TRIPLE-BINDS AND UNINTENDED CONSEQUENCES:
EXPLORING SCIENTIFIC DISCURSIVE IDENTITY DEVELOPMENT WITH
THREE WOMEN OF COLOR

A dissertation presented by

Heather M. Falconer

to the Department of English

In partial fulfillment of the requirements for the degree of Doctor of Philosophy

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College of Social Sciences and Humanities
Northeastern University Boston, Massachusetts

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ABSTRACT OF DISSERTATION

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Abstract

In the past decade, the educational literature has been steadily growing with regard to racial and gender disparities in STEM education and their systematic roots. Yet, much of this work has focused on where our systems have failed students. This dissertation adds to this body of knowledge through the lens of success. Through case studies of three students participating in a highly successful inner city undergraduate research program from August 2015 to August 2017, I explore how female students of color in science “use language to symbolically cue their [identities]”– in other words, develop discursive identities – as scientists (Brown, Reveles, & Kelly, 2005). I explore the roles reading, writing, speaking, and listening for academic purposes play in that process. Data gathered includes over 16 hours of student interviews, over 12 hours of mentor and administrator interviews, 18 student research proposals (including all drafts with mentor feedback), and direct observation memos. Through the use of emergent thematic analysis (Boyatzis, 1998) and coding for rhetorical conventions of scientific discourse (using Hyland, 2005 and Swales, 1990 as referents), I examine each students’ experience in granular detail. A conceptual model of discursive identity development is presented that clarifies the influence of factors that push and pull students to and from the discourse. Findings from this research bring into focus the relationship between situated learning and discursive development, highlighting that situated learning alone does not appear to be sufficient for the development of rhetorical awareness or skill (particularly for historically marginalized groups). However, situated learning combined with positive mentor-mentee fit and explicit writing instruction through a mentored writing approach may help those at the threshold of their disciplines begin to acculturate to the ways of knowing, being, and communicating endemic to the discipline. Findings also highlight that exposure to genres and discourse early and often builds a knowledge base that can influence
discursive identity development. These student experiences have the potential to be a rich resource for understanding the ways in which such factors influence the persistence of women of color in STEM and, more importantly, educational strategies for helping them succeed in the field.
For Iain and Lachlan.

“You may encounter many defeats, but you must not be defeated. In fact, it may be necessary to encounter the defeats, so you can know who you are, what you can rise from, how you can still come out of it.” ~ Maya Angelou

Faites toi
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This dissertation was written in the interstitial spaces. On scraps of paper riding the Red Line. In late-night boughts of insomnia and pre-dawn hours of resolve. In the few hours between school drop-off and pick-up; the quiet of office hours; the marathon sessions during summer camp. Mothering as a doctoral student has meant that neither being a mother, nor being an academic, has been done with any sense of normalcy. What normalcy has existed is due in large part to the generous and thoughtful people who have surrounded me and to whom I would like to now give thanks.

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List of Abbreviations

STEM........Science, Technology, Engineering, and Mathematics
HSI..........Hispanic-Serving Institution
MSI..........Minority-Serving Institution
LUPC.........Large, Urban Public College (pseudonym for research site)
PURS.........Program for Undergraduate Research in Science (pseudonym for program)
URE..........Undergraduate Research Experience
WAC/WID.....Writing across the Curriculum/Writing in the Disciplines
IMRaD.........Introduction, Methods, Results and Discussion
Chapter 1: Introduction

This study, in many ways, began in the early 1990s with my own struggle to become a recognized scientist. As a low-income female at a wealthy private college, attempts to acculturate into the field of science were disrupted by my own under-preparedness, male professors who did not see women as belonging in the field, and an inability (because of financial resources) to participate in the many extracurricular activities (i.e., unpaid internships) that led to job placement and graduate school acceptance. At the time, of course, I didn’t recognize this disruption as something outside of my own skills and abilities. Instead, I saw these as evidence of my inability to “do science.”

With time and life experience, however, I came to recognize that my inability to acculturate and make a career in science was similar to many others’, and not entirely in my control. The “pull yourself up from the bootstraps” mentality that permeates American society is fraught with tensions and obstacles that are rarely explicitly addressed by and with those whom they most powerfully affect.

In 2009, I took on the role of Science Grants and Projects Administrator for the research foundation of a large, public university system. Placed in the largest 4-year Hispanic-Serving Institution in the northeast, I was tasked with helping to build capacity for academic programs in science serving students much like myself. Though most of these students identified as part of Latinx, African-American, and Asian-American communities, many of them were women and almost all of them came from low-income households. These were students who, like I had, worked part- or full-time jobs to pay for tuition, housing, and food. They juggled family commitments and expectations with the rigor of an academic discipline with specific modes of communicating and expectations for participation. They were trying to negotiate membership in
a new community with very specific ways of being, thinking, and knowing while keeping one or both feet rooted in the communities that raised and supported them. The difference between them and me, however, was that they were making it work. They were figuring out how to become recognized members of the scientific community, publishing papers and moving on to postgraduate programs in various scientific fields.

As part of my professional role with the college, I designed and participated in assessment practices that would help us both report back to our granting agencies on project success, as well as offer insight into the initiatives that were having a real impact on student persistence and growth. The various initiatives were examined through the lens of Tinto’s (1993) framework of social and academic integration, showing how the institutionalization of the initiatives support student success throughout their collegiate experience (Carpi, Ronan, Falconer, Boyd, & Lents, 2013), as well as through Social Cognitive Career Theory to examine how the undergraduate research experience affects career choice (Carpi, Ronan, Falconer, & Lents, 2017). Through all of this research, however, the role of reading, writing, speaking, and listening was left unexamined.

As has been demonstrated by Lave and Wenger (1991), Wenger (1998), Winsor (1996), and Beaufort (2007), acculturating into a community of practice involves adopting the ways of being, thinking, and knowing of the community. Included in these ways are the communicative practices – the discourse conventions (Swales, 1990) – that help members of the community recognize other members of the community. During my time with the program, I was impressed at how students could enter the program with what could be considered poor writing skills (I was not privy to their reading skills), yet graduate with publications to their name. I wondered whether they were being explicitly taught the discourse conventions of their discipline, or if their
mentors simply carried them along in the writing aspects of science (e.g., providing pre-constructed data sheets to fill out or proposal text to revise). I wondered whether students’ prior knowledge about science and the genres common to the community helped or hindered their development as scientific writers; whether their identities as women, minorities, or low-income students permeated this writing and was revealed or suppressed. To that end, this research project was born.

In March 2015, after consulting with (at that time, potential) members of my dissertation committee, I reached out to my contacts at the college to explore whether there was interest in allowing me to conduct a research project into the discursive practices of students within the undergraduate research program. The response was overwhelmingly positive, and after working through the main research questions this project would answer, and the methodology most appropriate for answering such questions, Institutional Review Board approval was sought and received in August 2015 – first from RF-CUNY (IRB# 2015-0770), and subsequently from Northeastern University (IRB# 15-09-16).

This dissertation is part of a larger, longitudinal case study of the Program for Undergraduate Research in Science (PURS – a pseudonym), a unique undergraduate research program housed within a large, urban public college (a senior college within a major university system). What makes this program particularly interesting is not simply its structure (it conducts real-world research in physical and computer sciences), but that the majority of the students participating in it are women of color – predominantly Black and Latina; populations largely
underserved nationally in higher education.\textsuperscript{1} Further, since its inception in 2006, the program has had great success in placing students in graduate programs (particularly PhD, MD, and MPh programs) – something that was virtually unheard of for graduates of the Forensic Science major before its creation. In more recent years, the number of Research-1 institutions comprising these acceptances has also increased, likely a result of the professionalization that occurs as part of the program (e.g., publishing research and presenting at scientific conferences).

It is worth noting, here, that the extensive data being collected for this longitudinal project lends itself to examination through various lenses. For example, the role of the institution and PURS proper (including positioning through documents); a feminist examination of the experiences of women of color with members of different genders and/or ethnicities; or the comparison of undergraduate research experience by gender and/or ethnicity. Though the IRB approvals cover such a large data corpus (including students from both genders, and from White as well as different Latinx, Black, and Asian ethnicities), I have consciously chosen to present in this dissertation a selection of case studies representing women of color, with particular emphasis on mentoring, writing instruction, and prior knowledge. The rationale for that choice will become evident in the sections that follow.

It is also worth noting, here, that I am approaching this research interdisciplinarily – drawing on education, writing, linguistics, and cultural studies to understand what is happening in these participants’ experiences. I am intentionally not drawing on rhetoric of science (i.e.,

\textsuperscript{1} In the 2015-2016 academic year, 70\% of students and 38\% of faculty mentors identified as female; 78\% of students and 38\% of faculty mentors identified as people of color.
Kuhn, Fahnestock, Bazerman) because my interest is not on how the discipline is using discourse, but how the participants are representing their scientific selves through discourse.

**Need for Research**

According to the Higher Education Research Institute (2010), underrepresented racial minorities “have reached parity with their White and Asian American counterparts in terms of their proportional interest in majoring in STEM disciplines at the beginning of their undergraduate studies” (n.p.); however, the disparity in completion rates and post-graduate study across races remains substantial. The most recent data from the National Science Foundation (2012) identifies 72% of the undergraduate degrees awarded in the United States as going to individuals who are White. Of the remaining, only 12% are awarded to Blacks and Latinxxs (6% to each group). The distribution by gender is more hopeful, with women representing 57.3% of those undergraduate degrees. However, of all degrees awarded to women, only 11% are believed to be to women of color, and the statistics for all women in the STEM workforce drop off significantly (they are earning undergraduate degrees, but not working in the field or persisting to graduate programs) (see Figure 1).

These disparities have been attributed to a number of factors: familial responsibilities in addition to academics, a lack of academic mentorship, need for a community of peers, and the missing experience of succeeding in self-directed, academic endeavors (Arana, Castaneda-Sound, Blanchard, & Aguilar, 2011). They have also been attributed to cultural conflict in the classroom as a result of White, European educational frameworks (Delpit, 2006; Gay, 2010), as well as the marginalizing rhetoric of scientific discourse (Kahle, 1988; Kelly, 1985; Lederman, 1992; Yager & Yager, 1985; Mason, Kahle, & Gardner, 1991; Bonilla-Silva, 2010; Torres, 2012). However, despite a growing body of research on these disparities and their systemic roots,
Figure 1: A breakdown of representation by race/ethnicity and gender of all doctorate-holding individuals in the workforce in 2013 (NSF, 2017).

the overwhelming majority of research on gender has focused on the experiences of White women, and the overwhelming majority of research on race/ethnicity has focused on males. Disturbingly little research has been conducted with individuals who not only have the double oppression of being both female and a racial/ethnic minority, but also the third oppression of
their chosen discipline – science (Cobb, 1975). The examination of intersectional identities of women of color within science disciplines is necessary if we as a nation are truly interested in increasing the number of women and minorities not simply studying, but also working in STEM disciplines. It is also critical in this research to ask whether the focus on men of color and White women in STEM has had the unintentional consequence of once again “othering” minority women by reinforcing a stereotype that women of color do not exist in STEM and/or are not interested in pursuing STEM careers.² Without critically examining the conditions of schooling for minority women – in this case, undergraduate research at a Hispanic- and Minority-Serving Institution – we may be unintentionally excluding, and also obscuring, areas ripe for reform.

This research project aims to provide insight into this triple-bind by exploring more specific queries relevant to STEM education and writing in the disciplines: 1) What are the experiences of female students of color in science within the context of an undergraduate science research program?, and 2) How does this experience affect their development of discursive identities as scientists? In examining these questions, considerations of prior knowledge, genre, and culture naturally arise. As do institutional and program factors (i.e., a Minority- and Hispanic-Serving Institution located in a large, urban city).³

² By way of example, a review of data collection by agencies such as the National Science Foundation demonstrate that data are collected by race and gender, but are not parsed by both (we know how many men and women are studying and working in STEM, but we do not know exactly how many of those women are women of color). This omission alone makes women of color in science invisible.
³ An exploration for what accounts for the success of the PURS program itself will be taken up elsewhere when examining the role of the institution in discursive identity development.
Significance of Research to Writing Studies, Writing across the Curriculum

Many scholars in rhetorical genre studies prioritize the influence of time and exposure in successfully developing rhetorical awareness of disciplinary discourse conventions (Hare & Fitzsimmons, 1991; Freedman, 1993; Smit, 2004; Brent, 2012). Yet, most undergraduate science students are not exposed to authentic disciplinary texts during their four-year degree. This is certainly the case at my research site. And while the educational literature praises situated learning (Lave & Wenger, 1991) through undergraduate research experiences as being transformative for STEM students because of its influence on reflective judgment and professionalization, the research presented here suggests that situated learning alone is not sufficient for the development of rhetorical awareness or the development of a discursive scientific identity – particularly with historically marginalized groups. Further, undergraduate research experiences are chiefly relegated to large Research-1 institutions, where predominantly upper-class students preferentially benefit. Minority-Serving Institutions and two-year colleges, where these programs are arguably most necessary, are among the least prepared in terms of available financial support and laboratory infrastructure to offer such experiences to students.

Additionally, in the writing in the disciplines literature, little research exists as to the education of underrepresented minorities in STEM. Significant contributions have been made to the body of knowledge in terms of how students from low socioeconomic backgrounds engage with the language and discourse of the academic community over time (see Sternglass, 1997; Herrington and Curtis, 2000; and Shaughnessy, 1977 for example); even more with regard to engagement at high-ranking and majority-serving institutions (see Poe, Lerner, & Craig, 2010, as well as Connolly & Vilardi, 1989, and Sorcinelli & Elbow, 1997). More recently, scholars have contributed to discussions on socially-situated reading identities (Alvermann, 2001), the
alignment of student identity with instructor expectations (Fairbanks & Ariail, 2006), and the negotiation of individual identities with the figured worlds of reading classrooms (Frankel, 2016).

Within discipline-specific contexts, however, there is still very little research into how individuals from marginalized communities acculturate into communities of practice that have historically relegated them to the periphery. Brandt (2008), for example, has offered insights into the material conditions of learning – how the “locations of possibility” within schooling can be leveraged to allow students (in Brandt’s case, indigenous women studying science) spaces for meta-discourse to flourish (p. 703). Brickhouse and Potter (2001) have examined how “the experience of marginalization [by young women of color in vocational schooling] can make membership in a school science community impossible or undesirable” (p. 965). More promising, Johnson, Brown, Carlone, and Cuevas (2011) have followed women of color through their education and early careers as scientists, examining the ways in which these women encountered and navigated the White, male-dominated field of science, and how their “opportunities to author legitimate science identities were constrained by their location in the matrix of oppression” (p. 339). Yet none of these studies examine the ways in which these scientific identities reflect or are reflected by the women’s discursive identities as scientists, nor the mediating factors in this identity development. In an educational climate where minority representation is a large concern – particularly in STEM disciplines – attention to the ways in which traditionally marginalized individuals negotiate academic and disciplinary boundaries rhetorically is paramount.

