foundation of its arguments for moving the research community forward, but the use of care and love holds the potential for an intriguing theoretical perspective for justice in
diversifying the STEM doctorate. The possibilities are intriguing because care theory, within the context of education, proposes “the main aim of education should be to produce competent, caring, loving, and lovable people” (Noddings, 1992, p.174) and this proposition is in tension with the dominating culture of STEM gatekeepers.

Furthermore, the absence of obvious and comfortable fictive and alternative fictive kinships coupled with the absence of feeling cared for led to a concept that was not considered prior to data analysis. Emerging from the possibility of theoretically framing this study’s problem with care theory presented two research questions:

• How do White and Asian doctoral students experience fictive kinships in their STEM doctoral program?

• How do White and Asian doctoral students perceive the role of being cared for and caring for others in their STEM doctoral program?

In addition to the concept of care theory emerging from the data, the concept of how men of color experience their doctoral program became a blind spot because, though not intentional, all participants in this study were female.

Men of Color in the STEM Doctorate

Men of color are the least successful of all demographic groups in STEM doctoral programs\(^3\), as women of color (although both genders are still severely underrepresented) have consistently earned more degrees in STEM than men of color each year in the last decade at every degree level (NSF & NCES, 2013). While there is a limited body of research on the experiences of women of color in STEM, studies of the experience of men of color in STEM doctorates is virtually non-existent, as men of color approach near invisibility in STEM programs (Washington, 2011). Therefore,

\(^{30}\) As they are for every facet of educational achievement in the U.S. educational system (NCES, 2013).
understanding why and how men of color experience oppression in the STEM doctorate and the subsequent ramifications is a crucial addition, and possibly a more urgent addition than experiences of women of color, to the plurality of perspectives required to understand and solve the problem of underrepresented people of color in STEM.

**Recommendations for Underrepresented Students in a STEM Doctorate**

Underrepresented students of color should expect to experience oppression in their STEM doctoral programs. However, this study indicates that underrepresented students of color are most likely oblivious to potential for this oppression to be present prior to entering their program, much less being prepared for that oppression’s potential to relentlessly threaten to overwhelm their social and cultural capital from their first day to their dissertation defense. As discussed in Chapter II, it is unlikely change will come from the gatekeepers of STEM without external pressure from leaders who are insightful and powerful enough to effect a paradigm change within the community. Given the social justice underpinnings of this study, this episodic change is the ideal and long-term solution I am working towards.

However, given that racism and other forms of oppression remain ingrained in U.S. institutions of power, episodic change is unlikely to occur in the near future. Despite institutionalized oppression, students can work toward continuous change within their departments. Continuous change has the most potential to be successful at breaking down institutional culture when those who are trying to effect change can deconstruct the institutions codes and expectations (Weick & Quinn, 1999). Freire (1970/2012) argued that the “pedagogy of the oppressed is the pedagogy of people engaged in the fight for their own liberation” (p. 53) and that liberation is acquired by “conquest, not by gift”
Therefore, while underrepresented students of color in STEM need to be armed with robust conceptual scientific knowledge and laboratory skills they also need to be enabled with enough autonomy and responsibility to “struggle for their own redemption” (Freire, 1970/2012, p. 54).

To be enabled with the autonomy and responsibility to have the right to freely pursue their career in STEM, underrepresented students of color need to ensure they have accessed as much knowledge about how knowledge is shaped by social interactions in scientific communities and the nature of oppression prior to beginning the doctorate. Underrepresented students of color, like this study’s participants, may be less blindsided by the hegemonic culture of their doctoral programs if they have a better understanding of the sociocultural dimensions of science. To understand the social factors that influence how scientific communities negotiate scientific fact, especially as outsiders-within, students’ need to access information that makes explicit the inherently social nature of scientific communities (Brown, 2001; Latour & Woolgar, 1986). How and why science is done and who eventually gets to do science is defined by “the values and assumptions inherent to the development of scientific knowledge” (Lederman & Zeidler, 1987 as cited in Lederman, 1992). These values and assumptions are socially negotiated (Harding, 2008) and making the social nature of scientific communities explicit, also makes explicit that the creation of scientific knowledge is a social construction (Ravetz, 1979) and therefore neither objective nor value-free (Leggon & Malcom, 1994; Leggon & Pearson, 1995).

However, whether students are ever explicitly exposed to how scientific knowledge is socially negotiated is dependent on their teachers (Lederman, 2010).
Further, this exposure is unlikely, as many teachers do not explicitly bring the sociocultural dimensions of science in their classroom because they cannot teach what they themselves have not been taught and therefore do not understand (Lederman, 1992).

In addition, because knowledge is shaped by race, gender, and class (Collins, 2004), and knowledge in STEM has been shaped by White elite men, the implicit codes that shape the sociocultural aspects of science will likely be more intangible to underrepresented students of color than their white peers because of their outsider-within status. Therefore, if underrepresented students of color seeking a STEM doctorate have not had been explicitly educated on the sociocultural dimensions of science, they need to seek out this knowledge independently. This may mean that they seek out undergraduate classes and/or independently read texts that are not obvious choices given their STEM major.

Opportunities to take a class that will philosophically examine science in relation to knowledge construction and society are most likely available in education and sociology departments. There are also texts that make the social formation of scientific knowledge explicit and accessible. *The Structure of Scientific Revolutions* (Kuhn, 2012) has been particularly successful in making the social construction of scientific fact and theory explicit. Reading of Kuhn’s groundbreaking work transformed my image of science and the 72,429 citations of this text identified by Google Scholar on June 27, 2014 indicates that this text has been similarly powerful in transforming the image of science for many other readers and compels me to echo the assertion that “Thomas Kuhn was out to change our understanding of the sciences--that is, of the activities that have enabled our species for better or worse, to dominate the planet. He succeeded.” (Hacking, in Kuhn, 2012, p. vii). However, for underrepresented students of color in STEM the
transformation of the image of science that Kuhn’s (2012) work provokes is not as meaningful without access to knowledge that contextualizes the social construction of scientific knowledge within a framework of oppression.

Therefore, access to groundbreaking sources of knowledge that discuss what oppression means on individual and systematic levels becomes crucial. Freire’s (1970/2012) *Pedagogy of the Oppressed* and Patricia Hill Collin’s (2004) *Black Feminist Thought: Knowledge, Consciousness, and the Politics of Empowerment* in conjunction with conversations with those who have and are willing to share their experiential knowledge on oppression (Harding, 2014) can become crucial avenues to unbind underrepresented students of color from the role of the oppressed. Being unbound from the role of the oppressed is vital to underrepresented students of color well-being and their ability to initiate and sustain continuous change in their STEM department’s culture.

**Recommendations for Programs and Policy**

Studies that have disaggregated data (Leggon, 2010; Nettles & Millet, 2006; NSF & NCES, 2013; Zhao et al., 2005) reveal that outcomes for underrepresented students of color vary at the discipline and institutional levels. Therefore, just as oppression’s manifestation and influence is idiosyncratic at an individual level, policies and practices to increase the number of Black, Latina/o, and American Native students in STEM need to be idiosyncratic based on the specific STEM discipline (Nettles & Millet, 2006; Zhao et al., 2005), and the culture of the institution in which departments are housed. That is, what policies and practices work for an institution are not necessarily transferable to other institutions or even transferable from one department to another at the same institution if the disciplines are different. This lack of transferability makes it imperative
for institutions, programs, and policymakers to be able to discern what would be the most
effective policies and practices based on the culture of individual departments (Leggon,
2010). This discernment can only be derived from a dynamic system of program
evaluation research and these program evaluations must be tied to research funding.