While research has been conducted on PURS regarding the ways students acculturate into these micro-communities of practice, it has been conducted on a program-wide level, focusing
on the ways in which the structure of Tinto’s (1993) framework for social and academic integration has been implemented at the college (Carpi, Ronan, Falconer, Boyd, & Lents, 2013), and how Social Cognitive Career Theory helps us understand the effect of undergraduate research experiences on the career choices of graduates (Carpi, Ronan, Falconer, & Lents, 2017). It has not examined the way the program structure, including mentoring and writing requirements, interacts with the intersectional identities of women of color. Additionally, the writing across the curriculum and writing in the disciplines literature as a whole is lacking regarding how individual students reconcile their own knowledge, experience, and identity with a discourse whose affordances and constraints are foreign, and whose rhetoric is traditionally marginalizing to women and minorities.

Possibly “the most salient [gap]” in the literature this project works to address, however, is “the need to address STEM pedagogy and curriculum for diverse populations as well as research on the relationship between pedagogical changes and cognitive outcomes for women of color” (Ong, Wright, Espinosa, & Orfield, 2011, p. 198). As Ong et al. argue, there is a strong need for research into “campus-based resources” that provide preparation for postgraduate programs in STEM, in particular “the role of mentoring to women of color in formal and informal settings” (p. 198). As the authors note, while some research into these topics has taken place at Historically Black Colleges and Universities and Predominantly White Institutions, “there is a dearth of literature on the distinct academic and social environments found at Hispanic-serving institutions (HSIs) and tribal colleges and universities (TCUs) as they pertain to the collegiate experiences of women of color in STEM” (p. 183).

This research works to address these concerns through an exploration of how three women of color in an undergraduate science research program “use language to symbolically cue
their [identities]” – in other words, develop discursive identities as scientists (Brown, Reveles, & Kelly, 2005, p. 781). As Burgess (2004) and Ivanič (1998, 2006) have argued, writing (and by extension speaking) is an enactment of identity:

Asking a person to write a particular type of text, using particular media, materials, and resources, and particular discoursal and generic features, in a particular context, will be requiring that person to identify with other people who write in this way. Writing demands in educational settings are also identity demands. (Burgess & Ivanič, 2010, p. 228)

Because recognition as a group insider is heavily influenced by discourse, this research has potential implications for those interested in retention and persistence of women of color in STEM, as well as for those interested in changing learning cultures and incorporating writing instruction into disciplinary arenas. The continued exclusion of women of color in STEM is not simply an issue of underutilized economic resources and innovation, but a concern of justice. Particularly for writing instructors who work across the curriculum, this research could provide insights into approaching writing instruction in new ways. Further, this project aims to provide insight into the various factors that influence the development of a scientific identity – factors that may also be applicable to other disciplinary areas and of interest to writing across the curriculum practitioners.

**Introduction to the Program Site and Researcher Positionality**

The research site I have identified for this project is a unique one that speaks directly to many of the inequalities noted in the previous sections. A four-year public institution located in a large, urban city, Large Urban Public College (LUPC – a pseudonym) has been recognized as the largest Hispanic-Serving Institution in the northeast (LUPC on the Move, 2006). Of the total
undergraduates enrolled at the institution, 45% identify as Latinx, 22% as Black, 10% Asian, and 23% White (Native American, Pacific Islander, and Native Alaskan students constitute less than 1% of the student body). Further, 41% of undergraduates are first-generation college students, 49% come from homes earning $30,000 or less per year, and 58% work while taking classes (many full-time) (LUPC, 2015).

The Program for Undergraduate Research in Science (PURS) – which is unique for Hispanic- and Minority-Serving Institutions – was begun in 2006 to provide opportunities for students in the Forensic Science major to gain research experience that would prepare them for graduate programs in the sciences (it has since been extended to students majoring in Computer Science and Cell and Molecular Biology). The initial pedagogical goals in creating the program were three-fold: 1) to facilitate the engagement of students with the Forensic Science curriculum so as to assist their passage through the major; 2) to increase graduate/professional school acceptance rates and career success for graduates; and 3) to assist in the creation of a professional community that would extend beyond their years at the institution (Carpi, Ronan, Falconer, & Lents., n.d.). In order to accomplish these goals, the program recognized that a multi-faceted approach was necessary to increase interest in and motivation for STEM-related academic career paths among students. Interestingly, but not surprisingly given the insular nature of disciplinary work, the multi-faceted approach focuses on mentoring, immersive experiences, career advice, research training, and academic tutoring in mathematics and science. It does not include formalized instruction in the discursive practices of scientists.

4 Though these goals are problematic in-so-far as they seek to acculturate minority students and women into the institutionalized White, male, middle-to-upper class framework of science rather than critique it, that discussion will take place elsewhere so as not to detract from the case studies presented here.
Over the course of five years (2009 through 2014), my role as the Grants and Projects Administrator for PURS allowed me direct exposure to the inner workings of the program – its intentions, the underlying educational philosophies, and the institutional ideologies influencing priorities. While the focus of my work was primarily to administer the program activities as decided by the Directors, for those five years I was able to directly observe and informally assess the various interventions. This experience has allowed me to identify particular areas where instruction is occurring in situ in response to exigencies created both by the program and by the research being conducted. It has also afforded me a unique position as both insider and outsider to the community: I know the program and its faculty/staff participants closely, but have never held a position of authority over any of them; further, having been retired from the program for four years, I am now seen almost as an alumna – someone who is “one of them” but who has no real stake in day-to-day program activities. In conjunction with my own early educational experiences, I believe that this positionality affords me a unique place as researcher, which allows me to effectively examine the research questions outlined in the next chapter. At the same time, however, I am aware of how this positioning may initially impede the research process in that mentors and staff already have preconceived ideas about me and my role, and students may perceive me as a person of authority due to prior affiliations. These are all factors I have consciously worked to address throughout the project.

Climate of Research

It is important, given my focus on women of color in a traditionally White, male discipline, to make a note about the social context in which this research has been taking place. This research began in August 2015. The social climate in the United States, and in New York City in particular, was already tense due to incidents surrounding police brutality and “broken
“windows” policies. At the research site, discussions related to the deaths of Eric Garner and Freddie Gray (among many others), the Black Lives Matter movement, and the Ferguson unrest continued to be common place, making race a prominent issue for many in this diverse community. At the same time, the college itself dealt with hate crime incidents on a smaller scale (e.g., swastikas spray-painted in campus bathrooms).

During the course of this research, the 2016 presidential election and the Electoral College win of Donald Trump brought race, gender, socioeconomic class, and legal status of immigrants to the forefront. The new administration also brought with it a perceived war on science. All of the students who participate in the larger project this dissertation draws on in one or more ways belong to groups that are targeted by far right rhetoric: women, African-Americans, Latinos and Latinas, immigrants (some Dream students), Muslims and those who are assumed Muslim due to ethnicity. In short, issues of security – personal and familial – on a daily basis have been inescapable for the participants in this study. In some instances, this has affirmed students’ identities and solidified their need to be representatives in science. In other instances, these tensions appear to have further marginalized students and suppressed their desires to pursue science as a career. I have carefully and consciously stayed true to students’ representations of these experiences, drawing as much as possible on direct quotations to let their voices and experiences be heard.

**On Terminology**

Because of the nature of this research and its focus on people, it is important to take a moment to address the terminology used in this dissertation. The language used to describe groups of individuals (particularly with regard to race/ethnicity), as well as institutions, frequently aligns with the categories used by data collection and reporting agencies (e.g., NSF,
the U.S. Census Bureau). Where these references occur in quotations or participant demographic profiles, I defer to the choices made by the author, speaker, or participant. In some instances (e.g., Latinx), I have consciously opted for the gender-neutral form. The terms most commonly used in this research include: African American, Black, Hispanic, Latina, Native American, Indian, and Asian American. Within this dissertation, I use Black and Latinx primarily, selecting African American and Hispanic when discussing institution types and statistics drawn from national agencies. The terms women of color, minority women, and female students of color are used interchangeably.

Throughout this dissertation, I use the term “science” broadly, while also referring to “Forensic Science” and “Forensic Entomology” specifically. While each subdiscipline has its own unique ethos – for example, Forensic Scientists are explicitly concerned with the use of scientific evidence to solve crimes and be used in a court of law – many of the rhetorical approaches used by the various subdisciplines are consistent across them. When I use the term “science,” I am invoking practices that are common to scientific fields generally; specific subdisciplinary conventions are explicitly referred to by name.

Finally, a note about names. All names used are pseudonyms. Some have been chosen by the participants directly, others assigned by me. In all cases, I have deferred to the way participants refer to others – for example, many of the student participants refer to their mentors by last name only; in some instances, use “Dr.”; in others by first name only. Because these rhetorical choices carry power (they connote a level of respect and familiarity), I have been true to those students’ choices. Pseudonyms have been selected based on a generic, common equivalent that matches the self-identified ethnicity of each individual.
Definition of Terms

Discourse: Written and spoken communication that is intimately connected to the social circumstances in which an individual is conditioned (see Fairclough, 1989).

Discursive identity: The identity an individual creates through writing and speaking. Though similar to “the discoursal self” (Ivanič, 1998), discursive identity is a matter of embodiment, not simply performativity. The discourse has become one’s own and reflects one’s understanding of themselves within a given community.

Dissociation: In its most literal sense, the separation of one thing from another. In this project, dissociation is being used to describe the state of being so new to a discourse or discipline that there is little understanding of how to perform (physically/discursively) as a member of that new community, and a lack of personal identification with that community.

Embodiment: To make a part of, of incorporate into, an existing discourse, identity, or practice. In this project, embodiment refers to an individual’s acceptance of scientific discourse, identity, and practice as their own – as something they have a right or claim to, not as something separate from them.

Genre: Drawing on Miller (1984), genre here is the typified response to a (seemingly) recurrent rhetorical situation and is the residue of social action, situated in time and space.

Identity: Who or what an individual sees themselves as. This include what “rights [and] duties” (Davie and Harre, 1990) they ascribe to themselves as having – in other
words, where they ‘belong’ and what they see themselves as being able, and not able, to do.

Intersectional identity: As first presented by Kimberlé Williams Crenshaw (1991), refers to the various social identities an individual has, the spaces where they intersect and/or overlap (e.g., being Black and Queer, being female and socioeconomically disadvantaged), and the relationship of these overlapping identities to power.

Mentee/protégé: A newcomer or less seasoned individual within a specific context who receives guidance from a more senior individual.

Mentor: An individual who is seasoned within a specific context and serves as an adviser to a less seasoned individual.

Scientific identity: The identity one has as a scientist. Their position in the field of science as determined by themselves and others.

Underrepresentation/overrepresentation: Within a discipline (i.e., science, engineering), the representation of a particular demographic in relation to their portion of the populace at large. For example, the number of Latinxs working in academia compared to the number of Latinxs composing the U.S. population.

Underrepresented minority: Refers to a member of a group that is underrepresented within a given context. In higher education and science, for example, “underrepresented minority” typically refers to Black, Latinx, and Indigenous peoples. In science, women are also considered an underrepresented minority, though that status is beginning to change.
Chapter 2: Theorizing Discourse and Identity

Theoretical Framework

At the heart of this project are two major areas of focus: discourse and identity. Only in the consideration of the two together can we gain any grounds in exploring discursive identity, or the ways in which we construct and embody identities in and through discourse. In this research, I draw upon Fairclough’s (1989) definition of discourse, where language is considered “a form of social practice,” which by extension means that it is “socially determined” (p. 20-21). “Language,” Fairclough argued, “is not a product of individual choice, [as Saussure claimed,] but a product of social differentiation – a language varies according to the social identities of people in interactions, their socially defined purposes, social setting, and so on” (1989, p. 21). At the same time, the individual’s selection of what language to take up and how either reinforces or critiques. As Ivanić (1998) notes, using a specific discourse “is an act of identity in which people align themselves with socio-culturally shaped possibilities for self-hood, playing their part in reproducing or challenging dominant practices and discourses, and the values, beliefs and interests which they embody” (p. 32). The nature of these variations make discourse inherently political; it is deeply embedded in struggles for power, is rooted in social structures, and is ideologically shaped (Fairclough, 1989, p. 17). Thus, discourse is a perfect fit for discussions of equity in education.

Similarly, identity – how we see ourselves, the world, and our place in the world – is critical in understanding how women of color present themselves within professional discourses. In understanding identity, I draw upon the work of Vygotsky (1978) and social psychology, and in particular Rom Harré, whose early discussions of “positioning” with Davies (1990), and later theorizing with Moghaddam (2003), help explicate how individuals understand themselves, the
world’s social order, and their appropriate place within it. Positioning theory, with its roots in discursive psychology, is far more suited than other social psychology frameworks\(^5\) in understanding how the scientific writing, reading, speaking, and listening practices of women of color positions these students within the construct of an undergraduate research program, as well as in the professional field of science as a whole. Further, this conceptualizing of positioning helps clarify the “subject positions” that Fairclough explains as being central in discourse, because “it is only by ‘occupying’ these positions” that one becomes a scientist, and is recognized as such (Fairclough, 1989, p. 31). Because of this deeply intertwined nature, I will introduce identity and positioning theory first, and then discuss its connection to discourse after.

**Constructing Identity**

Defining ‘identity’ is not a simple task. As Ivanič (1998) notes, researchers across disciplines have historically conflated identity with terms like “role,” “self,” – even “subject position” (p. 10). In the scholarship of writing studies and linguistics, identity has likewise been conceptualized in a variety of ways that, if not in disagreement with one another, certainly make it challenging to know what, exactly, is being examined. What is seen as constituting identity and the methodological approaches to its examination varies from researcher to researcher.

For example, Brickhouse and Potter (2001) conceptualized identity in young women of color in an urban high school as “[referring] to one's understanding of herself in relation to both her past and potential future. Identity refers to ways in which one participates in the world and

\(^5\) After consideration of my research questions alongside various social psychology frameworks – for example, multiple identities (Jones & McEwan, 2000; Abes, Jones, & McEwan, 2007), agency, and figured worlds (Holland, Lachicotte, Skinner, & Cain, 1998) – it became clear that positioning theory was the framework that would get me closest to answering those questions outlined above.
the ways in which others interpret that participation” (p. 966). To that end, the authors relied on students’ perceptions of themselves as computer scientists (or potential computer scientists), as well as the perspectives of the students’ science teachers, in assessing that identity formation. This, in many ways, suggests that identity construction is a conscious act and, whether intentionally or not, does not account for the social constructs that have (subconsciously) helped shape that identity.