According to Leggon (2010) racially diversifying the STEM doctorate requires (a)
finding targeted policies and practices that are based on empirical evidence (both
qualitative and quantitative), (b) the rigorous implement of STEM programs with
empirically based policies and practices, and (c) continual evaluation of STEM program
policies. However, forms of capital (Bourdieu, 1986/2008) and CRT (Bell, 1987; 1992;
1995) that theoretically framed this study would predict that the exertion of significant
economic pressure on the gatekeepers of the STEM doctorate would also be needed for
such racially diversifying strategies to be systematically, systematically, and nationally
implemented and thereby affect large scale episodic change. Economic pressure on the
gatekeepers of STEM is expected to be a necessary component for national and episodic
change because universities are increasingly capitalistic enterprises rather than
institutions of education (Noble, 2001), all exchanges in capitalistic economies are
oriented toward maximization of profit (Bourdieu (1986/2008), and social thought on
race are created, altered, or retired when economically convenient and advantageous to
the power elite (Bell, 1995; Delgado & Stefancic, 2012).

One expedient path to implement such capitalistic based episodic change might
include large funding organizations such as the National Institutes of Health and the NSF,
obligating STEM departments to evaluate their policies and practices\textsuperscript{31} related to racial, gender, and religious\textsuperscript{32} equity if faculty from that department wish to submit grant proposals. Thus, faculty within STEM departments who fail to adequately diversify should be put at risk of losing the privilege to submit grant proposals to government funding organizations. Further, this obligation for programs to work toward equity would likely create a cycle of feedback since external pressure from funding organizations to meet all criteria required for submitting grant proposals will serve as fuel for increasing primary research studies on oppression in STEM organizations’ culture (Leggon, 2010). Such a widespread and iterative process holds the potential to create, over time, a comprehensive database of what works and what does not from which STEM department leaders can make informed decisions about their organizational culture.

Finally, given that the recommendations made above would jeopardize the monopolizing power and privilege of the current gatekeepers of STEM, many of whom are among the white elite, CRT (Bell, 1987, 1988, 1989, 1992, 1995) would also indicate that the implementation of such strategies might take many years to come to fruition, if ever. However, university leaders and leaders within STEM departments who wish to change a culture of oppression for ethical rather than economic reasons (or perhaps both) can take steps to implement alternative plans that would obligate their faculty to at least suppress and at best abandon oppressive practices. College deans and department chairs can initiate evaluation of their STEM programs to find and institutionalize targeted

\textsuperscript{31} The Equity Scorecard (Harris & Benison, 2007) is one such nationally recognized evaluative and responsive action process.

\textsuperscript{32} These were the primary classifications of identities that gave rise to participants’ encounters with oppression in this study. However, other identity classifications that are sources of oppression should be included, for example, sexuality and physical ability.
policies and practices that would put their organization on a path towards elimination of cultures of oppression.

Further, as the findings of this study indicated, the faculty members who practice oppression often have widely known reputations for such practices within their department. In other words, other faculty and the administration alike tolerate their oppressive actions. However, people who engage in oppressive practices are not locked into their socially transmitted background (Polkinghorne, 2004) and can change how they view their role in educating students (Bensimon & Harris, 2012). Projects such as *Equity for All: Institutional Responsibility for Student Success* use sociocultural critical race theories to engage faculty in long term interventions through extended research-based reflective inquiry and have had success in the changing beliefs and behavior of individuals and teams (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003).

STEM institutions have pathways to institutionalizing equitable cultures; they just have to have the impetus to take action. So, while undoubtedly tenure and the economic impact faculty members’ research should have roles in their value to their departments, departments can also assign similar weight in determining faculty members’ value based on their ability to respect and nurture diversity, in all its forms, within their research group. Additionally, the findings of this study indicate storytelling may offer faculty and students more interpersonal paths to fostering mutual respect and identifying their common humanity.

In asking others to share their stories, we not only build bridges to help us see their humanity (Delgado & Stefancic, 2012), we also give them a gift (Harding, 2014). For Avenus, telling her story resulted in validation of her experiences. This validation
reinforced her empowerment to share her struggles with oppression in educational institutions in a storytelling project within the organization in which she works. For Soraya, telling her story inspired gratitude for her parents’ support of her academic interests, support she previously took for granted. In a conversation during the member checking process, Soraya also indicated that telling and then reading her story alongside the other stories in this study also inspired her to have a conversation with her parents to express this gratitude.

Such life affirming results align with the personal transformations expected of a critical qualitative research study where, in part, such a study includes the objective to free researchers and participants from the constraints of social, cultural, and psychological assumptions facilitating empowerment to change their social context and themselves (Merriam, 2002). Additionally, this study has brought the realization that in asking others to share their stories with us they also give us a gift. In listening to the stories of the three selected participants, my own experiences were affirmed and in that affirmation I found empowerment.

Through their stories and this doctoral journey, I feel the real possibility of exiting the role of the oppressed and becoming a being for myself (Freire, 1970/2012). Similar life affirming and life transforming experiences have been documented in other studies using storytelling (Anderson & Goolishian, 1992; Dean, 1995; Jones, 2004) and counterstorytelling (Barton & O’Neil, 2008; Faircloth, 2009; Stinson, 2008; Williams, 2004); such experiences cannot be understood outside of the storied lives we live and the telling and retelling of our stories (Jarvinen, 2004; Paulus, Woodside, & Ziegler, 2007). However, despite such transformative potential, few higher education learning
environments allow students and faculty to exchange stories and to collaborate to make sense of them (Paulus et al., 2007).

It is feasible to create such a space for storytelling in STEM doctoral programs by designing a required doctoral seminar for first year students, or embedding storytelling into an already required seminar, where invited faculty not only share their research, but where faculty also have authentic conversations about their academic journey with students. Whether the use of storytelling will result in increase retention and eventual academic success of underrepresented students of color in STEM is beyond the scope of this study’s findings. However, for students who will likely be severely isolated in their doctoral programs because of their underrepresentation, like the participants in this study and myself, telling their stories may be the life affirming and transforming gift their departments can offer and in turn receive.

Summary

In conclusion, the use of critical methodologies, such as those advanced by CRT and LatCrit, shifts our understanding of underrepresented students’ of color science doctoral attrition from a problem primarily of social integration and economics to one of oppression and social justice. As we move through the counterstories of Avenus, Soraya, and Devina, it is revealed that institutionalized oppression contributed to scientifically promising women from their scientific field because of faith, skin color, and gender among other minoritized identities. Knowledge of such oppressive behaviors and their consequences on academic and career choices of people of color can lead researchers to make more informed theoretical and method choices in identifying research problems, forming research questions, and choosing data collection and analytical tools when
exploring the problem of underrepresented students’ of color higher rates of attrition, compared to their white and Asian peers, from science doctoral programs.

Such methodological paradigmatic shifts can change how and why science education research and also shift both who does research and ultimately whose knowledge counts (Harding, 1991). Since "science and science education are cultural enterprises which form a part of the wider cultural matrix of society" (Maddock, 1981, p. 10), limiting who gets to do science based on their socioculturally bound identities has discriminatorily limited science research to a narrow demographic subset of individuals. Such narrow demographic limitations have also narrowly limited scientific knowledge production because the societally based problems science research addresses, the purpose of scientific research, and subsequent technological innovations have been constrained by the beliefs, belief pre-dispositions and meta-claims of a very limited subset of individuals.

I use Chapter VI as a space for some personal thoughts on how a doctoral program and discipline that nurtures rather than oppresses can reshape the doctoral journey of a woman of color.

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33 There are direct reciprocal influences between science and resulting technology and societal interests. Science has extensive impacts on the lives of individuals while societal needs direct the natural phenomena scientists explore (McComas, Clough, & Almazroa, 2002).
CHAPTER VI

FINAL THOUGHTS

Grumet (1976/2006) described *currere* as “a reflexive cycle in which thought bends back upon itself and thus recovers its volition” (p. 130-131). More clearly, *currere* is an iterative and temporal excavation of who we are, who we were, who we want to be and how we choose and work towards social commitments (Schubert, 2004). I have written so much of who I am and who I was into this dissertation that I have bent myself intellectually and emotionally as far back as this present moment allows me. Through my literature review in Chapter II, my reflexive statement in Chapter III, my personal reflections in Chapter IV, and my recommendations in Chapter V, collectively written over the span of two and half years, I have continually tried to practice reflexivity. However, there are some spaces related to reflexivity and *currere* I feel compelled to excavate.