Similarly, Carlone and Johnson (2007), in their study of the science experiences of 15 successful women of color, described science identity as accounting “both for how women make meaning of science experiences and how society structures possible meanings” (p. 1187). However, in this work the authors took the construction of identity further than simply perception by devising a model for assessing identity based on three factors: competence, performance, and recognition. According to the authors,

Identity is not simply what an individual says about her relationship to, abilities in, or aspirations regarding science; it is not purely an emic construct …. Identity arises out of the constraints and resources available in a local setting. Identity is not just something an individual feels; it is not even what an individual does, although both feelings and actions are components of identity. A science identity is accessible when, as a result of an individual’s competence and performance, she is recognized by meaningful others, people whose acceptance of her matters to her, as a science person. (p. 1192).

This is in alignment with Gee’s (2000) argument that individuals are recognized as a “certain ‘kind of person’” whenever they act or interact with others, and that the “kind of person” they are recognized as is mediated by the interaction’s context and participants (p. 99). Since there are a multitude of interactions an individual can participate in, “all people have multiple identities,”
multiple selves, based on how they perform – or position themselves – in a given interaction (Gee, 2000, p. 99).

In this research, I see identity as both fluid and dynamic. How we see ourselves and identify with others (and are identified by others) is the product not just of the immediate context or circumstance, but of all those that have come before. In this way it is cumulative, with each interaction either reinforcing prior experiences and conceptions, or deconstructing them. It is also, as Fairclough argued, deeply entwined with discourse. How we speak and write – our word choices and dialects, inflections and accents, volume – reifies identity both inwardly and outwardly. Our desire and ability to shift from one identity into another is influenced not only by the interactions between the old and new, but also by social considerations that direct what rights to that new identity we see ourselves as having (or believe are possible). The Methodology section that comes later in this chapter will explicitly discuss the analytical approach I have taken to tease out the connection between an individual’s scientific identity and their representation of that identity in discourse.

**Positioning Theory**

“Positioning” is a concept originally introduced by Ries and Trout (1981) as a marketing tool that refers to the creation of a perception of a product, brand, or company. Through positioning, an identity is constructed in the mind of the target audience, often through visual rhetoric, which allows “one to ‘place’ a certain product among its competitors” (van Lagenhove & Harré, 1994). This constructed identity guides how the target audience sees and engages with the product, brand, or company.

In 1984, Wendy Holloway brought the concept of positioning into the realm of social psychology and gender studies, using it as a means to conceptualize gender differences and
subjectivity in discourse, arguing that “discourses make available positions for subjects to take up. These positions are in relation to other people. Like the subject and object of a sentence […], women and men are placed in relation to each other through the meanings which a particular discourse makes available” (p. 236). This conceptual framework allowed Holloway to make claims as to why women speak less frequently in mixed-gender groups than they do in gender-homogenous groups – her explanation being that in heterogeneous groups women are positioned as having fewer rights than the male group members. Such positioning, Holloway argues, is something done to women and takes away a woman’s ability to act.

Taken up by Davies and Harré in 1990, and extended by Harré, Moghaddam, and others in the decades since, “positioning theory” has become a foundation block of discursive psychology and has proven to be a useful tool for examining identity, and particularly discursive identity, in practice. It is, as Harré (2004) explains, “the study of the way rights and duties are taken up and laid down, ascribed and appropriated, refused and defended in the fine grain of the encounters of daily lives” (p. 4). With each speech act (whether spoken or written), we locate ourselves as well as others within larger communities and contexts, claim rights “for ourselves and place duties on others” (Harré and Moghaddam, 2010, pp. 2-3). We author selves (Ivanič, 1998) through performativity of perceived discoursal norms, and over time develop a discursive identity as an insider through our embodiment of those norms.

It is worth noting, here, that at the same time Davies and Harré were explicitly theorizing positioning in psychology, Fairclough was likewise exploring the same concept in linguistics, which has been effectively taken up by Clark and Ivanič (1997) in their exploration of politics and writing, and Ivanič (1998) and Burgess (2004) in exploring writing identity (or the “discoursal self”) in UK adult education. Drawing on the Vygotskian view of identity as being
located outside of the individual person and socially constructed through interactions with others through social relations, Fairclough argued that identity and ideology are critical factors in what “resources” – or “cultural capital” (Bourdieu, 1977) – an individual brings to their discursive practices (p. 24). Davies and Harré similarly explored the ways in which our world-views influence our reading, writing, speaking, and listening practices; however, their work drilled even deeper down into the ways in which these ideologies and identities are shaped through social structures.

“Positions,” Harré and Moghaddam (2003) argue, “exist as patterns of beliefs in the members of a relatively coherent speech community,” which are reified in discourse conventions, performativity, and epistemology (p. 4). However, positioning goes much deeper than simply adhering to discourse conventions. Davies and Harré (1990) argue that how we see and interpret ourselves, the world, and our place in the world involves a series of interconnected processes. We must first understand that categories exist that include some individuals while excluding others (for example, gender, race, and socioeconomic class). We must also participate in discursive practices through which these categories are not only reinforced, but ascribed meaning (e.g., white is good, girls are sensitive). Then, we must position ourselves in relation to these categories and meanings, which “involves imaginatively positioning oneself as if one belongs in one category and not in the other” (n.p.). This last element involves recognizing oneself as having the attributes and characteristics of a group and subsequently committing to the group and “the development of a moral system organized around the belonging” (n.p.). This moral system is deeply tied to the ways of being in the group – what it means to perform as a group member (for example, scientists have a moral obligation to be objective, conduct methodologically sound research, etc.). The degree to which an individual adheres to this moral
system is intricately linked to their perception by others (their *positioning* by others) as a group insider.

For Davies and Harré, becoming a group insider is not as simple as performing or engaging in a discourse appropriately. At its heart is the examination and *embodiment* of the rights and duties an individual believes they have within a given context, as well as those rights and duties others ascribe to them. What an individual does (and says/writes) within a given situation is dictated both by what they are physically and cognitively *able* to do, as well as what they believe they are permitted or forbidden to do. Such beliefs include an individual’s personal history (what they have done or been perceived of as in the past, and includes group histories like race, gender, class, and educational experience) as well as their individual attributes (i.e., mental, characterological, and/or moral). These beliefs can directly or indirectly position someone favorably or unfavorably within a given context.

Equally important to address, here, is that positioning has both physical and rhetorical power. We place things, ideas, words – people – where we think they belong. Mountford (2001) explains that space can serve as a metaphor “to describe the cultural landscape of laws, customs, and beliefs that form the geographies of our lives” (p. 41). These spaces “carry the residue of history upon them,” as well as “a physical representation of relationships and ideas” (p. 42). In addition to there being hierarchies and expectations to the relationships that take place within these spaces, there are expectations regarding *performance* (Mountford, 2001, p. 49-61). Our performance is linked to how well we are able to read the cultural “‘cues’ for how one must argue, act, or even be” within a given space (p. 41). When our performativity aligns with these expectations, we have power and a ‘position’ within the hierarchy; when it does not, we are marked as outsiders.
This power is linked to embodiment, and these aspects of positioning relate directly to my questions regarding the ways in which the development of a scientific identity is mediated by factors such as genre, discourse conventions, and cultural references. As a specific discourse becomes a constituent part of an individual’s language use, it allows others to recognize them as an authority within the communal space (i.e., within the field of science, within a laboratory).\(^6\) What is important to note in this discussion is that none of what has just been described occurs consciously – or, at least, is not commonly a conscious exercise in identity formation. Instead, these categorizations and practices, these ways of being, thinking, and seeing, are institutionalized and reified socially so that they become, as Fairclough noted, “common sense” (1989, p. 2). It is through this implicit buy-in that power is exercised and boundaries reinforced.

**Positioning in Discourse/Discourse as Positioning**

Discourse achieves its power largely through positioning. Who is allowed to speak? When? Who is expected to understand what is being said? And what are the connections of these affordances and constraints to societal categorizations such as class, race/ethnicity, and gender? As Fairclough explains,

Institutional practices which people draw upon without thinking often embody assumptions which directly or indirectly legitimize existing power relations. Practices which appear to be universal and commonsensical can often be shown to originate in the dominant class or the dominant bloc, and to have become *naturalized*. (1989, p. 33)

\(^6\) As will be discussed shortly, discourse alone is not sufficient. As Foucault hinted at in his later works, discourses “must be experienced and embodied. Practices of ‘discipline’ inscribe power constellations and discourses into subjective experience and bodies” – what Wehrle defines as “normative embodiment” (Wehrle, 2016, p. 56). In the interest of continuity and argument, I have chosen to take up the discussion of how this happens and what it looks like in my presentation of the model of discursive identity development later in the chapter.
In this way, not only is discourse functioning ideologically, it is also functioning politically.

Access to language – particularly the *standardized* forms of language – are unequal because of where these languages are located. The association of standardized American English, for example, with “the most salient and powerful institutions” of the U.S. (higher education and the legal system, for example) means that this form of English has become “the language of the politically and culturally powerful,” and non-*standard* forms (as well as the groups associated with them) have been “stigmatized” (Fairclough, 1989, pp. 56-57).

Within the context of this research, we can view scientific discourse as a standardized form of disciplinary communication with a high barrier to access. Facility with scientific discourse (including genres and conventions, as well as jargon) is an asset, a form of cultural capital, because its use serves as a “passport” to well-paying jobs, further academic opportunities, and “positions of influence and power in national and local communities” (Fairclough, 1989 p. 57). It is also a discourse to which access is restricted -- through literacy practices, educational opportunity, and economics. This restrictedness helps reinforce a narrative of exceptionalism that often places scientists in opposition to laypeople, and makes science as a career seem out of reach to so many.

Such a narrative is not entirely false, however. To engage successfully with scientific discourse requires a high level of reading and writing proficiency, particularly in English; it requires the ability to reach the later stages of higher education, as most individuals do not begin reading scientific papers until their 3rd and 4th years in undergraduate coursework, or writing such genres until they reach the postgraduate level; and it requires not only the economic ability to pay for higher education for many years, but the ability to attend institutions that grant access to scientific publications (and if not, the ability to purchase access for oneself). Thus, the
exceptionalism that is imbedded in science is not necessarily one of innate brilliance and daily breakthroughs, but of access. Once through these gates, however, engaging successfully means negotiating the power relations and ideologies embedded in the discourse itself.

Some of these embedded ideologies are innocuous. For example, within the community of science, an author is expected to position themselves as having credibility and authority while still being part of the larger community of practice, which often is demonstrated through the use of the pronoun “we” (van Lagenhove and Harre, 1994, p. 9). Such positions are considered social in the sense that the beliefs are shared from one member to the other – e.g., “we” suggests joint activity; that what is being presented is a natural extension of the accepted knowledge base. In this way, “the speaker is not locating him or herself as the only authority, but positioning the audience both as following the talk and as working together” (van Lagenhove and Harre, 1994, p. 9).

However, not all embedded ideologies are as innocent or harmless. Many scholars have explored the construction of scientific discourse as masculine and White (see, for example, Kahle, 1988, Kelly, 1985, Gilbert & Yerrick, 2001). As Torres (2012) has effectively demonstrated, even discourse surrounding efforts to promote gender and racial equity and science at institutions such as Iowa State University positions equity and diversity as primarily an economic issue, maintains “male dominance and the general status quo,” and positions “the ‘universal woman’ and the normalization of Whiteness” (p. 33). Thus, it is not the discourse of science alone that marginalizes, but includes the discourse surrounding science (i.e., institutional initiatives, programming).
Combined with the historical positioning of people of color and women as the subjects of science, as opposed to the practitioners, such discourse has contributed not only to distrust between communities of color and that of science, but also to a lack of minority representation both in higher education broadly, and STEM specifically. One goal of the longitudinal research that this dissertation is part of is to shed insight into the role of agency in this positioning and the ability (or not) of these women of color to critique the dominant modes of power in science, rather than conform.

**Conceptualizing a Model of Discursive Identity Development**

As noted earlier, we author “selves” whenever we speak or write – through the language choices we select, our intonation and rhythm, how we engage with genres and read our audience. Ivanič (1998) defines this as the “discoursal self” – the impression one creates through discourse of who they are: “Every time people write, they reaffirm or contest the patterns of privileging among subject positions which are sustained by the relations of power in the institution within which they are writing” (p. 33). This discoursal self is mediated by the “autobiographical self” – the writer’s “sense of themselves” within these institutions and power relations. It is only

7 The institutionalization of racism in the U.S., for example, can be directly attributed to scientific theories from individuals such as Louis Agassiz, E.B. Tylor, and Frances Galton. Agassiz, a great orator and proponent of science with strong connections to Harvard University, was a polygenist who believed people of color to be biologically inferior, and therefore justified to be enslaved and colonized. Tylor, similarly, used the measurements of craniums and nose widths by anthropologists to argue for biological determinism, asserting that since all races originated from one point, Whites must be the realization of the evolutionary process and thus at the top of the hierarchal pyramid (Lorimer, 375-376). Galton appropriated Tylor’s theory and used it to build his concept of Eugenics – that by proper genetic selection one could and should improve mankind even further (Mayr, 1997, p. 246). “Improvement” was made by selecting for the ideal: White, intelligent, attractive and talented. Galton’s plan would lead to mass involuntary sterilizations, particularly through castration, and ultimately give Adolph Hitler the scientific justification to murder millions of Jews across Europe (Black, 2003). Though it would be hard to find a practicing scientist today that would actively support these theories, it is important to note that none of these theories have ever been formally dismissed in the scientific community, and the subversive institutionalization of these ideals has been massively damaging.
through the intersection of the autobiographical and discoursal selves, however, that we begin to understand discursive identity and how it is developed or interrupted.

Discursive identity, I argue here, is the embodied identity of an individual as reflected in discourse. It is more than the words an individual puts on paper, however; it is the degree to which discourse becomes second nature to the individual and the merging (as well as tensions) of that discourse with other embodied discourses and ideologies. Spellmeyer (1998) has argued that Words…come from the past unembodied, and they cannot be embodied – cannot have meaning, as opposed to an abstract definition – until they take on the power to explain the [writer/speaker’s] circumstances to himself…. To the extent that words become real and meaningful, they also change how the [speaker/writer] thinks and sees and feels.” (p. 257-58)

Developing a discursive identity as a member of a community is not about assimilating into another’s discourse, it is about embodiment with agency – adopting it as one’s own, which includes agency to critique and modify it. It involves understanding one’s self in light of the new discourse. Because language has “the potential to conceal as well as disclose, any struggle over language at the same time entails a struggle over worlds fought on the deepest levels of the self – that part of the self that most intimately connects with other selves and with history” (Spellmeyer, 1998, p. 258). To take on a new discourse as one’s own requires recognizing that that discourse has the ability to describe an aspect of one’s self that other discourses cannot adequately represent.

Understanding what this looks like in practice is critical for understanding the intersections of discourse and identity. The data from this research led me to conceptualizing a
Figure 2: A conceptualization of discursive identity development and the various factors that influence that development.
model of discursive identity development, which I present in Figure 2 and is further elucidated within the case studies. Like legitimate peripheral participation (Lave & Wenger, 1991) and Vygotsky’s “zone of proximal development” (1978), it involves moving from a position as a novice (or outsider to the community) to one as an expert (the highest level of insider). However, development is influenced by many factors that affect where one sits on the continuum between dissociation and embodiment – what I refer to as “push” and “pull” factors.

At the initial stage of entering a discourse community, an individual begins by experimenting, or “trying on” the discourse – attempting to write and speak in a way that approximates the writing and speaking practices of the community in which they are attempting to join. This stage is influenced first and foremost by access to the discourse (e.g., a course or internship that requires attempting to converse or write in the discourse). It is also influenced by culture and ideology: whether the individual sees the discourse as a possibility for themselves and how far from their native discourse(s) this new one lies. In many ways, this is this is the stage highlighted in Carroll’s Rehearsing New Roles (2002), where students are writing and speaking without the context or discourse knowledge required to compose rhetorically effective documents (p. 53). I am drawing on the term “dissociation” to describe this end of the continuum in its most literal sense: The separation of something (in this case, an individual’s ‘home’ discourse) from something else (i.e., the new discourse).[^8] There is a gap between how the learner

[^8]: Note that all language use is socially constructed. My use of ‘home’ and ‘natural’ are meant solely to describe the language use an individual has already embodied, which is shaped by the ways in which their home communities use language and what they have adopted already as their own. I am also invoking our understanding that Standard American English as used in academia (and in science) is normed on White, middle-to-upper class, male language use. Thus, if an individual’s home discourse is not aligned with SAE, there is a greater gap between their home language and the one they are entering (in this case, academia and science as a field).
uses language ‘naturally’ and how the community they are attempting to enter uses language. This gap varies from individual to individual depending on how closely aligned their ‘home’ discourse is to that of the new one (e.g., Standard American [Academic] English).

With experimentation, however, comes familiarization. This second stage involves beginning to understand the rhetorical and discourse conventions of the community (e.g., what language and tone is acceptable, what genres are used in which contexts). This stage also involves beginning to learn the hierarchies of the rhetorical space in which they are circulating: Who is allowed to speak and in what manner? Mountford (2001) explains that “rhetorical space is an extraordinarily important aspect of rhetorical performance” – even more so in revered spaces (such as a laboratory) “where each object and participant are set in place according to the [practices] performed in that space” (p. 61-62). Within rhetorical spaces, individuals are expected to assume roles appropriate to their status in the hierarchy (e.g., a novice scientist does not make assertions about which methods are best). How quickly an individual learns these conventions is determined by the teaching methods of the instructor (if applicable), the individual’s prior experience with writing both within and outside of the community, their understanding of threshold concepts in writing, as well as their education level and culture. This second stage is where explicit teaching can be particularly effective, because it is at this point that individuals begin to internalize the perceived discourse conventions and confront social associations with it. As Carroll (2002) notes, “knowing what to do [is] not the same as knowing how to do it” (p. 114). It is also not the same as knowing that you are allowed to do it. Such ‘rights,’ as will be demonstrated in the case studies, are deeply entwined with an individual’s perceived status in the disciplinary community, their content knowledge, and their beliefs regarding language as a marker of identity generally.
If an individual understands the rhetorical and discourse conventions of the community, with practice they develop facility with the discourse – continuing to experiment and receiving reinforcement or correction from experts/insiders. As this knowledge base solidifies, development is then influenced by the individual’s affiliation with the community, their sense of belonging, as well and their commitment to and engagement with the discourse itself. As metacognitive awareness increases at this point, the writing practice shifts from being a performance to becoming embodied. Rather than attempting to “sound like” a member of the community, the individual is becoming one and beginning to take responsibility for and ownership of it – moving from facility to adoption.

Adoption of the discourse is not, as noted earlier, assimilation. Rather, it is the taking up of an identity and the negotiation of that identity in relation to other identities. For example, identifying as a scientist and a woman of color and a first-generation college student. This includes external positioning, and requires a negotiation of how much the individual will adopt; what discourse conventions will become part of their way of being, thinking, and communicating. At this stage, individuals have already encountered and begun to explore new ways of thinking, and “alternative paths for a future…. They are,” as Herrington and Curtis (2000) described, “looking for sponsoring frameworks” (p. 125). Here, individuals are seeking structured approaches “through which they can pursue their interests…. [and] are reflecting on their families and pasts, sorting through and trying to shape how that past fits with their present and future” (Herrington and Curtis, 2000, p. 125).

Finally, when that negotiation and reconciliation has been accomplished and ownership claimed, an individual is in a place to critique and manipulate the discourse to suit their own practical and ideological needs. Here, we can see instances of “writing against the grain” of the
community, but in such a way as to still be acceptable. All discourse communities, to paraphrase Swales (1990), have mechanisms of communication and participation, with specific lexies and genres, which are in service to maintaining the community’s broadly agreed-upon set of goals (p. 24-27). These communities rely on a certain “threshold level of members with a suitable degree of relevant content and discoursal expertise,” thus there is a significant amount of agency at this stage, as the individual is part of the community that sets the norms. At this stage, individuals have (or are close to having) developed a stance toward the discipline which is reflected in their writing. This stance, as Sternglass (1997) explained, “permits them to understand the significance of ideas in the particular field to the level where they become able to question some of the assumptions in that field” (p. 296). This orientation to the discipline not only encourages critique, but allows the individual to determine what their future role within the field will be (for example, in science, their focus of research and methodological choices).

When examining the development of an individual’s discursive identity within a specific context, what we are investigating is the transition from the “trying it on” stage to the “critique and manipulation” stage, while simultaneously considering the influence of intersectional identities on that development. What makes the individual’s discursive identity unique are the ways in which they negotiate different intersecting factors along the way, what conventions and identity characteristics they choose to take up, and which they choose to resist. How that is assessed will be addressed in the data analysis section to come.

**Methodology**

Brown, Reveles, and Kelly (2005) have argued that given the “notion that all forms of discourse come to symbolize cultural membership and identity,” those interested in science education particularly should be conscious of the complications that students face in “the literate
practices of science” (p. 790). Knowledge, scientific or otherwise, is constructed by the individual and in conjunction with others and can have powerful effects on student identity. As such, educators should understand identity as a “resource as well as an artifact of classroom interaction. As students’ position themselves via discourse, they allow themselves to access specific knowledge and conceptual understanding that might otherwise be out of their reach” (p. 790).

The goal of this research is to take up this call and study the ways in which women of color learn to read, write, speak, and listen according to the standards of the professional scientific community – in other words, to develop their discursive identity as scientists. My intention is to “gain an in-depth understanding of the situation and meaning” of the undergraduate research experience on individual students’ discursive identities and identities as scientists (Merriam, 1998, p. 19). More specifically, I aim to explore whether there is a connection between how students see themselves as scientists and their written and spoken products by focusing my dissertation on the following question and its subparts:

1. What are the undergraduate research experiences of female students of color in science?
2. How does this experience effect their development of discursive identities as scientists?
   a. How is this development mediated by prior knowledge?
   b. How is this development mediated by mentors?
   c. How is this development mediated by scientific genres?
   d. How is this development mediated by program requirements and expectations?
e. How is this development mediated by race, gender, SES, and/or other societal markers?

While this project to some extent adopts ethnographic and grounded theory methods in the pursuit of answering these questions, the in-depth case study was selected as the primary methodology. As Stake (1981) argues, case study research yields knowledge different from other qualitative methodologies – it is more concrete, resonating with our own experiences rather than being abstract; is rooted in context, where knowledge is distinguishable from abstract, formal knowledge of other designs; is more developed by reader interpretation; and is based more in reference populations determined by the reader than through generalizations (pp. 35-36). The in-depth case study approach allows me to make connections between actions and events that occur in the research program repeatedly (i.e., proposal deadlines, Symposium presentations) and the writing produced by participants. It also allows me to chronicle how these factors interact with and influence participants’ thinking about writing, their actual scientific writing development, and their identities as scientists. My interest in this project is on how these participants are experiencing the world of the research program and the writing demands it places on them, and how those experiences intersect with their identities as scientists. By studying individual students within a “real-life, contemporary bounded system [(i.e., their laboratory and the program as a whole)]…over time, through detailed, in-depth data collection involving multiple sources of information,” I am able to get an understanding of how individuals border-cross discourses and adopt, incorporate, or reject scientific identities (Cresswell, 2013, p. 97).

Additionally, the data streams available help solidify my questions and methodology selection. As is noted in the Program Description (Chapter 3), students in the URE conduct a significant amount of writing – from proposals each semester, to conference posters and other
textual artifacts. They do this on a regular occurrence, which allows for the collection of the same types of documents over time – and multiple drafts of each, which lends itself nicely to rhetorical analysis (see Analytical Approach later).

Direct observation has also been an option, though it has been restricted due to location, as well as to the fact that students and mentors do not keep ‘working hours’ in the laboratory. (It is not uncharacteristic for students to be working in the lab well past midnight, and on weekends, and to go weeks without seeing their mentor in person.) This makes direct observation of laboratory practices challenging, though not entirely impossible. The most critical data stream, fortunately, is also among the easiest to collect: interviews. While many were collected in person, it was technologically possible to conduct and record interviews virtually through Skype and on the telephone. Finally, analytical memos were also a strong data source for this project, which helped with reflexivity when analyzing other data streams and writing up the research. A more detailed account of data collection is provided later in this chapter.

**Participant Selection**

In August 2015, I received IRB approval from both the Research Foundation of CUNY (IRB#2015-0770) and Northeastern University (IRB#15-09-16). At that time, I emailed the 27 mentors associated with PURS introducing the research project and asking if I might speak to them about participating. After introductory conversations, 10 mentors agreed to participate (consent was both verbal and written – see Appendix A for student and mentor consent forms); initial data collection was a one-hour semi-structured interview about their own experiences learning to read and write as scientists, their writing processes, and their pedagogical approaches in the classroom and laboratory. It is important to note, here, that not all mentors interviewed had students participating in this project, and not all student participants had mentors participating.
Data from the larger group of mentors, however, provided important insights about the program as a whole administratively, and about the culture and inclusiveness of the individual laboratories.

At the end of August 2015, I attended PURS’s three-day Research Training Workshop – a requirement for any student wishing to pursue undergraduate research. At that workshop, I introduced myself to the 12 students attending and anonymously collected perceptions on the discourse community of science. I subsequently emailed each student who had participated asking them if they would like to take part in the research (offering a $25 certificate to a major online retailer as incentive). Two students agreed (verbal and written consent were obtained), and initial audio-recorded interviews took place in autumn 2015. In January, the process was repeated with the newest cohort of research students, and again in August 2016 and May 2017. The students represented in this dissertation come from the 2015 and 2016 cohorts.

Because the focus of this research is on women of color in science, participant selection has been deliberate – I have prioritized the recruitment of women, and women of color in particular. Participants were screened for age: only those 18 years old and older were accepted as participants. I did not screen for any other social factors (i.e., socioeconomic class). Also, because the project focuses on development, I intentionally recruited only those students who were just entering the program – often before they had connected with a mentor. In this way, I have been able to follow them from their start in the program through multiple semesters as undergraduate researchers (including summer externships), and in some cases to graduation. Demographic information about each student, as well as when they joined this research project, is shown in Table 1.
Data Collection

The data collected for this dissertation include:

- 12 hours of semi-structured interviews with mentors;
- 16 hours of semi-structured interviews with the three student participants;
- 18 drafts of student research proposals and 6 poster drafts (where applicable);
- individualized proposal feedback from mentors and program staff;
- analytical memos and direct observation of program training workshops;
- and an assortment of textual artifacts produced or read by the student informants (e.g., lab notes).

A complete breakdown of data collected by students is presented in Table 2.

Data collection involved conducting a preliminary one-hour interview with students before (or just at the start of) their undergraduate research experience (see Appendix B for preliminary question guide), and then subsequent 45-minute interviews after proposals were submitted, at the end of each semester, and in some cases at the point of graduation. On average, this provided check-ins with students once every three months – long enough for some development to occur, but not so long that the students would not be able to recall their experiences in the intervals between interviews. All interviews were semi-structured and largely student-driven⁹, allowing for rapport and confidence to develop.

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⁹ By “student-driven,” I mean that I pursued what students seemed most interested in discussing at a given moment, connecting back to my research interests as appropriate. This allowed for richer data and also made for much more natural conversation.
Table 1: Participant Information (n = 3)

<table>
<thead>
<tr>
<th>Name</th>
<th>Ethnicity*</th>
<th>Gender</th>
<th>High School</th>
<th>Parents’ Highest Level of Education</th>
<th>Final Major</th>
<th>Year in Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anne</td>
<td>African American (Guyanese)</td>
<td>F</td>
<td>O Levels (UK system); Science-focused</td>
<td>High school (both)</td>
<td>Cell and Molecular Biology</td>
<td>3 (1/16)</td>
</tr>
<tr>
<td>Amrita</td>
<td>Indian</td>
<td>F</td>
<td>International Baccalaureate</td>
<td>Medical school (both)</td>
<td>Cell and Molecular Biology</td>
<td>3 (9/15)</td>
</tr>
<tr>
<td>Natalia</td>
<td>Hispanic (Ecuadoran)</td>
<td>F</td>
<td>STEM-focused</td>
<td>High school (both)</td>
<td>Forensic Science - Toxicology</td>
<td>2 (9/16)</td>
</tr>
</tbody>
</table>

Table 2: Data corpus (n = 3)

<table>
<thead>
<tr>
<th>Name</th>
<th>Number of interviews conducted</th>
<th>Number of Proposals collected</th>
<th>Posters collected</th>
<th>Abstracts, etc. collected</th>
<th>Mentor Feedback</th>
<th>Coordinator feedback&lt;sup&gt;10&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amrita</td>
<td>6</td>
<td>S 2016 (5 drafts)</td>
<td>2</td>
<td>1 Conf. Abstract 1 Conf. Presentation (2 drafts)</td>
<td>Yes (4)</td>
<td>Yes (1)</td>
</tr>
<tr>
<td>Anne</td>
<td>6</td>
<td>S 2016 (2 drafts)</td>
<td>2</td>
<td>2 Abstracts</td>
<td>No</td>
<td>Yes (1)</td>
</tr>
<tr>
<td>Natalia</td>
<td>4</td>
<td>F 2016 (2 drafts)</td>
<td>2</td>
<td></td>
<td>Yes (1)</td>
<td>No</td>
</tr>
</tbody>
</table>

<sup>10</sup> Because of staffing issues, no formal feedback from the Coordinator was provided in Fall 2015 or after, except on problem proposals.
Students were also asked to save and share with me copies of all proposal and (where applicable) presentation and poster drafts, including mentor feedback. Where multiple drafts were unavailable (i.e., because the student and mentor used Google Docs and over-wrote their file), detailed questions about the mentor feedback were posed to both the students and mentors in interview. The level of detail-recall by students was particularly impressive. In some instances, additional written materials from students, such as laboratory notebooks, papers written for class, and personal notes, were collected as referents. While student-mentor phone texts and emails were not available for direct analysis, questions about this material were also addressed in interviews.