**Achieving Thick Descriptions**

A “thick description is an unadulterated and thorough presentation of the data” (Heppner, Kivlighan, & Wampold, 1999, p. 263) taking the reader into the setting being described (Patton, 2002). I hoped for a sample size of five participants with data collection extending over six months to achieve thick descriptions that would immerse readers not only in the setting of the study, but also in the broader location of the nature
and sources of participants’ experienced injustices. However, after three months and three participants and with “no rules for sample size in a qualitative inquiry” (Patton, 2002, p. 244), I achieved thick descriptions that immersed readers in the study and more specifically in the lived experiences of each participant and more broadly in the critical perspective of injustice. It is likely that thick descriptions were achieved in less time and fewer participants than expected because of (a) being closer to an insider on the insider/outsider spectrum, (b) incorporation of currere into interview guide, and (c) follow-up request for participants’ reflections on the interview and member checks. The details of how each of these contributed to thick descriptions are discussed below.

Close to Being Insider on the Insider/Outsider Spectrum

All three participants knew that, like them, I was a woman of color similar in age who struggled with oppression in a chemistry doctoral program and who had other identities parallel with theirs. They also knew I viewed them as autonomous, empowered beings who were experts of their own realities and that I came to them with the specific purpose: to tell their stories. Therefore, some of my identities and the study’s purpose aided instant and sustained trust and solidarity with participants subsequently helping me elicit richly descriptive and emotionally intense stories in approximately two hour long interviews. However, these identities that forge trust and solidarity can also forge bias in the elicited data (Dwyer & Buckle, 2009).

To attend to these biases, I engaged in reflexivity through discussions of how my lived experiences both paralleled and diverged from the lived experiences participants shared during their interviews in the My Reflection sections of Chapter IV. This reflexivity also highlighted some of the identities that marked me as an outsider with
these participants, mainly my immigrant status and having an unsupportive family throughout my doctoral experience. Further, the in-between spaces I occupied as researcher along the insider/outsider added a layer of illumination and complexity that enriched the thick descriptions of participants’ experiences. For example, after sharing my reflections on the interviews with participants, Soraya replied:

Just read your reflection. It was beautiful. Something you'll never know without me saying. I try so hard to fit in that I wonder what my true personality is. It drastically changes depending on who it is. Other comments, during grad school my mother started to tell me I didn't need to be married, to have kids, and continues to this day to set me up with Mr. Right. You were never alone. We had each other.

**Currere and Temporality in Interview Data**

The accumulation of capital in all its forms, and the effect of this accumulation through activation of acquired capital, is temporal (Bourdieu, 1977; 1984; 1986/2008). Therefore, it was vital that the interview intentionally and cohesively take participants through time as they explored their experiences in educational institutions. This was achieved by adopting *currere* as a sensibility (Pinar, 2012) within the methodology of the study, and more specifically in the construction of the interview guide. The interviews moved participants from their earliest memories of how their personal identities, family, and school intertwined, to their last memories of their experiences in their doctoral program; to how those past experiences shaped who they hoped to become to who they are now; and to how their past, future, and present experiences may be reflected in the experiences of other underrepresented people of color who aspire to a doctorate in the scientific field they once pursued their doctorate. So, although participants were interviewed only once, the cohesive movement of participants through decades of time
and a multitude of places and spaces resulted in clear and compelling interview data.

This temporality was further enriched through a three month member checking process.

**Additional Temporality through Participants’ Reflections and Member Checks**

Participants’ reflections and member checks added additional layers of temporality to the interview data. Reflexivity, through reflecting on participants’ stories prompted me to go back and ask participants to reflect on what it meant for them to share their stories. With the exception of Devina, who did not participate in member checking, in the spirit of *currere*, participants’ reflections demonstrated how past, present, and future experiences interconnect and captured in that moment the temporality the study hoped to achieve. For example Avenus noted:

> Sharing my experience helped me with a future story I was asked to share for an organization wide initiative on improving diversity. I felt more confident in telling my education journey because I was validated during our conversation. So I came to my other work with perspective and recognition that what I experienced was for real (not just in my head or a single event only related to me).

Soraya’s reflection also captured the role time plays in how we view and understand our experiences and therefore, how the temporality of life influences who we are. She notes:

> It [telling my story] reminded me of all the horrible things you have to go through to get to where you are and you just remember the good stuff. I didn’t go into, like you know, any emotional distress from it, but it was kind of crappy that you had to go through all of that without support and without really anybody to talk to about it because no one really truly understands.

Additionally, the member checking process kept participants engaged in the research study beyond the data collection phase into the data analysis phase. This return of participants to the data and what it meant to me and to them also prompted participants to continue to engage in reflection.

A poignant example came when Soraya mentioned during her penultimate member check. After reading my analysis relating to oppression and the role of a lifetime
of capital and fictive kinships in influencing the academic outcomes and career paths, she felt compelled to have a conversation with her parents to thank them for their moral and financial support. This return to participants and to ask them to reflect on what it meant to tell their stories and to clarify the data analysis primarily occurred because of this study’s methodology. As a qualitative study, my own reflections on the process were crucial methodologically for trustworthiness. However, as a critical study, participants’ experiences needed to be centered and extended member checking facilitated this centrality. Ultimately, common identities, moving participants temporally through their lived academic experiences, sharing my reflections with them, including their reflections on engaging with study, and engaging them with their stories and the stories of others theoretically during member checking not only crucially and holistically interwove the temporality of life narratives, but added layers of nuances and deep insights that when combined with interview data resulted in thick descriptions.

A Regressive Moment

The completion of data analysis forced me to briefly return to the regressive moment. In particular, the participants’ experiences with oppressive advisors were a place where my chemistry doctoral experience significantly diverged. As I alluded in Chapter II, I felt that my chemistry doctoral advisor was supportive and, I feel I need to add, kind. However, prior to the analysis of the data collected for this study I never extended my thoughts beyond those conclusions.
I have now realized that that support and kindness were nullified by my inability to understand, much less express, that I needed care\textsuperscript{34} that was perhaps beyond my advisor’s expectation of what his typical student needed. There is little doubt that he would have made genuine attempts to provide that care. I also have little doubt that our attempts to incorporate care into our advisor/advisee relationship would have been filled with awkward moments. I am unable to conjecture whether materialization of that care would have been sufficient to overcome the oppression in the department and the absence of my family’s support.

Yet, I do know that in this second doctoral journey was surrounded by a multitude of professors and peers from diverse cultural heritages and who seemed to instinctively nurture rather than instinctively oppress those around them. Subsequently, my institutionalized social capital exploded in volume and viability and a rapid accumulation of cultural capital has followed. However, this journey has not been an easy one. As someone who had no experience with social science theories, research methods, or terminology, the conceptual and practical learning curves were the steepest I have ever experienced in my tertiary education. It has also been filled with financial and emotional sacrifices. I have lost count of the number of consecutive days and nights over the last three years I left so early and came home so late I did not see or speak to anyone in my family for days. These are the sacrifices that a chemistry doctoral journey would also likely demand, however, what made me persist was being surrounded by so many people who expected me to succeed and supported me accordingly.

\textsuperscript{34} See Tronto and Fisher’s (as cited in Tronto, 1993) on p. 164 for a definition and my discussion on the possible role of care in the doctoral experience.
My gender, the color of skin, the ever so slight accent that indicated I was an immigrant, and my socioeconomic status were not seen as liabilities, they simply were. Such a nurturing culture transformed my understanding of what the doctoral journey could be and, more importantly, should be for everyone regardless of their field of study. It has also caused me to rewrite the future I resigned myself to six years ago after departing my chemistry doctoral program. Six years ago, I was convinced that I did possess whatever “stuff” was required to get what Nettles and Millet (2006) aptly described as the three magic letters behind my name. Even in the minutes prior to this dissertation’s defense proposal a few months ago, I still questioned whether I had that stuff. Six years ago, it seemed the story I wrote for myself as a teenager had been rewritten by more affluent people who had what I thought I lacked. However, my professors, peers, and my newly formed family have helped me regain control of my life story and have placed me back on the path to those three magic letters.

A Hopeful Future

I am, I think, on the verge of having the three magic letters of Ph.D. behind my name. Three letters that follow no one else’s name in my family or my husband’s family and now when I recall the path that led to this moment and is leading to the future moment of a successful dissertation defense I wear a smile, my husband tells me, that lights up the room. It has been almost impossible to see this moment for the last three years, much less see past it. However, as this document slowly changed from a proposal to a dissertation thesis, a path beyond earning the Ph.D. has begun to surface. I have decided to forego a more immediate path to personal economic capital by pursuing a postdoctoral experience rather than a tenure track position to gain social and academic
capital. My future seems to be filled with choices that echo Avenus’s assertion that a lack of money means you can never have everything all at once. That concept deeply resonates with me, yet I feel all the financial sacrifices have been and will continue be worthwhile.

The story I wrote for myself as a 16 year old who toppled head over heels for chemistry and who was ready to do whatever it took to join the chemistry research and teaching community never aligned with the reality of my lived experiences. Although that story has been rewritten, I think the anticipated ending will be the same; I get to make the lives of others better through a lifetime of learning from a community of likeminded peers. It is this realignment, finally, between the stories I write and the stories I now live, that induces a smile that lights up the room.
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231


As a former McNair Scholar and a doctoral student of Chemistry now a doctoral student in science education I am interested in understanding the experiences of the academic experiences of other former McNair Scholars of color who are currently or were formerly students in a science, technology, engineering, or mathematics doctoral program of study.

If you decide to volunteer you will be asked to:

• Complete a questionnaire about your academic and demographic profiles.

• Share your most meaningful academic experiences, from your earliest memories of school to your current and anticipated experiences through writing in an electronic journal*.

• Relate how your race, class, gender, sexuality, nationality, native language or any other personal characteristics have supported or aided your academic experiences in your writing.

• Commit to sharing your academic experiences with me via an Internet-based tools, primarily an Internet-based word processor (Google Docs)* over **five consecutive months**.

• Participate in an online focus group interview with other McNair Scholars who contributed to this study in which your name will be confidential unless you specify otherwise.

* You will have a private electronic journal via Google Doc, which can only be viewed and edited by you and me. There is no compensation for participating in this
research study. There is the risk that in reflecting long term on and sharing how your race, class, gender, sexuality, nationality, native language or any other personal characteristics have influenced your life may cause some discomfort or embarrassment. Your responses to the questionnaire and in your journal will remain confidential. At no time will your actual identity be revealed. You will be assigned a numeric code. Anyone who helps me transcribe responses or in any other way views your responses will only know you by this code.

The log linking your name with your number will be kept in a locked box in a locked room, and no one else will have access to it. It will be destroyed when dissertation has been accepted. The data you give me will be used for a future article and presentations in the future. I will never use your name or any information that would identify you in any publications or presentations.

Your participation in this study is completely voluntary and you may refuse to participate or withdraw from this study at any time. You may withdraw by informing me that you no longer wish to participate (no questions will be asked). You may skip any activities I request or specific requests within activities, but continue to participate in the rest of the study.

If you have questions or concerns about this research, please contact me, Senetta Bancroft, at sfp4@zips.uakron.edu You may also contact my research advisor Nida’a Makki, Assistant Professor at nm32@uakron.edu or (330) 972-6955.

The nature and purpose of this research have been sufficiently explained and I agree to participate in this study. I understand that I am free to withdraw at any time without incurring any penalty.

Please click on the following link to provide an electronic signature:
Link to Qualtrics Consent Form Goes Here

Sincerely,
Senetta Bancroft, MSE
Doctoral Candidate
College of Education
Curricular and Instructional Studies
The University of Akron
APPENDIX B

REVISED CONSENT FORM

Department of Curricular and Instructional Studies
College of Education
Akron, OH  44325-1802
(330) 972-7765 Office
(330) 972-5636 Fax

As a former doctoral student of chemistry who is now a doctoral student in science education, I am interested in exploring the experiences of other former students of color who are currently or were formerly students in a science, technology, engineering, or mathematics (STEM) doctoral program of study. This dissertation study is entitled: Currere as a tool for examining the experiences of underrepresented STEM doctoral students of color.

If you decide to participate in this study you will be asked to:

• Complete a questionnaire about your academic and demographic characteristics.

• Share your past, present, and anticipated academic experiences through a one-to-one interview with me. This interview is expected to be approximately 2 hours.

• Relate how race, class, gender, sexuality, nationality, native language or any other classifications have influenced your academic experiences.

There is no compensation for participating in this research study. There is the risk that in reflecting on and sharing how your race, class, gender, sexuality, nationality, native language or any other personal characteristics have influenced your life may cause some discomfort. Your responses will remain confidential. At no time will your actual identity be revealed. You will be assigned a numeric code. Anyone who helps me transcribe responses or in any other way views your responses will only know you by this code.
The log linking your name with your number will be kept in a locked box and no one else will have access to it. It will be destroyed when my dissertation has been accepted. The data you give me will be used for a future article and presentations in the future. I will never use your name or any information that would identify you in any publications or presentations.

Your participation in this study is completely voluntary and you may refuse to participate or withdraw from this study at any time. You may withdraw by informing me that you no longer wish to participate (no questions will be asked). You may refuse to answer specific questions within the demographic questionnaire or interview and continue to participate in the study.

If you have questions or concerns about this research, please contact me, Senetta Bancroft, at sfp4@zips.uakron.edu You may also contact my research advisor Nida’a Makki, Assistant Professor at nm32@uakron.edu or (330) 972-6955.

This study has been approved by the university Institutional Review Board. If you have questions about your rights as a research participant you can contact the IRB at 330-972-7666.

Please click on the following link to provide consent electronically:
Link to Qualtrics Consent Form Goes Here

Sincerely,
Senetta Bancroft, MSE
Doctoral Candidate
College of Education
Curricular and Instructional Studies
The University of Akron
APPENDIX C

QUALTRICS CONSENT FORM

This form contains two sections.

In Section A. below, you will have the opportunity to indicate your consent to participate in this study.

In Section B. on the next page, you will have the opportunity to indicate the parts of the study you are willing to participate in.

Section A.

I have read and understood the accompanying consent letter for the study *Currere as a tool for examining the experiences of underrepresented STEM doctoral students’ of color*. I know that I do not have to answer all questions and that I can decide to withdraw at any time.

To indicate your agreement to participate in this study please check the box below.

__I consent to participate

Section B.

I would like to take part in (please check off one or more of the following boxes):

__A demographic survey
__An academic autobiography
__An individual interview
__A focus group interview
1. What was your undergraduate area of study?
   
   Medical Sciences  
   Mathematics  
   Chemistry  
   Physics  
   Biological Sciences  
   Engineering  
   Computer Sciences  
   STEM Research and Learning  
   Other______________

2. What is your current or most recently completed area of study?
   
   Medical Sciences  
   Mathematics  
   Chemistry  
   Physics  
   Biological Sciences  
   Engineering  
   Computer Sciences  
   STEM Research and Learning  
   Other______________

3. Do you have a master’s degree? If yes, please indicate area of study.
   
   Yes ______________  
   No

4. Have you ever departed from a master’s degree program without receiving a degree? If yes, please indicate the area of study.
   