Interviews with mentors and administrative staff were conducted less frequently than with students. Because of confidentiality, neither mentors nor staff were made aware of student participation, and vice versa. In some cases, students self-disclosed to their mentor prior to or during the study. In such cases, when I was given permission, I asked mentors specific questions about the participating students. Where this was not the case, I asked mentors specific questions about all the PURS students within their laboratory. Since feedback from the program coordinators was also an important pedagogical element, the written feedback on documents were requested for all students and parsed afterward and interviews focused on the program as a whole, rather than individual students.

During the two-year period this dissertation covers, I was also able to observe 3 training workshops (2 in person, 1 virtually) offered by the research program, as well as 2 annual program Symposia where students publicly presented their research in poster sessions. This provided an opportunity to observe public speaking skills. Though direct observation of the students in their everyday laboratory practices was an initial goal in data collection, in the end
this was not possible due to conflicting student schedules and the odd hours students worked in the lab (i.e., from 8 to 10 pm on weekday evenings and on weekends). Further, from interviews I learned that students rarely worked alongside their mentor in the laboratory – rather, they checked in via email or text and met for weekly or monthly laboratory meetings for updates. As such, direct observation of mentoring was not an option. Direct observation of laboratory meetings was also not an option because mentors felt this would be too disruptive.

Data Analysis

My analysis of the data has been ongoing and recursive. As Boyatzis (1998) notes, “[the] type of information collected both affects and is affected by the unit of analysis,” thus identifying early what the primary aims of the project were and the ways to address those aims was critical (p. 63). Since student experiences and development are at the heart of this project, I decided that my primary unit of analysis would be the individual students themselves because they are “the entity on which the interpretation of the study will focus” (Boyatzis, 1998, p. 62). This decision was methodologically congruent with my selection of the case study and allowed for the identification of specific data streams that lent themselves to meaningful assessment regarding the phenomena in question. As such, two primary units of coding per participant were determined: the student interviews and the student writing.

Student interviews.

Transcription of interviews began at the start of the project, blinding materials as I went to ensure informant anonymity. Using my research questions as a loose referent, I initially
coded\textsuperscript{11} these interviews inductively using my interpretation of what was occurring on the page – for example, when a student spoke explicitly about genre or discourse conventions. This initial step was conducted in an effort to organize the data and identify preliminary themes (i.e., genre awareness) across the participants, as well as across time. At this same time, possible \textit{in situ} codes were identified (such as “the young Padawan” to describe status in science), as well as quotations that seemed particularly significant to the research questions at hand. This initial step allowed me to see that certain themes surrounding identity and development were present, for example the influence of mentor expectations and “rules” on student confidence.

Subsequent to this first step, I determined that using my research questions as a more specific referent (i.e. “prior genre knowledge,” “mentor expectations”) was an effective way to code the interview data for organizing, and identity-related codes (e.g., “positive identity association”) were effective for understanding the level of affinity the student may or may not have felt with the scientific community at a given time. A complete list of codes and their criteria are provided for reference in Appendix C. Interviews were coded in batches, by student, to allow for focus on the individual’s experience and development over time.

\textbf{Student writing.}

Rhetorical analysis was the primary method used to analyze student writing. The students’ use of rhetorical devices was assessed to determine the proximity of student writing to scientific discourse conventions. Proposals and other textual artifacts produced by students were coded for rhetorical conventions of scientific discourse, using Hyland (2005 & 2012) and Swales

\textsuperscript{11} All coding was done by hand, on paper, rather that digitally. Not only was this approach more in line with my own work style, it allowed me to see, spatially, the changes that took place over time.
as referents, including analysis of changes between revisions. Such coding involved the examination of tone, point of view, use of jargon, rhetorical conventions, and genre conventions. Issues of production and consumption (who produced the text, target audience, etc.) was also explored. Descriptors of strong scientific writing provided by mentor and staff in interviews were used as referents for coding for context, since mentor and staff are the ultimate evaluative audience for (and instructors of) the writing artifacts students provided. This coding scheme allowed for the analysis of discourse convention use by students across drafts and across proposals. Feedback from mentors and staff were also coded for pedagogical moments and for their reconciliation with scientific discourse conventions. Examples of such moments will be presented in the case study chapters proper.

Finally, intertextual and interdiscursive elements were identified (what broad, social currents were affecting the text; how did students draw on other texts, scientific or otherwise). The results of this multi-dimensional approach were used to triangulate with student and mentor interviews in order to explore my research questions.

**Analytical Approach**

The overarching, guiding question for this project – How do women of color develop discursive identities as scientists? – is a complex one. In asking this, what I have been interested in discovering is how women of color learn to present themselves as scientists in written and spoken discourse, and how their reading and listening practices change to be more or less in line with the practices of professional scientists. To get at the answer to this larger query, I broke out sub-questions that would help elucidate different facets. What follows is a description of the analytical approach I took in attempting to answer each.
How is this development mediated by prior knowledge?

In this research, the term “mediation” refers to the influence – positively or negatively – of a facet in the development of discursive scientific identity. In this instance, how does a student’s prior knowledge with science, writing, reading, etc., affect the way in which they present themselves as a scientist discursively? In the spirit of Reiff and Bawarshi (2011), I approached this sub-question by asking:

- What experiences with reading and writing scientific materials do students report having had prior to joining PURS?
- What scientific genres are noted, and what associations (positive, negative, or neutral) do students report having with those genres?

Because this project is deeply connected to agency and identity, I also asked:

- What relevant educational experiences do students report having before becoming a student at the college, and an undergraduate researcher?
- What identities have been applied to students from family, community, and education professionals prior to joining the program?

Drawing largely on the interviews, I prepared by noting that this might look like a student having had a high school experience that was very focused on STEM (i.e., magnet or charter school), or growing up with scientists (chemists, doctors, pharmacists, etc.) in their family, thus having prior associations with science. It might also be the opposite – limited exposure to science coursework and/or reading/writing pre-college, or growing up with family that distrusts science or does not see it as a viable pathway. In terms of reading and writing skill, it was important to know how students identified with the acts of reading and writing (as well as speaking and
listening) as they entered the program. Had they adopted an identity as a “strong reader” or “bookworm”? Had they been told by others that they were academically gifted or challenged?

In the case of this sub-question, I was interested in learning not just what students knew about science before entering the program, but also what they “knew” about themselves. Thus, when reviewing and coding transcripts, I was looking for moments where students talked about how they came to the program – what sort of experiences they had with regard to science as a discipline, how they saw themselves as readers and writers, what their perceived ideas were about the kind of reading and writing scientists do, including what makes for “good” scientific writing.

As Reiff and Bawarshi (2011) noted in their research into the influence of prior knowledge on genre transfer, relying “on students’ reported cognitive processes and retrospective reflections has its limitations” (p. 317). And while, like them, I have been cautious in my analysis that students are not always aware of their skill level, their transfer of knowledge from one space to another, or even the social circumstances that have helped construct their identities, the lived experience of the student – what they believe about themselves as they enter the program – is paramount to understanding discursive identity development.

Clearly, prior knowledge influences the other sub-questions I pose below. It affects genre, mentoring, cultural considerations, and program expectations and requirements. I used this interweaving to my benefit by using the prior knowledge question to address elements of the other four. For example, I was able to identity the scientific genres each individual student had exposure to prior to joining PURS, including both macrogenre types (such as article summaries) and situated rhetorical genres (such as abstracts and scientific posters). This was important because, in terms of identity work, the different genres serve very different purposes – for
example, summaries allow a student to demonstrate comprehension and knowledge of difficult scientific content, while abstracts allow a student to demonstrate knowledge of the discourse conventions of the discipline. One speaks to content, while the other speaks to form. Some students excel in one form (e.g., summaries) because it allows for rhetorical leniency, while others excel in others (e.g., proposals) because of the strict language rules and perceived formulaic, plug-and-play structure.

**How is this development mediated by mentors and mentoring?**

The influence of mentors on the discursive identity of these students is also of importance. Mentors – primarily faculty, but also peer – play critical roles in the students’ research and practical science education. They also have varying approaches to teaching the reading and writing practices of professional scientists. While every individuals’ process is different, the end results must conform to the discourse community’s expectations if the work is to be seen as credible. Thus, the bar I set for “professional” is that of the scientific community’s expectations on style, genre, tone, etc.

For this question, I was interested in learning how the mentor’s instructional style (e.g., explicit genre instruction), as well as their requirements and expectations (even their own writing style), assisted or restrained student development of the discursive practices of the scientific community. This involved identifying how mentors guided students in the proposal, poster, lab notebook, etc., writing processes, as well as in presentation preparation. Reading is also important, so I examined the ways in which mentors explicitly or implicitly taught their students how to read scientific material. In answering this question, it was important for me to consistently ask:

- In what ways are mentors cultivating scientific identity in their students?
• What kind of scientific identity, if any, are mentors cultivating?

• How involved are mentors in the instruction of scientific reading, writing, speaking, and listening practices for their students?

These data largely came from interviews with both mentors and students, but also included the examinations of textual artifacts for comments and modeling of discourse conventions. From prior experience with the program I knew that there were widely disparate approaches to mentoring, and to discourse instruction particularly. For example, some mentors had histories of writing their students’ proposals for them (because they perceived their students incapable of the task), while others were deeply involved in guiding students step by step through understanding the genre and language of the research proposal. There is a wide continuum in approaches, and I was interested in learning what effect these might have on students’ own discursive and reported scientific identities. As such, when examining both student and mentor interviews, I looked for moments when either spoke about the mentor’s reported approach (or actual practices) with students in the lab. This included how mentors spoke to their students, their expectations for language use, documentation procedures, and other activities that constitute the being of a scientist. In examining textual artifacts, I similarly looked for moments where mentors explicitly or implicitly instructed students in the discursive practices of scientists, as well as “teaching moments” that were not taken up.

How is this development mediated by scientific genres?

Much of the communal discourse in science takes place through specific scientific genres: research proposals and reports, scientific articles and brevia, etc. In order for individuals to be recognized by other scientists as scientists, successful engagement with and performance of scientific genres is critical. In posing this question, what I was interested in discovering was how
the students engage with different scientific genres and whether success or failure in one influences success or failure in another. For example, if students wrote literature reviews as part of their early-research, did that help them in their first proposal writing process? Also, how did their experience with writing in a genre change over time? Did the proposals get stronger semester to semester? Stay the same?

**How is this development mediated by program requirements and expectations?**

As an undergraduate research program, PURS has instituted various requirements and expectations (both explicit and implicit) for students. Explicitly, students must be majoring in Forensic Science, Computer Science, or Cell and Molecular Biology, as well as possessing some interest in an advanced degree. Before partnering with a lab, students must attend the Research Training Workshop, where they discuss scientific ethics, conduct, professional and community responsibility, as well as more practical aspects of science – literature searching, record keeping, report writing, and basic laboratory techniques/protocols. (A complete Program Description is provided in Chapter 3.)

Though institutional factors are a study unto themselves, by focusing on program requirements and expectations in this sub-question, I was interested in exploring whether the requirements and expectations of the program itself – not the mentor – influenced the students’ discursive identity. In exploring this question, I needed to pay close attention to the ways in which students spoke of engaging with the various deadlines, samples, and procedures of the program, asking of the data:

- In what ways, if any, does the way *staff enforcement* of genre requirements (i.e., proposals, posters, abstracts) influence the ways students write/approach the documents?
• Do students see the research proposal as simply a hurdle to be jumped, or a heuristic for their research process?

• How do these requirements influence the ways in which students present themselves discursively?

• Are program expectations reasonable and clearly identifiable by students?

**How is this development mediated by race, gender, SES, and/or other societal markers?**

How we approach an identity is influenced by its prevalence in our culture. Science is typically a field that pays well; thus, socioeconomic factors play a role in whether an individual sees science as a viable career path. Science is also predominantly White and male; thus, underrepresentation influences how women and people of color approach the discipline. As a perceptively antiseptic, sterile field it can likewise present conflicts for those who have deeply rooted religious beliefs. Thus, when considering this question, I was looking to see if and when issues of gender, race/ethnicity, religion, SES, or any other societal marker became salient in the data, and if that had an influence on whether or not a student engaged with or successfully took up the conventions of scientific discourse. Part of this question also connects to students’ future career intentions, as that is an SES factor. Motivation for getting into science also presented useful information for exploring this question.

Given the context of the institution (an HSI and MSI), as well as the social circumstances in which this research was taking place (i.e., the 2016 presidential election and subsequent administration where race and gender issues have been prominent), I sought to identify ways in which these women of color embraced, pushed against, and/or disrupted the rhetoric of science –
both as an embodied practice, as well as a discursive one. To that end, questions of culture and social factors were regularly posed, with an eye toward answering:

- How do women of color perceive the community and culture of science before, during, and after their undergraduate research experience?
- In what ways are gender, race/ethnicity, religion, SES, or other cultural identifiers embraced, rejected, or ignored during this experience?
- Are any cultural identifiers absorbed as part of these women’s discursive identity as scientists, and if so how are they made apparent?

**Analyzing discursive identity development.**

The aim of this study was to explore the effect of the factors noted above on the individual students’ discursive identity development. To determine this, I used multiple data streams with coding (see data analysis section) to triangulate how students’ reported feelings about the discourse and field (including their place within it) reconciled with their written products, how their oral communication with me in interviews about their research reconciled with their scientific writing, and how their mentors positioned them within the laboratory (both reported from students and from mentors). This approach allowed me to track the development of spoken identity with written identity and positioning from others over time. Before presenting how this worked within the individual student cases, however, a brief overview of the program and its requirements is required to further contextualize the study.
Chapter 3: Program Description

In order to contextualize the student cases in the chapters that follow, I outline how PURS works administratively – including the research and writing tasks, program expectations, and selection process. Because these particulars are relevant to every student in the program, it seems prudent to outline them here, separate from the cases proper. It is important to note, however, that there are various levels of participation available for PURS students, including simply attending monthly lectures, day-long shadow experiences, and outreach activities (see Appendix D). What is discussed here are the requirements and expectations for those wishing to conduct undergraduate research (URE) specifically, since that is the case for each of the student participants in this dissertation. Thus, this chapter will chronologically present the steps each URE student must take, as well as program expectations.

Admission Requirements and Applying for Research

There are two reasons students apply to PURS’s URE during their time at LUPC. The first is that they simply want to gain research experience in their field in order to apply for graduate school. The second is that they want to use the experience to satisfy a capstone requirement for graduation (FOS402). Regardless of their reasons for pursuing undergraduate research, however, every student must go through the same process and meet the same requirements.