   Yes ______________  
   No
5. Do you have a doctoral degree? If yes, please indicate area of study.
   Yes __________________
   No __________________

6. Have you ever departed from a doctoral degree program without receiving a degree? If yes, please indicate the area of study.
   Yes ________________
   No ________________

7. How many years did you spend in your most recent doctoral program?
   0-1 years
   2-4 years
   5-7 years
   More than 7 years

8. What form of financial support do you have (or have had) during your graduate studies? (Select all that apply)
   Teaching Assistantship
   Research Assistantship
   Fellowship
   Grant
   Loan
   Other ________________

9. Select the highest education level of your mother.
   Some high school
   High school degree
   Associate degree
   Bachelor degree
   Master’s degree
   Doctoral degree
   Professional degree (eg. MD, MBA)
   Other ________________

10. Select the highest education level of your father.
    Some high school
    High school degree
    Associate degree
    Bachelor degree
    Master’s degree
    Doctoral degree
    Professional degree (eg. MD, MBA)
    Other ________________

11. Select your gender:
    Female
    Male
    Transgender
    Other ________________

12. Please select your race/ethnicity (select all that apply):
    Black (Non-Hispanic)
    Hispanic
    Asian
    White
    Alaskan Native
    Native American
    Pacific Islander
    Other __________________
APPENDIX E

INITIAL GUIDELINES FOR JOURNAL

I want your writing experience to flow naturally as much as possible and for you to feel that you can contribute exactly want you want to this research study—almost as if you are having a conversation with yourself while I listen in occasionally. However, in the absence of real time and face-to-face communication I think it is worth providing some guidelines prior to starting the writing process.

As I discussed with you when I inquired about your interest in contributing your experiences to this research study, there are some general topics I would us to cover and these will be used to guide your recording of your autobiography. However, please never hesitate to ask me questions via email or within your electronic journal (which I will check at least twice daily) or raise any topics that you think is relevant that I have not mentioned—but I ask that we try to stay within the themes of academic experiences (and/or your personal life when your academic life overlaps) and the role the characteristics of race, ethnicity, gender identity, socio-economic class, sexual orientation, nationality, or any other characteristics you feel have surfaced significantly or subtly at some point in your academic experiences.

Your journaling as the written word, video or audio recordings, and/or photographs and most forms of communication will occur using Internet-based
applications within a package of tools in *Google Drive*. To access these applications you will need a Google account I recommend you create a Google account specifically for the purpose of this study. Keeping this account isolated will aid in protecting your privacy and confidentiality. Please share this email account name with me by emailing me at ____________, the Google account I have created specifically for this study.

**Once you share your new Google account name with me at __________ I will share a Google Folder, via a link, which only you and I will have access and you begin to chronicle your experiences.**

- Your journal, which will be a Google Folder, containing your experiences can include:
  - Video recordings
  - Audio recordings
  - Photographs
  - The written word
  - Any other form that can be captured and shared digitally

Your video recordings, audio recordings, and photographs can be uploaded as files within our shared Google Folder. I will have immediate access to these files once upload is complete. If you choose to use the written word you can use a Google Document, which functions very similarly to a Microsoft Word document, however, we have simultaneous access to the document via the Internet and we can view in real time what the other is recording if we happen to be viewing the document at the same time, it also has chat capability. There is information and a few questions I provide to help you get started on step one of your academic autobiography in this Google Document. I will “check in” with you in the mornings and evenings Monday through Friday, please feel free to pose questions or provide comments within this document as a way to facilitate the conversation I hope to have with you for during the coming months.
Regression

These questions are meant to serve as a guide rather than a rigid prescription for focusing Scholars on their *currere*. Questions, particularly those addressing the doctoral experience, will vary based on the stage of each Scholar in the doctoral process.

**Pre-kindergarten through High School Years**

1. Who are you?
   a. Where did you grow up?
   b. What is your family like?
   c. How would you describe your culture in the home and in the neighborhood in which you grew up?

2. Who were the people around you as you grew up?
   a. What are the demographics of the family and friends around you as you grew up?
   b. Did you live in a race and class diverse neighborhood?
   c. What kind of schools did you attend? Public, private, both, neither?
   d. Were your schools—elementary/middle/high schools racially diverse? Class diverse? Gender diverse? Open to different gender identities (lesbian, gay, bisexual, transsexual, queer communities)? Nationally and/or linguistically diverse?
   e. Did you voluntarily interact with people who were from another race, class, gender, or sexual identity from yourself in your family, neighborhood, and schools?

3. Do you have any specific events in your life as a child or teenager where your race, class, gender, sexuality, or any other personal characteristics became important to you or to someone around you?

4. Did you know what you wanted to study in college and which college you wanted to pursue those studies? Did you consciously prepare for these studies?

5. Did you have family, friends, and/or teachers who were influential in preparing you for college? If so, can you describe them and how they influenced you?

**Undergraduate years**

13. What was the first year or two of college like?
   a. Did you live on campus?
   b. Did you work? If so, what did you do and how many hours a week did you work? If not, why not?
   c. Was the student and teacher populations different from your earlier school years? If so, how were they different?
   d. Did you know what degree or career you would pursue? Did your decision change in these early years?

14. What was the rest of your undergraduate years like? Was it different in any significant way from your first year or two?
a. Did you change majors?
b. Did you have a professor or professors who played a significant role (positive or negative) in your college experiences? If so, can you describe them and their influence?

15. When in your academic life did you know you wanted to pursue a doctoral degree? What were your reasons at the time for wanting to earn a doctorate?

16. How did you become a McNair Scholar?
   a. How did you hear about the McNair Program?
   b. What about the program appealed to you?
   c. Were you a sophomore, junior/senior when you joined the program?
   d. Did you enjoy the opportunities the McNair Program offered? Looking back can you describe the opportunities that stand out as particularly influential?

17. Did you feel that there were experiences as an undergraduate that were influenced by race, class, gender, sexual identity, nationality, or any other personal characteristic?

18. Can you describe any peers and professors who you perceived as so similar to or different from you based on demographics or life experiences that they provoked you academically and/or emotionally? Can you describe any interactions with those peers and professors you still recall?

19. Did your family play a significant role in your life as an undergraduate?

   **Doctoral Years**

1. Describe your first year of being a doctoral student?
   a. Did you feel comfortable, excited, overwhelmed, scared, isolated, prepared, supported, etc. in your role as a “minority” doctoral student within your department?
   b. Can you describe the people from your doctoral program that stand out from this year? Can you describe your interactions with them?
   c. Describe what it was like conducting research in your first year?

2. Describe the process of advancing to candidacy?
   a. Did you study with your peers? Get advice from more advanced students? Get advice from your advisor or other faculty?
   b. Did you feel that the process was easy, challenging but transparent and achievable, or challenging because advancing to candidacy was designed to favor a certain type of student or the expectations were obscure?

3. Do you feel race, class, gender, sexuality, nation, or any other personal characteristics advantaged or disadvantaged your success as a doctoral student? If so, can you describe events, whether explicit or subtle, where you feel one or any combination of these characteristics played a role in your perception of it/them as an advantage or disadvantage?

4. If you left your program, describe the decision process and the significant events that drove your decision to leave.
Progression

1. Who would you like to become?
   a. What is your dream job? (If currently working, do you have it now?)
   b. If you are still working towards your dream job, what is your plan for the
      next few months to a year to get this dream job? In next two to five years?
      The next ten years?
   c. Do you think having a partner or young children will affect your plans?

2. Describe the contributions you hope to make to your field of study with your
dissertation research? With the dream job you aspire to?

3. Describe in what ways your race, class, gender, sexuality, nation, or any other
personal characteristics may advantage or disadvantage you in getting and/or
keeping this dream job?
   a. Can you describe the demographics and qualities of someone who
typically holds your dream job? Describe how you share or deviate from
those demographics and/or qualities.
   b. Describe the type of career pressures and rewards you perceive the typical
person holding your dream job experiencing? What about those pressures
and rewards appeal to you or worry you?
APPENDIX F

INTERVIEW GUIDE

Regression

Pre-kindergarten through High School Years

6. Who are you?
   a. Where did you grow up?
   b. What is your family like?
   c. How would you describe your culture in the home and in the
      neighborhood(s) in which you grew up?

7. Who were the people around you as you grew up?
   a. Describe the demographics of the family and friends around you as you
      grew up?
   b. Describe the diversity of the neighborhood(s) in which you grew up?
   c. What kind of schools did you attend? Public, private, both, neither?
   d. Describe the diversity of your primary and secondary educational
      institutions. Were your schools-elementary/middle/high schools racially
      diverse? Class diverse? Gender diverse? Open to different gender
      identities (lesbian, gay, bisexual, transsexual, queer communities)?
      Nationally and/or linguistically diverse?
   e. Did your race, class, gender, sexual identity, and/or language matter to
      you while you were in school? Did these identities matter to your peers
      and teachers?

8. Describe your interactions with people who were from another race, class, gender, or
   sexual identity from yourself in your family, neighborhood, or schools? Describe any
9. specific events in your life as a child or teenager where your race, class, gender, sexuality, or any other personal characteristics became important to you or to someone around you? If there were no such events, why do you think no such event ever arose?

10. When and how did you know what you wanted to study in college and which college you wanted to pursue those studies? When and how did you prepare for college?

11. Describe whether and how your family, friends, and/or teachers were influential in preparing you for college?

12. Describe any other people or events in your years before you started college that you feel eventually became influential on how you perceived educational institutions and interacted with the people within them?

Undergraduate years

1. Recount your first year or two of college?
   a. Did you live on campus?
   b. Did you work? If so, describe that work experience and its influence on your academic life? If not, how do you think not working influenced your academic life?
   c. Recount if and how the student and teacher populations compared to the students and teachers in your earlier school years?
   d. Describe how you felt about your new: educational institution, peers, teachers, and the experiences they collectively created in these early college years?
   e. Describe your progress towards your degree in these first two years.
      Describe any changes to your degree and career path in these two years. If there were no changes, why do you think your path remained unchanged?

2. Describe, in broad strokes, the remainder of your undergraduate years? Were they different in any significant way from your first year or two?

3. Describe any professors who played a significant role (positive or negative) in your college experiences? Can you describe how they influenced you personally and/or academically?
4. Describe any research or experience related to your undergraduate degree that was influential in your view of conducting research in science, technology, engineering, or mathematics. If and how did this eventually influence your decision to pursue a doctoral degree?

5. When in your academic life did you know you wanted to pursue a doctoral degree? At that time, why did you want to earn a doctorate?

6. How did you become a McNair Scholar?
   a. How did you hear about the McNair Program?
   b. What about the program appealed to you?
   c. Were you a sophomore, junior/senior when you joined the program?
   d. Did you enjoy the opportunities the McNair Program offered? Looking back can you describe the opportunities that stand out as particularly influential?
   e. Were there any aspects of the program you felt had a negative effect on your undergraduate?

7. Describe, in broad strokes, if and how racism, classism, sexism, sexual identity, nationality, or any other personal characteristic affected your undergraduate experiences?

8. Describe any peers and professors who you perceived as so similar to or different from you based on race, class, gender, sexual identity, nationality, or any other personal characteristics that they provoked you academically and/or emotionally? Can you describe any interactions with those peers and professors you still recall?

9. Describe the role your family played in your life as an undergraduate?

10. Describe any other people or events during your undergraduate years that you feel eventually became influential on how you perceived educational institutions and interacted with the people within them?

**Doctoral Years**

1. Describe your first year of being a doctoral student?
a. Did you feel comfortable, excited, overwhelmed, scared, isolated, prepared, supported, etc. in your role as a “minority” doctoral student within your department?

b. Can you describe the people from your doctoral program that stand out from this first year? Can you describe your interactions with them?

c. Describe what it was like conducting research in your first year?

2. Describe the process of advancing to candidacy?

a. Did you study with your peers? Get advice from more advanced students? Get advice from your advisor or other faculty?

b. Did you feel that the process was easy, challenging but transparent and achievable, or challenging because advancing to candidacy was designed to favor a certain type of student or the expectations were obscure?

3. How do you think race, class, gender, sexuality, nation, or any other personal characteristics advantaged or disadvantaged your success as a STEM doctoral student? Can you describe events, whether explicit or subtle, where you feel one or any combination of these characteristics played a role in your perception of it/them as an advantage or disadvantage?

4. If you left a doctoral program, describe the decision process and the significant events that drove your decision to leave.

5. Describe any aspects of the McNair Program you felt had a positive effect on your doctoral experiences?

6. Describe any aspects of the McNair Program you felt had a negative effect on your doctoral experiences?

7. Describe any other people or events during your doctoral years that you feel eventually became influential on how you perceived educational institutions and interacted with the people within them?

8. Describe how you felt when you interacted with other faculty? Did you feel comfortable academically in these conversations, comfortable socially (that the words you choose as you talk and how you talk (that is tone, pronunciation, and coherency of thought)?

9. Describe how your advisor supported you academically.
10. Describe how your advisor supported you emotionally

11. Describe your perceptions of your advisor and other faculty understanding of the challenges you faced as an underrepresented person of color and/or as a low-income first generation student in STEM?

12. Describe your interactions with your peers? Did you perceive them as understanding the challenges you face as an underrepresented person of color in STEM, as a low-income first generation student? Why or why not?

13. Overall, describe how your advisor supported you allowing you to feel like a part of your group?

14. Describe anything you wished your advisor had done more of that would have made you feel more welcomed and supported and ultimately integrated within your group and your discipline.

15. Overall, describe whether how your department welcomed and supported you so you feel like an integral part of the department?

16. Describe anything you wished your department had done more of that would have made you feel more welcomed and supported and ultimately integrated within your department and your discipline.

17. Was there anyone you regarded as a mentor within your department? That is, did you find someone who reliably and constructively give you the “inside scoop” on to successfully navigate the doctoral process (whether it is dealing with specific personalities, politics, scholarly writing, postdoctoral experiences, etc.)?

18. Was there anyone outside of your department who taught you how to deal with these doctoral processes before you started or you turn to currently as a mentor?

19. Did you have moments where you felt that you were not only representing yourself, but everyone within the cultural heritage you identify with?

20. If you did, can you describe the circumstances under which you tended to have those moments? For example, where were you when you had these moments? Who were the people around you? What were some of the thoughts that went through your head about yourself and about the peers and faculty you work with?

21. How did you cope with these feelings if you had them?

22. How did your family support you through the doctoral process?
23. Describe any differences, if any, in how you thought, talked, and/or behaved when you interacted with your family and/or friends versus when you were interacting with peers and faculty in your doctoral program.

Progression

1. Given your current personal and academic achievements, in broad strokes, describe who would you like to become? How do you think your race, class, gender, sexuality, nation, or any other personal characteristics influence who you hope to become?

2. Describe your dream job? (If currently working, do you have it now?)

3. If you are still working towards your dream job, outline your plan for the next few months to a year to get this dream job? In next two to five years? The next ten years?

4. If and how do you think having a partner or young children will affect your career plans?

5. Describe the contributions you hope to make to your field of study with your dissertation research? With the dream job you aspire to?

6. Describe in what ways your race, class, gender, sexuality, nation, or any other personal characteristics may advantage or disadvantage you in getting and/or keeping this dream job?

7. Describe the demographics and qualities of someone who typically holds your dream job? Describe how you share or deviate from those demographics and/or qualities.

8. Describe the type of career pressures and rewards you perceive the typical person holding your dream job experiencing? What about those pressures and rewards appeal to you or worry you? Do you think your race, class, gender, sexuality, nation, or any other personal characteristics will influence these pressures and/or rewards?

9. Discuss any other future academic or career experiences you hope to have that is influenced (or you think has the potential to become influenced by) your race, class, gender, sexuality, nation, or any other personal characteristics.
Analysis

1. Describe your current career?
2. What about this career is attractive to you?
3. What about this career is unattractive?