Eligible students must have declared a major in either Forensic Science, Computer Science, or Cell and Molecular Biology. Major-declarations typically occur during the second half of sophomore year, once general electives have mostly been satisfied and students have been successful (a grade of B or higher) in introductory science courses. Forensic Science and Cell and Molecular Biology students must also have completed, and passed, CHEM201 (Organic
Chemistry I). This course is openly referred to on-campus as a “gate-keeper” for PURS because, historically, students who are unable to successfully pass Organic Chemistry I tend not to be able to conduct the complex chemistry required in many of the laboratories. An overall GPA requirement of 2.5 is also a requirement; however, students are expected to have “demonstrated proficiency in all science, math, and computer courses” (PURS, 2016). Finally, potential students should have a sincere desire to pursue graduate work in the sciences or medicine.

Though the program does actively recruit high-performing students from CHEM202 (Organic Chemistry II) each spring, any student who meets these minimum requirements is allowed to submit an application. This application includes demographic information, evidence of grade point average and courses taken, and open-answer questions regarding career intentions and research interests. The Program Coordinator reviews this application and invites students to a one-on-one interview. This interview allows the Coordinator to assess first-hand the students’ motivations for applying to the URE. In recent years, PURS has been hit with financial challenges, and thus has begun reducing the number of students it accepts into the program. In this way, students who already know (or convincingly demonstrate) that they are interested in graduate school are prioritized.

**Research Training Workshop**

Approximately 15 new students are accepted into the program each year. In order to conduct research, however, they must take part in a three-day research training workshop. Historically, this workshop has taken place in January and August of each year, though in response to budget

\[12\] These interviews are highly subjective and do require some performativity on the part of students to be convincing of their postgraduate intentions. A critique of this process will be taken up elsewhere outside of this dissertation.
constraints and a reduced acceptance pool the program began offering the workshop only once per year in 2017. This workshop introduces students to laboratory techniques and research methodologies that are most common across the program. It also provides insight into the many possible directions in which undergraduate research can go. Through tours of the 18 unique laboratories in the program, students see that even within the confines of the College they have many options to choose from. While all of the laboratories fall within the major-tracks of Cell and Molecular Biology, Toxicology, Criminalistics, or Computer Science, the 18 PURS mentors work in areas as diverse as epidemiology, environmental toxicology, ballistics, genetics, and computer modeling. When students have successfully passed this workshop (mostly through perfect attendance), they are allowed to approach a mentor.

**Finding a Mentor**

The onus of securing a mentor is placed on the students proper, though there have been occasions when a mentor sought out a promising student from one of their own courses. Students are advised to look at the *PURS Chronicle* (an annual program “yearbook”) to learn about the various lines of research mentors conduct. Then, they are responsible for contacting those mentors to set up meetings and discuss whether or not there is space in the laboratory for newcomers. As will be discussed in the student cases proper, some mentors accept students based solely on space allowances, while others spend time ensuring that there is an appropriate “fit” between the mentor and mentee. Some mentors have one major research line in their laboratory, with student projects supplementing that line; others have multiple lines of major research taking place that do not intersect. As a result, some mentors allow only 2 or 3 students to work in their lab in a given semester, while others have 10 or more students.
No instruction other than “find a mentor” is given to students, and the Program Coordinator intentionally does not get involved in pairing because of its labor-intensiveness. As will become evident in the student cases, this poses a serious impediment to students who are new to research. It is worth noting, as well, that mentors do not receive any formal guidance on how to mentor. Though a few books are available on mentoring in the PURS library, there is an implicit assumption that faculty who are interested in having students join their laboratory (which is incentivized fiscally through supply money based on number of students) already know how to guide newcomers in (and to) their sub-disciplines.

**Research Proposals**

All students who participate in PURS and wish to receive a stipend for their URE are required to submit a research proposal for each semester they participate. This requirement is meant to reflect the practicalities of conducting scientific research. Though fiscal restrictions have come into play in recent years, a typical semester sees upward of 40 students stipended within the URE, with each receiving between $750 and $2,500 per semester depending on level of commitment (i.e., hours in the laboratory). These stipends help to offset the costs of engaging in extracurricular laboratory work, intentionally mimicking the genre engagement and exchanges that take place in the professional scientific community.

The program provides students with a formal “call” each semester, outlining the expectations and, to some extent, genre conventions of the proposal (see Figure 3). Proposals must include a review of the literature, methodology for the project, a discussion of how it contributes to the larger body of scientific knowledge, and the amount of time and resources required to complete the project. Though there are no requirements that mentors work with their students in the writing of these proposals, mentors are expected to guide each student toward the
identification of an appropriate research question (which is subjective and depends on the laboratory), and then subsequently must physically “sign off” on the proposal prior to the student’s submission. Mimicking the peer-review process critical to science, proposals are carefully reviewed by the Program Coordinator and written feedback on the merit of the project is often (though not always) provided.

Clearly, such a process serves a gate-keeping function. Most students enter the research experience with no prior knowledge of or exposure to scientific genres other than the laboratory notebook and, occasionally, a scientific article pulled from a non-peer-reviewed source (in other words, Google searches). This proposal writing process is more often than not the first time students have been asked to produce a scientific genre other than laboratory notes. As will be explored in the student cases, how instruction in this proposal writing is conducted has strong effects on students’ discursive identity development.

Proposals for the program tend to be due a few weeks into each semester to allow students and mentors to clarify what research will be conducted, as well as time for the writing (and sometimes revision) of the research proposals themselves. By nature of this timeline, many students are actively working on their research at the time their proposals are submitted.

**Scientific Poster and Presentation**

The final formal requirement of PURS is that students present their work in the annual PURS Symposium. This event mimics scientific conferences, where research is presented in both poster and presentation form. Each Spring, all PURS students are required to present the work they have conducted over the previous academic year in poster form. Templates, again, are provided, as is a short “poster presentation workshop” during which the Program Coordinator discusses grammatical and formatting considerations, as well as ways to think about presenting
**CALL FOR PROPOSALS FOR SITE-NAME UNDERGRADUATE RESEARCH PROGRAM**

**Fall 2023 Research Funding**

Forensic Science Students

We are accepting Undergraduate Research Proposals for funding. However, funds are limited. Please submit only a DIGITAL COPY (by email) of your proposal by midnight on Wednesday, September 30th, 2023. You will be informed if your proposal is accepted as is or if any changes are required. Despite funds are increasingly limited and following the guidelines will be a major consideration. We might contact you to ‘fix up’ the proposal. You will have 30 days to return the proposal to us with the requested amendments. Non-adherence to these guidelines will result in a loss of funding for the fall period.

The following must be rigidly adhered to:

1. A new ‘Proposal Template’ is available on our website [http://SITE-NAME.FROMU.edu/faculty/research-proposals/](http://SITE-NAME.FROMU.edu/faculty/research-proposals/). You must use this template to submit your proposal. You can copy and paste into it, or work in the template directly. The main text in your proposal must be in Arial font, size 12, double-spaced. Please make sure you use correct scientific nomenclature, that you indicate the proper name of a term before presenting any designations, and that you use proper grammar and spelling. Feel free to use the JGA/Writing Center before submitting.

2. The cover page must have the title of your project, your name, your mentor’s name, and the proposal number (number of times you have submitted a proposal to SITE-NAME). Where designated at the bottom of the cover page, indicate the approximate number of hours that you will commit to this research as the total hours per week times the number of weeks. New students must commit a minimum of 50h and returning students must commit to a minimum of 75h to qualify for funding. It should cover the period September 30th to January 31st.

3. The proposal should not exceed 2,500 words of text (with additional tables, figures, etc. included) and must include (with each section labeled a, b, c, etc. and titled as below):
   - Abstract: 250 words or less, include a brief overview of your project; a statement of your project's objectives; your hypothesis; a brief statement describing your proposed work; and a summary of the research questions you will address. This section will be shared with the research team.
   - Introduction: Brief introduction on the general scientific relevance of your proposed research. Your introduction should aim to explain the basic science behind your subject of study and why it is important to study it. The introduction should also explain any technical details particular to your work or field of study. Your introduction must give your audience the information needed to understand the rest of your proposal.
   - Hypothesis: A hypothesis is the proposed explanation or supposition of the phenomenon you are testing. It is an educated guess (meaning that it must be based on previous observations) of the anticipated results of your research. The hypothesis must be tested so that it can be tested by your research. Do this by expressing the hypothesis using your independent variable (the variable you change during your experiment) and your dependent variable (the variable you observe - changes in the independent variable depend on changes in the dependent variable). In fact, many hypotheses are stated exactly like this: “If a particular independent variable is changed, then there is also a change in a certain dependent variable.”
   - Methods and Equipment: Brief description of your facilities and anticipated work for the research period. This section should not be a technical description of your work (that’s what the next section is for) but a description of what is your role in your lab, your project, and of what you will be doing during this period.
   - Methods and Equipment: Brief description of the methods, equipment, protocols, and/or materials that you will be using. In this section you should aim to demonstrate how are the different experiments done, with what equipment, what controls are required, and how you plan to analyze the data.
   - Peer Mentoring: The federal grant that pays for your stipend requires that students develop mentoring skills during their training. Before your third SITE-NAME-funded term you will receive instructions on how to fill out that section. Some of the activities involved can be a) more senior student can serve as peer mentors to new students joining the lab, b) you can mentor students (stand-alone or through the MSRC or other training services on campus) c) serve as a SITE-NAME Peer Ambassador helping us with events aimed at informing students about SITE-NAME.
   - Bibliography: Please be consistent in the format of your references. Please include 3-5 relevant references to your project. Unlike the social sciences and humanities, which use APA and MLA style respectively, the physical and biological sciences do not have a single standard format for references. Each subdiscipline and even each journal has their own unique variations on how references are made, both in text and in the bibliography. Please discuss the issues.

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**Figure 3:** Research proposal guidelines provided by PURS to aid students.
the “research story.” Mentors are encouraged, but not required, to assist students in the preparation of both the poster and their presentation. One graduating senior is also selected as the Outstanding Graduate Researcher by the program’s directors based on mentor nominations and evidence of engagement with research. This individual must present their research to the entire audience in a formal presentation.

**Program Expectations**

As was noted in the application requirement description, there is an expectation that all PURS students will apply to graduate school. Though this expectation complicates some of the initial rationale for the program, it has nevertheless moved from being an implicit to explicit expectation over the course of this research period. Rather than bringing students who otherwise wouldn’t pursue such degrees into research experiences in an effort to show them possibilities, the program is now using the URE space to support those who have already clearly defined such a route for themselves. Other initiatives (such as lectures, job shadows, and “field trips” to laboratories) are being implemented to target those students who would otherwise be “leaked” from the “pipeline.”

More recently, expectations on summer activities have also become explicit. Rather than allowing PURS students to continue research (with funding) during the summer, students are now expected to pursue external research opportunities (as all of the case study students here did) to become more competitive for graduate programs. The Program Coordinator is currently pursuing efforts to make external research a formal requirement of PURS participants, as there is some evidence in the educational literature that external experiences increase the likelihood of graduate school acceptance.
Finally, students are expected to attempt to write and submit a research article with their mentor during, or shortly after, their research experience. Again, while this is not explicitly a requirement, it is becoming more and more an expectation for students – largely based on the Program’s desire to increase graduate school acceptance rates. Students who are part of PURS to earn capstone credit (i.e., FOS402) must also submit a final “thesis” that examines the research conducted over the entire URE period. This document mirrors the theses produced by Masters students and is given a “Pass” or “Fail” grade by the mentor alone.

**Introduction to Student Cases**

The three student cases selected for this dissertation represent various ethnicities and socioeconomic classes. Each one also presents interesting insights into how women of color develop discursive identities in science. What I have endeavored to do, here, is not simply recount the intellectual work produced by each of these women, but to explore the embodied experiences that have emerged from our conversations.

Each chapter begins with a brief discussion of the relevant literature to situate the case. This is followed by an introduction to the participants (both student and mentor), as well as a narrative describing the students’ experience in undergraduate research and with scientific writing over their time in PURS. This presentation – using the students’ own descriptions and voices as much as possible and member-checked – provides context for the discussion of mediating (push- and pull-) factors in that discursive development.

These chapters have been deliberately scaffolded in their presentation. The first offers an examination of the importance and influence of mentor fit on discursive identity development. The second explores a context where the fit is strong, but where the mentor also adopts a mentored writing approach to teaching disciplinary discourse. The final case chapter examines
the influence of strong prior knowledge and experiences on development within the context of strong fit and mentored writing instruction. Intersectional identities are a thread that run throughout. While I focus each chapter on one specific factor, I am not arguing that each factor alone was responsible for pushing or pulling the participant from the discourse and discipline. Like most things, these factors falls within a matrix of influence and I aim to show how certain practices can mediate the influence of those factors.

In Chapter 4, I present Anne, a young woman originally from South America who self-identifies as African American. Though her academic identity was strong from the beginning, Anne encountered challenges with both the practices and writing of science, as well as with her mentor, throughout her URE. Yet, she persisted and ultimately used her ingenuity to create a unique educational experience that pushed her discursive identity development forward. Anne’s experience speaks to the influence of mentor fit on learning to read and write in the sciences and has implications for pedagogy in mentoring.

Chapter 5 introduces Amrita, a young woman of Indian descent (first generation) who benefited from a strong fit with her mentor, Dr. Bianchi. Dr. Bianchi’s own experiences learning to read and write while a doctoral student informed her pedagogical choices as a mentor, which included an approach I describe as “mentored writing.” Amrita’s experience sheds light onto the impact of explicit writing instruction situated within undergraduate research on the development of discursive scientific identity.

Finally, Chapter 6 concludes the student cases with Natalia, a Latina who grew up in the boroughs surrounding the college. Natalia came to the college from an inner city high school that focused specifically on STEM through health and human services and had a strong minority population. Natalia’s strong background with instruction in reading and writing in the sciences
allowed her to navigate the discursive requirements of the program smoothly while also critiquing its expectations. Natalia’s story speaks the role of prior knowledge and experience in the development of discursive identity – particularly the development of more sophisticated rhetorical skills.