Synthesis

1. Putting about your past, present, and anticipated experiences together, overall what role does racism play in those experiences?
2. Does cultural heritage?
3. Does money and/or class?
4. Does gender?
5. Describe your perception of how these identities (and any others you can think of that I haven’t mentioned) influence earning a Ph.D. in Chemistry.
6. Broadly, how do you think these identities influence how underrepresented people of color view the possible careers that can follow from that Ph.D.?
7. Why did you choose to share your experiences with me?
8. Is there anything else we haven’t spoken about that you would like to add?
I just completed transcription of all my interviews and I am beginning to finalize data analysis. I did a reflection after I completed the transcription of each interview. I never anticipated my own catharsis would emerge from listening to your experiences and those experiences of the two other women I interviewed.

And this unexpected catharsis left me with a question: how did the act of telling your stories affect you?

I was hoping that you would be willing to write a paragraph or two (or present it in any other form you choose) to respond to the above question. Of course, you can decline to do so without explanation.

My reflection is attached. My reflections will be included in the results section and the pseudonym included will be used. Please let me know if you would prefer a different pseudonym than the one I chose (it is the name of a childhood friend).
### APPENDIX H

### VALIDITY MATRIX

<table>
<thead>
<tr>
<th></th>
<th>Definition</th>
<th>Additional references</th>
<th>Interview Guide Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oppression and</td>
<td>Racism, sexism, etc. is normal (Bell, 1996; Freire, 1970; Delgado &amp; Stefancic, 2012). Being a numerical minority can activate gender and racial stereotypes (Eagly &amp; Carli, 2008). Negative stereotypes for racial minorities include perceived lack of motivation and competency (Schumann et al., 1997) and for women include not being good at math and science (Adams, Garcia, Purdie-Vaughns, &amp; Steele, 2006).</td>
<td>Gildersleeve, Croom &amp; Vasquez, 2011</td>
<td><strong>Regression</strong> PreK-HS Q.1-6 Undergrad Q.1c; 3; 7; 8 Doctorate Q.1a-b; 3; 4; 8; 19;20-21</td>
</tr>
<tr>
<td>negative cultural</td>
<td><strong>Progression</strong> Q.1; 4; 6-9</td>
<td></td>
<td><strong>Synthesis</strong> Q.1-6</td>
</tr>
<tr>
<td>stereotypes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fictive Kinship</td>
<td>Fictive-kinship, is “a kinship-like connection between and among persons in a society, not related by blood or marriage, who have maintained essential reciprocal social or economic relationships” (Fordham, 1988, p. 56). It extends politically as a collective social identity concept that the collective is brother, sister, and blood. Further it is more than skin color, it is a mind-set used to determine membership, if it is sought (Fordham, 1988; 2010).</td>
<td>Réndon, Jalomo, &amp; Nora, 2000</td>
<td><strong>Regression</strong> PreK-HS Q.1c; 2b.-f Undergrad Q.1c; 3; 8; 9; 10 Doctorate Q.1a-c; 3; 7; 18; 22-23</td>
</tr>
</tbody>
</table>

259
<table>
<thead>
<tr>
<th>Social fit, socialization, and advisor relationship</th>
<th>Perceiving oneself as socially connected or member of the community of their academic department in their particular discipline in the academic setting with certainty of high quality of the social bonds (Walton &amp; Cohen, 2007; Golde, 1998). Socialization is the process by which “the process by which persons acquire the knowledge, skills, and dispositions that make them more or less effective members of their society” (Weidman et al, 2001, p.4).</th>
<th>Lovitts, 2001; Holley &amp; Gardner, 2012</th>
<th>Regression Undergrad Q.1d-e; 2; 4; 10 Doctorate Q.1a-c; 2; 9-17 Analysis Q.1-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation for pursuing Ph.D.</td>
<td>Motivation can be defined as a choice of courses of action, intensity, and persistence of effort (Bandura, 1991). Within the doctoral program environment motivation will be categorized as professional a focus on tangible goals such as publications in top-tier journals and placement post-graduation at highly ranked research institutions as the metric for success in the program and personal with a focus on learning and developing as an individual (Sweitzer, 2009)</td>
<td></td>
<td>Regression Q.3-6 Progression Q. 2-3</td>
</tr>
</tbody>
</table>
APPENDIX I

A PRIORI CODES

Dimensions of oppression

- **Racism**: Actions and policies that legitimates the exclusion of non-whites from particular areas of social and economic life while promoting a tolerance among whites for these inequities. Linked to domination and power to affect aspirations of participants.

- **Sexism**: Prejudice, stereotyping, or discrimination, typically against women, on the basis of sex.

- **Classism**: Prejudice against or in favor of people belonging to a particular social class.

Dimensions of capital

- **Economic**: Capital which is immediately and directly convertible into money and may be institutionalized in the form of property rights. Related to resources that the possession of money meaningfully increases access to.

- **Cultural**: The characteristics of the mind and body which include cultural values and personal preferences and academic achievements. Related to their expressions of self-worth and self-efficacy.

- **Social**: The collective real and possible resources connected to institutionalized relationships of mutual acquaintances and recognition, i.e., it is dependent on one’s group membership. Related to the ability to form a viable social network within doctoral program and the size and diversity of that network from which the student can invariably find peer or mentor support.
Dimensions of fictive/alternative fictive kinship

- **Presence of peers:** educational institution has enough peers of similar heritage participant feels they comfortably fit socially and culturally.

- **Sense of belonging:** educational institution has enough peers of similar heritage and/or creates a culture where despite differences participant feels they comfortably fit socially and culturally.

- **Absence of peers:** educational institution has no peers (or so few diffused among different educational levels) of similar heritage or creates a culture where cultural differences seem heightened and participant feels they do not comfortably fit socially and culturally.

- **Isolation:** The inability to fit socially/culturally/academically with peers or faculty results in a feeling of aloneness within institution.

- **Support:** Whether from faculty, peers, or family participant feels they are encouraged to be successful within their doctoral program.
APPENDIX J

REVISED CODES

Dimensions of oppression

- **Racism**: Actions and policies that legitimates the exclusion of non-whites from particular areas of social and economic life while promoting a tolerance among whites for these inequities. Linked to domination and power to affect aspirations of participants.
  - *Pre-doctoral*: time spent as student in prekindergarten-undergraduate
  - *Master’s*: time spent as student in master’s program prior to entering STEM doctoral program
  - *Doctoral*: time spent as student in STEM doctoral program
  - *Post-doctoral*: time spent once participant departed or graduated from STEM doctoral program

- **Sexism**: prejudice, stereotyping, or discrimination, typically against women, on the basis of sex.
  - *Pre-doctoral*: time spent as student in prekindergarten-undergraduate
  - *Master’s*: time spent as student in master’s program prior to entering STEM doctoral program
  - *Doctoral*: time spent as student in STEM doctoral program
  - *Post-doctoral*: time spent once participant departed or graduated from STEM doctoral program

- **Classism**: prejudice against or in favor of people belonging to a particular social class.
  - *Pre-doctoral*: time spent as student in prekindergarten-undergraduate
  - *Master’s*: time spent as student in master’s program prior to entering STEM doctoral program
  - *Doctoral*: time spent as student in STEM doctoral program
  - *Post-doctoral*: time spent once participant departed or graduated from STEM doctoral program
Dimensions of capital

• **Economic:** capital which is immediately and directly convertible into money and may be institutionalized in the form of property rights. Related to resources that the possession of money meaningfully increases access to.
  
  o **Pre-doctoral:** time spent as student in prekindergarten-undergraduate
    
    ▪ *Home:* obtained from immediate or extended family or from community members in which family has ties.
    
    ▪ *School:* obtained from institution in which participant is a student or anticipated to be a student
  
  o **Master’s:** time spent as student in master’s program prior to entering STEM doctoral program
    
    ▪ *Home:* obtained from immediate or extended family or from community members in which family has ties.
    