These student cases are followed by Chapter 7, an in-depth discussion of the ways in which these student experiences help to answer the questions posed initially regarding the development of discursive identity. Using the research questions as a guide, I explore the various push- and pull-factors that influenced each woman’s development. This helps explicate how the consideration of positioning and intersectional identities helps us think about writing instruction specifically, and undergraduate science education more broadly, for underrepresented minorities. This chapter concludes with the implications for learning and teaching that this research suggests.
Chapter 4: “I think when I speak, I don’t sound like that”: The Influence of Mentor Fit on Development of Discursive Identity

The concept of mentoring – pairing a more experienced member of a community of practice with a novice member for the explicit purpose of acculturating that novice – is not new to the sciences. In fact, the apprenticeship model of education has been an integral feature of the scientific community for some time. Since the National Science Foundation released a report in 1989 advocating for increased research experience and faculty mentorship, however, apprenticeship through formalized undergraduate research experiences (UREs) have grown in popularity and integrated into institutions of higher education nationally (Kardash, 2000), with a more recent trend of URE programming in non-science disciplines (see, for example, the 2016 CCCC Statement on Undergraduate Research). While such growth has been encouraged and supported by organizations such as the Association of American Colleges and Universities and the Council on Undergraduate Research – each of which consider undergraduate research to be a “high-impact” practice that influences career preparedness and educational improvement – it is important to note that that the positive effects of mentoring through UREs have been widely presumed. There is, in actuality, a lack of empirical evidence to support such claims, which includes understanding what factors influence successful experience (Thiry, Laursen, & Hunter, 2011; Hunter, Laursen, & Seymour, 2007; Seymour, Hunter, Laursen, & DeAntoni, 2004). As Seymour, Hunter, Laursen, and DeAntoni (2004) note,

Notwithstanding a high level of interest in undergraduate research, and the large number of programs and models, supported both by institutional policies and by funding from private and public agencies, examples of well-designed program evaluations are rare.
Research findings upon which sound evaluation strategies might be grounded are even rarer. (p. 493)

I should explain, here, that I am not attempting to discredit UREs. In fact, my prior work with colleagues on PURS has helped to remediate some of this gap. As both qualitative and quantitative data from PURS demonstrate, not only has mentoring in this specific URE had positive effects on persistence of minority students in the science majors (Carpi, Ronan, Falconer, Boyd, & Lents, 2013), but has also positively impacted self-efficacy and career ambitions for this same student body (Carpi, Ronan, Falconer, & Lents, 2017). Still unexplored in the undergraduate research literature broadly, however, are factors that lead to successful experiences.

In this chapter, the impact of mentor fit on the students’ experience and whether such fit has an influence on student outcomes – particularly discursive practices – is my focus. The lack of research into this particular factor may be related to claims that mentor characteristics have little effect on positive outcomes for students, such as those by Russell, Hancock, and McCullough (2007), who base this claim on multiple-choice survey data. Yet, as I will attempt to show here, an exploration of fit in the context of undergraduate research has not been adequately explored with an appropriate or rigorous enough methodology to warrant such claims, and the continued emphasis on time, exposure, and access over relationship in such programs continues to privilege students who are already well-represented in STEM rather than help those who are underrepresented.

Fit, in the context of mentoring, is far more extensive than similarity (e.g., shared area of study or interest, gender, or other demographics). As Baker, Pifer, and Griffin (2014) note, “Fit is achieved through the presence of shared values, complementarity, and mutuality” (p. 84). Both
the mentor and mentee must have a common goal and means to achieving that goal, each play a role that benefits the relationship, and each offer something to the other. In short, fit is bidirectional, not unidirectional. While fit has been of great concern to scholars working in organizational and management realms (Backhaus, 2003; Chatman, 1989, 1991; Schneider, 1987), it has largely focused on employer-employee relations and influence on productivity. As Baker, Pifer, and Griffin (2014) note, mentors play a different role than supervisors in the lives of students, and thus require “a different understanding of fit” (p. 84). These authors provide a framework through which fit can be assessed, utilizing professional identity, relational identity, and personal identity as a trichotomy. What is missing from this assessment, however, is a consideration of the effects of intersectionality and interpretation on the relationship. By this I mean that while seeing oneself as becoming a member of a specific disciplinary community (professional identity), as fitting with one’s familial and cultural roles (relational identity), and generally fitting with one’s “sense of self” and “personal characteristics” (personal identity) (Baker, Pifer, & Griffin, 2014, p. 85) are all important factors to consider with fit, it is also important to consider how both student and mentor intersectional identities can influence the interpretation of practices and events within the relationship. This chapter works to elucidate this influence by examining how differing (and often unarticulated) student and mentor expectations and assumptions influence not only the research, but the discursive development of the student.

In this chapter, I explore the experience of Anne and the influence mentor fit had on the development of her discursive identity. Here, I argue that matching instructional approaches and personality traits (which includes both understanding of and respect for intersectional identity) has far more impact on student outcomes than, in this case, gender and subject area affiliation. This issue of fit also speaks to the notion that time and exposure (Hare & Fitzsimmons, 1991;
Freedman, 1993; Brent, 2012) and situated learning (Lave & Wenger, 1991) take priority in students successfully developing rhetorical facility with disciplinary discourse conventions.

As with each case chapter in this dissertation, I will begin by introducing both Anne and her PURS mentor, Meijer (Anne referred to her by last name only). This will be followed by a chronological account (drawing heavily on Anne and Meijer’s voices) of Anne’s experiences both in research and the discursive practices surrounding that research. Because Anne’s journey through college is unique in that it includes additional mentors and research experiences outside of PURS, I present these mentors and experiences as they arise to compare and contrast to Meijer’s approach to illustrate the impact of fit not just on research skill, but on discursive identity development. The chapter will conclude by drawing out and discussing the main insights Anne’s experience demonstrates regarding student learning and the intersection of identities.

**Participant Profiles**

Anne is a young woman originally from South America who, when asked, self-identified as African American. Though she claimed to be relatively unfocused prior to college – her professional interests ranged from modeling to photography, ballerina to veterinarian -- Anne was focused enough in her schooling to not only attend the top high school in her district, but to focus her academics on science, as well. Anne’s schooling was based on the British system, where students take all subjects for the first three years, then begin to “stream” according to career desires and aptitude. Anne earned her “O-levels”\(^ {13} \) in biology, chemistry, and physics. Rather than continue into the more advanced “A-levels,” which are prerequisites for university in

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\(^{13}\) O-levels are the equivalent of general requirements to graduate high school in the United States. A-levels are on par with Advanced Placement coursework, though slightly more rigorous.
the British system, Anne chose to leave school at 16 and move to the United States with her mother. Because of the differences in schooling, Anne’s mother wanted her to repeat high school in the US, but Anne resisted, agreeing only to “redo it” if she was not accepted into college. Her acceptance into LUPC ensured that she would not need to “backtrack.”

A lively personality with a deep Christian orientation, Anne demonstrated a zest for life and learning from the moment we first spoke: “My mom tells me all the time that there’s not enough me to go around and do all of the stuff that I want to do.” Inspired by female scientists in television shows like *CSI* and *Dr. G Medical Examiner*, Anne came to the college to study forensic science with the hope of becoming a medical examiner. Though she was enthusiastic about pursuing this degree and what it might mean in terms of contributing to the world, Anne did absorb some of her mother’s concerns that she might not be ready for the academic work – a doubt that persisted even after her success in coursework.

In conversations over the course of this study, it became clear that Anne was surrounded by strong women – from her mother, grandmother and aunt to her mentors. Yet, she was surprisingly unaware of gender disparities in science. We began working together when she was a sophomore, and it was clear that she had already created a strong identity for herself as a scholar and overachiever. “I like things that hurt my head,” she remarked early in our first interview, “I’m just academically oriented. I don’t know…like, I have no life outside of my books. I don’t go out, I don’t work, there is nothing I do. I basically just study. That’s my life.” This identity, she admitted, had its drawbacks in that she did not consider herself well-rounded and was almost apologetic in admitting that she hadn’t yet been involved in any extracurricular activities. It was actually this awareness of needing to be well-rounded in order to be competitive for graduate school that drove her to pursue undergraduate research opportunities (an awareness
that would later translate into searching for volunteer opportunities and internships more closely related to her medical interests).

Despite having a strong academic identity, however, Anne’s scientific identity was quite underdeveloped when we began interacting. Though she was inspired and excited to be working “with others who do the same thing and tilt the same way” as she did, she was cautious when approaching scientific research. She selected her mentor based on the fact that so many of the faculty worked in DNA, and she didn’t “want to work with DNA [because] there’s too much going on.” Instead, she pursued a mentor who worked in anthropology and seemed approachable. This identity was reinforced in Anne’s lack of awareness of scientific ethics and apparent struggle with scientific discourse. In our first conversation, she explained that her initial project ideas were deemed “unethical” by her mentor because of their use of biological contagions, and she stumbled over her words and mixed up terminology when explaining what it was that she was working on – which, ironically, involved extracting DNA and RNA from bone fragments. Yet, she was unapologetically aware of her “greenness” as a scientist, which was endearing. Anne didn’t try to sound like someone she wasn’t – she simply accepted that she had a lot to learn, and was doing her best to put herself into situations where that learning could take place. This attitude worked in Anne’s favor when, as we’ll see later, circumstances outside of her control postponed her proposed research.

In her choice of mentor, Anne found both a mother-like figure as well as a disciplinarian. Meijer had a stellar CV that would humble many. As a forensic anthropologist originally from northern Europe, she worked internationally on research of great social importance, exploring the ways in which humans interact with their environment, and was in demand from both students and academic scholars alike. Meijer was clear in interviews with me that she privileged self-
directed learners and that she had no interest in mentoring students who were not looking to be scholars. “One of the first things I say when they meet with me,” she explained, “is that if they are not thinking about publishing, they should not join my lab.” She was also very clear about the type of students she wanted: “I tell them that they need to come to me with solutions, not problems.” She directed interested students to a page on her lab website that gave potential mentees both practical advice (e.g., delay trying to join the lab if they are over-committed with coursework or other activities), as well as warning students about her approach to mentoring (“A sharp and quick mind cannot take the place of hard work,” and “If your adviser had the answer she would have published it already.”) Meijer was not interested in students who could not problem solve; she didn’t want to accept students who would email or text basic questions throughout the day, or who required too much hand-holding. She wanted future scholars who would step up to the challenge of research. This approach, she conceded, had a lot to do with her own experiences in academia – first, in the Netherlands, and later at a prestigious UK university. Her experiences at the undergraduate level, she recounted, were particularly competitive, harsh, and at times humiliating. Students were expected to self-teach, and much of the examinations for coursework were public and oral (with high stakes). One either performed or they failed. And if they failed, they were publicly directed to other majors.

At the same time, Meijer was an incredibly open and welcoming individual who had intentionally designed a scaffolded approach to introduce students to the lab. In recounting her approach, she described teaching new lab-members how to effectively use the internet (e.g., Google Scholar, otherwise referred to in the lab as “Dr. Google”) and databases to find scholarly material, including the use of Boolean searches. She claimed to teach students how to build literature reviews and assess sources. She demanded that they write their project protocol
(methods and materials) before any other parts of the proposal and visit the College’s writing center not once, but twice, to ensure clarity and coherence – even asking many to purchase themselves a copy of Strunk and White’s *The Elements of Style* for reference. In short, Meijer was (in theory and intention) investing in the content knowledge of her mentees, as well as the practical, mechanical aspects of scientific writing. However, as will be seen, the degree to which this instruction took place was also proportional to the amount of persistence students had in seeking out her time and knowledge. While Meijer was clear in her theoretical approach to bringing on new mentees, in practice these things did not always take place.

**Writing in the First Research Year**

As was noted in the program description (Chapter 3), students within PURS are required to write a proposal in order to be part of the program and receive a research stipend. When Anne entered Meijer’s lab, she had never read any scientific articles or books, short of textbooks. Her scientific writing experience, likewise, consisted only of having written laboratory reports for her Organic Chemistry course. When describing her approach to scientific writing in this context, she explained: “I write basically how I did it....But, like, what I’ve learned at [LUPC] is that basically just say why. Just ask ‘why?’ Everything you do – say why…That is basically how you make a discussion.” Her understanding of scientific writing at this stage was more aligned with academic assessment (i.e., laboratory notebooks for coursework) than with authentic disciplinary practice. Anne’s understanding of genre conventions were also somewhat distorted. She understood that there was a reason, for example, scientific papers and reports follow an IMRaD structure, but what that reason was and its execution was challenging:

The thing that really gets to me, though, is separating parts. It doesn’t happen too much in chemistry, but in physics lab reports I tend to merge, so my Introduction tends to have a
little analysis inside. And the analysis tends to have a little discussion inside…So stuff are going where stuff are not supposed to be. I don’t know why…

Thus, Anne was at a disadvantage entering Meijer’s high-demand laboratory with little prior knowledge of, or first-hand experience with the reading and writing practices of scientists (though, she at least had an awareness of this disadvantage).

Despite Meijer’s claims that she introduced students to the lab rhetorically through literature search practices, reviews, reading, and scaffolded writing, Anne had not received any of this instruction. Similarly, weekly laboratory meetings where students were expected to read and summarize articles from the field had been postponed indefinitely due to Meijer’s schedule. When I asked if she had ever been offered such instruction, Anne remarked that she had a memory of one optional group instruction in using referencing software, but it was scheduled for a time when she was unable to attend. One-on-one instruction or make up sessions never took place. When I asked Anne why she thought this was the case, she suggested that because Meijer was managing two laboratories (at two institutions) and had so many students working in her lab (when Anne joined there were at least 10 at LUPC alone), that there just wasn’t enough time.

Anne was also at a disadvantage mathematically when she joined the laboratory, having done only basic mathematics in high school and at LUPC. For a few months prior to writing or submitting her proposal, Anne was shadowing and assisting other students with their projects. One of these projects involved conducting a statistical analysis of wounds to bones from various sharp implements (e.g., screwdrivers). After conducting the analysis (using Excel), Anne was achieving “very weird values.” Meijer instructed Anne to use the program R instead – a program Anne had not previously heard of, let alone understood how to use. (In addition to being able to handle very large datasets, R is superior to Excel for this type of scientific analysis because it
offers more complexity to data visualization, calculates values considerably faster, and allows for more complicated mathematical formulae.) Using tutorials and trial and error, Anne taught herself enough of the program to generate results. But this took a considerable amount of time and, before she realized, the deadline for the proposal was suddenly upon her.

In order to help Anne make the deadline and acquire funding, Meijer strongly guided her toward a project to propose, rather than having her generate a topic independently. Meijer also provided Anne with a paper on similar work to reference and guide her understanding, though because of the eleventh-hour situation, Anne had not had an opportunity to read it before writing her proposal (thus missing critical information). Anne described the project to me hesitantly:

I [will be trying to] retrieve viral particles – DNA and RNA phages – from bones that have been … that have been left…you could just say left out in the wilderness. Been left on…I don’t know, what’s the word I’m looking for? Untouched? So that’s basically what I’m working on. And I’m going to be using pigs. Domesticated pigs to see if… I would have to look up internal viruses that are known to domesticated pigs, and then retrieve the bones to see if those viruses are present or are still present in the bones after, like, a period of let’s say two months? Or, I don’t know, sometime after. After all the decay and all of that has occurred.

Though she was enthusiastic, it was clear from her description that even after writing the proposal Anne wasn’t sure what her project was about or how it would be implemented. Did she need to look up viruses first? Infect the pigs? Or were the pigs infected prior to arriving at the lab? How was the testing going to be conducted? These were questions that she wasn’t able to answer clearly in that discussion of her research, and she frequently mixed up the names of procedures and instruments. It appeared at that early stage of the URE that Anne’s performance
of “scientist” in discourse was unconvincing. She was also, as Meijer intimated in an interview, a perfect example of the “average student” Meijer encountered in her faculty role: lacking skill in communicating, in both oral and written forms; lacking a strong vocabulary in science, and poor mathematical abilities. Fortunately, Meijer attributed these challenges to poor public schooling in the US and did not see them as deficits originating in the students themselves – though there was a suggestion that it was the students’ responsibility to remediate these discrepancies, which ultimately, I believe, influenced Meijer’s interpretation of Anne’s work in the laboratory.