    ▪ *School:* obtained from institution in which participant is a student or anticipated to be a student
  
  o **Doctoral:** time spent as student in STEM doctoral program
    
    ▪ *Home:* obtained from immediate or extended family or from community members in which family has ties.
    
    ▪ *School:* obtained from institution in which participant is a student or anticipated to be a student
  
  o **Post-doctoral:** time spent once participant departed or graduated from STEM doctoral program
    
    ▪ *Home:* obtained from immediate or extended family or from community members in which family has ties.
    
    ▪ *School:* obtained from institution in which participant is a student or anticipated to be a student

• **Cultural:** the characteristics of the mind and body which include cultural values and personal preferences and academic achievements. Related to their expressions of self-worth and self-efficacy.
  
  o **Pre-doctoral:** time spent as student in prekindergarten-undergraduate
    
    ▪ *Home:* obtained from immediate or extended family or from community members in which family has ties.
    
    ▪ *School:* obtained from institution in which participant is a student or anticipated to be a student
  
  o **Master’s:** time spent as student in master’s program prior to entering STEM doctoral program
    
    ▪ *Home:* obtained from immediate or extended family or from community members in which family has ties.
    
    ▪ *School:* obtained from institution in which participant is a student or anticipated to be a student
  
  o **Doctoral:** time spent as student in STEM doctoral program
• **Home**: obtained from immediate or extended family or from community members in which family has ties.

• **School**: obtained from institution in which participant is a student or anticipated to be a student

  o **Post-doctoral**: time spent once participant departed or graduated from STEM doctoral program

    • **Home**: obtained from immediate or extended family or from community members in which family has ties.

    • **School**: obtained from institution in which participant is a student or anticipated to be a student

• **Social**: the collective real and possible resources connected to institutionalized relationships of mutual acquaintances and recognition, i.e., it is dependent on one’s group membership. Related to the ability to form a viable social network within doctoral program and the size and diversity of that network from which the student can invariably find peer or mentor support.

  o **Pre-doctoral**: time spent as student in prekindergarten-undergraduate

    • **Home**: obtained from immediate or extended family or from community members in which family has ties.

    • **School**: obtained from institution in which participant is a student or anticipated to be a student

  o **Master’s**: time spent as student in master’s program prior to entering STEM doctoral program

    • **Home**: obtained from immediate or extended family or from community members in which family has ties.

    • **School**: obtained from institution in which participant is a student or anticipated to be a student

  o **Doctoral**: time spent as student in STEM doctoral program

    • **Home**: obtained from immediate or extended family or from community members in which family has ties.

    • **School**: obtained from institution in which participant is a student or anticipated to be a student

  o **Post-doctoral**: time spent once participant departed or graduated from STEM doctoral program

    • **Home**: obtained from immediate or extended family or from community members in which family has ties.

    • **School**: obtained from institution in which participant is a student or anticipated to be a student

• **Activation of capital**: participant is able to draw on previous social and/or cultural capital in a new educational context/institution to build new social networks and sustain previously acquired or accumulate new cultural capital.

  o **Pre-doctoral**: time spent as student in prekindergarten-undergraduate
Dimensions of fictive/alternative fictive kinship

- Presence of peers and/or sense of belonging: educational institution has enough peers of similar heritage or creates a culture where despite differences participant feels they comfortably fit socially and culturally.
  - Pre-doctoral: time spent as student in prekindergarten-undergraduate
    - Home: obtained from immediate or extended family or from community members in which family has ties.
    - School: obtained from institution in which participant is a student or anticipated to be a student
  - Master’s: time spent as student in master’s program prior to entering STEM doctoral program
    - Home: obtained from immediate or extended family or from community members in which family has ties.
    - School: obtained from institution in which participant is a student or anticipated to be a student
  - Doctoral: time spent as student in STEM doctoral program
    - Home: obtained from immediate or extended family or from community members in which family has ties.
    - School: obtained from institution in which participant is a student or anticipated to be a student
• Absence of peers: educational institution has no peers (or so few diffused among different educational levels) of similar heritage or creates a culture where cultural differences seem heightened and participant feels they do not comfortably fit socially and culturally.

  o Pre-doctoral: time spent as student in prekindergarten-undergraduate
    ▪ Home: obtained from immediate or extended family or from community members in which family has ties.
    ▪ School: obtained from institution in which participant is a student or anticipated to be a student

  o Master’s: time spent as student in master’s program prior to entering STEM doctoral program
    ▪ Home: obtained from immediate or extended family or from community members in which family has ties.
    ▪ School: obtained from institution in which participant is a student or anticipated to be a student

  o Doctoral: time spent as student in STEM doctoral program
    ▪ Home: obtained from immediate or extended family or from community members in which family has ties.
    ▪ School: obtained from institution in which participant is a student or anticipated to be a student

  o Post-doctoral: time spent once participant departed or graduated from STEM doctoral program
    ▪ Home: obtained from immediate or extended family or from community members in which family has ties.
    ▪ School: obtained from institution in which participant is a student or anticipated to be a student

• Isolation: The inability to fit socially/culturally/academically with peers or faculty results in a feeling of aloneness within institution.

  o Pre-doctoral: time spent as student in prekindergarten-undergraduate
    ▪ Home: obtained from immediate or extended family or from community members in which family has ties.
    ▪ School: obtained from institution in which participant is a student or anticipated to be a student

  o Master’s: time spent as student in master’s program prior to entering STEM doctoral program
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    - **Home**: obtained from immediate or extended family or from community members in which family has ties.
    - **School**: obtained from institution in which participant is a student or anticipated to be a student

- **Support**: Whether from faculty, peers, or family participant feels they are encouraged to be successful within their doctoral program.
  - **Pre-doctoral**: time spent as student in prekindergarten-undergraduate
    - **Home**: obtained from immediate or extended family or from community members in which family has ties.
    - **School**: obtained from institution in which participant is a student or anticipated to be a student
  - **Master’s**: time spent as student in master’s program prior to entering STEM doctoral program
    - **Home**: obtained from immediate or extended family or from community members in which family has ties.
    - **School**: obtained from institution in which participant is a student or anticipated to be a student
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APPENDIX K

THE UNIVERSITY OF AKRON INTERNAL REVIEW BOARD (IRB)

NOTICE OF APPROVAL

January 16, 2014

Senaita Beieroth

From: Sharon McWhorter, IRB Administrator

Re: IRB Number 2013-0094: "Camera as a Tool for Examinin Underrepresented Students' of Color Experience in STEM Doctoral Programs"

Thank you for submitting your IRB Application for Review of Research Involving Human Subjects for the referenced project. Your application was approved on January 10, 2014. Your protocol represents minimal risk to subjects and matches the following federal category for exemption:

☐ Exemption 1: Research conducted in established or commonly accepted educational settings, involving normal educational practices.

☐ Exemption 2: Research involving the use of educational tests, survey procedures, interview procedures, or observation of public behavior.

☐ Exemption 3: Research involving the use of educational tests, survey procedures, interview procedures, or observation of public behavior, not exempt under category 2, but subjects are recruited or appointed public officials or candidates for public office.

☐ Exemption 4: Research involving the collection or study of existing data, documents, records, pathological specimens, or genetic data.

☐ Exemption 5: Research and demonstration projects conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine public programs or benefits.

☐ Exemption 6: Taste and food quality evaluation and consumer acceptance studies.

Annual continuation applications are not required for exempt projects. If you make changes to the study’s design or procedures that increase the risk to subjects or include activities that do not fall within the approved exemption category, please contact me to discuss whether or not a new application must be submitted. Any such changes or modifications must be reviewed and approved by the IRB prior to implementation.

Please retain this letter for your files. This office will hold your exemption application for a period of three years from the approval date. If you wish to continue this protocol beyond this period, you will need to submit another Exemption Request. If the research is being conducted for a master’s thesis or doctoral dissertation, the student must file a copy of this letter with the thesis or dissertation.

By: N. Makk - Administrator

Cc: Valeria Callanan - IRB Chair

☑ Approved consent forms enclosed

269