The proposal writing process was similarly disjointed. Anne struggled to get and keep a meeting time with Meijer due to Meijer’s demanding schedule. Unfortunately, Anne also waited to work on the proposal until speaking with Meijer in person because she was, essentially, waiting to be told what she would be doing. This resulted in the drafting of the entire proposal from scratch at the last minute:

I did write a draft. I didn’t get to write it as best as I could because I wrote it the night before the [due] date. Not because… Like I said, she was busy. I had that meeting with her the 22nd and I was like, “Do you want me to submit a proposal, because I know the deadline, it’s so late?” And she’s like, “Go ahead!” So basically the night of the 23rd I had to write. I was up till like 4 o’clock in the morning writing a proposal. Then I sent it to her in the morning, she reviewed it, sent me my corrections, sent it back to me, and then I submitted it that night. …. I could have done it better….I didn’t read the paper that she gave me because I was against time. And I had to sleep. So I, like, I glazed over it. But when she sent me the reviewed version, I decided to take a look at it [the paper], like revising my parts. And then I realized what I did for my results and what they had for
their results was completely different from what they actually had! And I was like, “Oh my goodness!” So had to rewrite that whole part [before submitting it].

The proposal shows a student whose command of academic writing, in general, is strong, but whose understanding of scientific writing needs work. Figure 4 shows the Introduction to Anne’s proposal, with my annotations as to features that are not appropriate to scientific discourse. The use of boosters (Hyland, 2011) such as “very informative and exciting” lends more toward popular science writing, as does the over-explanation of viral replication and the incorporation of article titles. From this sample, it would seem that Anne was unsure of exactly who her audience for the proposal was – an audience that would “read” her as a beginner scientist without much understanding of the work or its significance to the field. At the same time, that such a coherent document was produced in the early morning hours the night before it was due, and with only a cursory understanding of the project at hand, suggests that Anne has resources to draw on that would help her down the road.

Anne submitted this proposal to Meijer, who responded the next morning (the day it was due). Much of the feedback Meijer provided were line edits and comments on the protocol. Figure 5 shows the minimal line edits made, simply replacing a few words, but not correcting misconceptions or errors. After submitting her proposal to PURS for funding consideration, the feedback offered from the Program Coordinator was quite telling:

Thank you for submitting your proposal on time, please my [sic] comments below.

1. When writing about science, you have to be careful with language: you have to be specific enough so that your message is not "open to interpretation", what you meant to say must transmit clearly. Here's a few examples: Though I am happy to have a philosophical debate about it, viruses are not really considered to be "organisms". The
b) Introduction:

Bacteriophages are viruses that can infect a host cell, and when favorable conditions arise, can reproduce and proliferate. Their reproduction can cause the host to fall ill and in severe cases, die. For this reason, many of the research surrounding phages explore their cause and cure aspect. This work departs from the norm, in that it explores the correlation between the living and the deceased. By successfully determining the presence of viral particles on the bones of slaughtered pigs sometime after death, one will be able to make assumptions about the lifestyle and the health of the person prior to death. In addition to this, if a statistical relationship of time versus phage population can be mapped accurately from the results, then this method can be used for confirming time of death. The article, “Effects of lyophilization on the infectivity of enveloped and non-enveloped viruses in bone tissue,” by Christina Uhlenhaut, et. al., discusses the importance of determining the presence of viruses on lYZOphiliated, that is freeze-dried, bones for future bone transplant. The presence of viruses on preserved bones in preparation for transplant can have harmful effects on the new host. Viruses are, in the end, are a very informative and exciting study because of their unique characteristics.

Figure 4: The version of Anne’s proposal Introduction sent to Meijer. Annotations highlight features that are not appropriate for scientific discourse.
b) Introduction:

Bacteriophages are viruses that can infect a host cell, and when favorable conditions arise, can reproduce and proliferate. Their reproduction can cause the host to fall ill and in severe cases, die. For this reason many of the research surrounding phages explore their cause and cure aspect. This work departs from the norm, in that it explores the correlation between the living and the deceased. By successfully determining the presence of viral particles on the bones of slaughtered pigs sometime after death, one will be able to make assumptions about the lifestyle and the health of the person prior to death. In addition to this, if a statistical relationship of time versus phage population can be mapped accurately from the results, then this method can be used for confirming time of death validations. In the article, “Effects of lyophilization on the infectivity of enveloped and non-enveloped viruses in bone tissue,” by Christina Uhlenhaut et al., discusses the importance of determining the presence of viruses on lyophilized, that is freeze-dried, bones for future bone transplant. The presence of viruses on preserved bones in preparation for transplant can have harmful effects on the new host. Viruses are, in the end, are a very informative and exciting study because of their uncommon unique characteristics.

c) Hypothesis:

In the recent article, “Bones hold the key to DNA, virus history and epidemiology.”

Figure 5: The final version of Anne’s proposal Introduction, showing changes from the initial draft. According to Anne, the line edits were primarily from Meijer; no comments were available in either draft.

first sentence of that abstract sounds like you are talking about spores that can stay in a state of dormancy [sic] for long periods until conditions improve. Viruses are not really "dormant", they just "are" because they don't have a metabolism, and they don't wake up under favorable conditions: the only "favorable condition" is when they come in contact
with the right cell in (or on) the right host that they can take over and force to make more viral particles. Another example, I imagine when you talk about "benign viruses" you mean phages, and you are calling them benign because they are not harming the pigs. But that does not mean they are benign, is just that pigs are not the host for them (although they can kill a pig if you inject enough of them and then the pig develops anaphylactic shock to their capsule proteins). Trust me, there's nothing benign about phages when they find their host: is carnage for the poor little guys! You also mix up viruses, bacteriophages, and phages throughout the proposal. Phages are viruses, but not all viruses are phages, that term is reserved for viruses that infect bacterial cells. On the first few sentences you say that phages can cause the "host to fall ill and in severe cases, die. Although that is true to some viruses (HIV, for example), it is not true for bacteria. There are two outcomes to a phage infecting a bacterial cell: they take over the cell and make it make new viruses until it explodes, or it integrates itself into the bacterial chromosome(s) and waits for the right conditions to take over the cell. Bacterial cells don't "fall ill,", humans (or pigs, or plants) fall ill. Your writing in this proposal is clear and has good flow, and most importantly shows your excitement about your project, but lacks specificity when talking about scientific terms.

2. It is still not clear to me if you are planning to use bacteriophages or porcine viruses to infect the pigs after death, and there's some logistical issues to take into account: If you are injecting post-mortem both will be difficult to detect, as there's no circulation to bring the phages or the viruses to the bones. If you are using bacteriophages, unless their bacterial host is located on the site of injection, there will be no replication so you will likely have to start with a very high phage count and inject directly into the bone. If you
are using porcine viruses and injecting right after the moment of death, there might be an increase in titer as cells become infected and shed new viral particles before they go bio/metabolically inactive (in a more technical term, before they go kaput). I imagine you will be working on this details during the next few months, so take these factors into consideration as you develop your project.

3. I look forward to learning more about your project and seeing your results.

I share this extensive feedback to highlight the fact that, despite writing a proposal and incorporating (limited) mentor feedback, Anne’s first submission to PURS was full of issues related to her basic understanding of her project, the discipline’s jargon, and even the purpose of the research itself. In “trying on the discourse,” it was evident that major tailoring was needed. In my own reading of the proposal, I see a student aware of the sections required, but unsure of how much detail and explaining is required, and in effect unsure of the rhetorical situation and audience. In some instances, terminology and procedures are explained that a practicing scientist would already know, in others she employs rhetorical structures that work well for expository arguments, but are not as effective in scientific writing (e.g., presenting an author’s point of view and then rebutting it). To Anne’s credit, she knew there were problems with the proposal and was wary when sharing it with me, begging “Please don’t laugh at me!” when I asked if I could see copies. Anne’s discursive identity in science clearly did not align with that of a practicing scientist and she knew it. Though metacognition about science writing was growing, Anne did not yet have to resources to know what, exactly, was wrong or how she could fix it.

Despite being funded, instead of conducting the work she had proposed, Anne ended up working on another project of Meijer’s in order, as Anne described, “to keep [her] busy.” Similar in nature to her proposed project, instead of investigating viral DNA, Anne was investigating the
presence or absence of mammalian DNA on bones. When talking about this second project, however, it became clear that that was not going according to plan, either. Laughing, Anne explained that “there were things that should have happened, but [she didn’t] know if they actually did”. These “things” ranged from chemical supply-ordering to actually procuring diseased pigs, and there was much confusion as to whose responsibility these tasks were. During this conversation, she seemed to still be confused as to what she should and should not be doing procedurally in the laboratory, and not entirely clear on what the actual steps (such as extracting cells or “put in protease”) looked like in practice. Though by this time she was a semester into her funded undergraduate research experience (and one academic year in the laboratory), Anne didn’t seem to present herself as any more of a scientist than when she began. In fact, she seemed quite comfortable in the role of being a novice who needed direct guidance and supervision – despite knowing that her mentor was not going to provide that. Taking this position seemed to be in line with the position Meijer (intentionally or unintentionally) prescribed, as well, in that Meijer did not want her to “get confused and mix [the DNA and RNA extractions] up.” When I asked Anne if she saw herself as a scientist, yet, given her laboratory experience, her reply was very telling:

No. I feel like [to be a scientist] you have to know a lot. Like, I don’t think I’m a scientist. I think I’m a researcher. More like, I’m investigating. I feel like a scientist – sure they do research, but they know the basics. I don’t know much about what I’m doing. I have to go look it up. But I feel like…it comes probably with age and experience? And failure? Because when you fail you’ll know why you’ve failed and you’ll know not to do that and you’ll know to try something else. And you learn from
there. So I think what a scientist…they’re more knowledgeable because they have come a longer way than me. So I don’t think I’m at that point, yet.”

When I asked if there were specific benchmarks in her mind she’d have to reach first, both age and level of education seemed to play a critical factor. “Like the Master’s students,” she explained, “when they speak, [they] sound so nice. Like, smart. I think when I speak, I don’t sound like that. They know what they are saying and they know what they are doing. By the time, then, when I’m their age and I’m about to graduate, I feel like I’ll be a little closer to that mark. That scientist mark.”

At the end of that semester, Anne attended PURS’s annual Symposium, but because her research never got started, she was not required to present a poster. “It was very…interesting,” Anne told me; “I learned a lot.” When I asked why she didn’t present a poster, she laughed: “I spoke with [Meijer after], and she was like, ‘You should have done a poster.’ And I’m like, ‘But I don’t even know what I’m doing!’” At the same time, the experience was hopeful. In watching the oral presentation by the annual Outstanding Undergraduate Researcher – an award for the best research conducted by a graduating senior – Anne thought to herself, “That could be me.”

Though the end of the semester arrived, the only part of her research that had taken place was that the pigs (infected with viruses) had been placed at a protected site outside of New York. Anne wasn’t part of that deposit, however, and wasn’t sure if they were in New Jersey or Pennsylvania. She wasn’t sure, either, when the pigs would be picked up so that analysis could take place. (It would turn out to be the following fall rather than the anticipated 6 weeks.) Instead, Anne had continued working on the side project for Meijer, extracting DNA from bones that had been buried in Meijer’s home garden. But, again, that research was not progressing, as Anne hit roadblocks with computer issues and finding the time to run “PBRs” (polymerase chain
reactions, or PCR, is a technique used in molecular biology to replicate a small sample of DNA into larger quantities so that analyses can be conducted. In our conversation, Anne referred to her personal lab notebook to refresh her memory on what had happened during the semester, but that didn’t help much. Mostly it surfaced summaries from a few research articles she had sought in her brief literature review.

Despite having positioned herself as an academically-minded individual, when it came to independent research Anne was at a loss and struggled. Though Meijer was welcoming to students, she was also hard to track down and had unclear standards and expectations, which seemed in many ways to keep Anne at a distance and in a state of limbo. Anne realized that she had to show more initiative in order to make her project progress, but my sense was that her understanding of what effective initiative would look like to Meijer was murky. (Anne’s version was to make appointments to talk and ask for direction; Meijer’s version was for Anne to do her own independent research and present a direction for approval.) Though Meijer commented to me that she wanted her students to be self-directed, her interactions with Anne were full of mixed messages – for example, expecting Anne to present ideas for research and protocols, but dismissing them when Anne tried. Anne felt incapable in Meijer’s eyes and often fell into the role of child requiring parental assistance (Anne went so far as to refer to herself and her lab-peers as “children”). This positioning did not leave room for Anne to author a different self. At the same time, Anne’s interest in the laboratory was waning and the isolation made it too easy to forget that research progress was necessary if it would pay off for graduate school applications. In fact, Anne’s heavy course-load and extracurricular activities (volunteering at a local hospital) were having the exact effect Meijer had warned of prior to Anne joining the laboratory – in her quest to become more “well-rounded” and attractive to medical schools, Anne had diluted her
energies so much that they were no longer having the positive effect they were meant to. Similarly, Meijer had so many students working on so many projects at the same time that she, herself, had diluted her mentoring energies to the degree that Anne was all but forgotten.

**Writing in the Second Research Year**

In the interim summer, Anne finished up aspects of Meijer’s side project and took some time to visit family abroad. When she had returned to New York, she found that the lab was “on lock-down” because Meijer was “dealing with some really valuable bones.” Having been locked out of the lab, Anne took the opportunity to return to her PURS proposal. Because she had not really made much headway, the Fall proposal would not need to be much different from the Spring’s – however, Anne’s sense of academic pride prompted her to take the feedback provided from the Program Coordinator, as well as her knowledge from her time in the lab, and rework it considerably. Though Anne claimed that mostly she “improved [her] English and some [mechanical] stuff,” the end result was a far more polished and coherent document that showed a stronger understanding of what she was doing and why. Anne asked Meijer if she wanted to review it before it was submitted to PURS and sent her a copy, but Meijer didn’t respond to the email before the deadline.

Taking some initiative, though, Anne *had* managed to get an in-person meeting with Meijer earlier in the semester where she shared her feelings about the lab experience to date: “I told her I was like so lost, I don’t know what to do. I felt like I wasn’t doing anything… So she had written out a plan for me of the… A step by step plan of what I needed to do. So that was really helpful. So that kind of guided me to writing the proposal.” This plan, shown in Figure 6, describes the protocol Anne was meant to follow, still focusing on the “side project” and not the pigs. Yet, as I learned later, this side project was meant to familiarize Anne with the procedures
and techniques of DNA extraction in a less-costly manner than the larger project – a strategic economic move on behalf of the lab, but with the unintended consequence of suggesting Anne’s participation was of lesser value than others’.

Figure 6: Diagrammatic ‘plan’ of protocol for Anne to follow.

Reflecting on the two proposals she had submitted, and the influence of the diagrammed protocol, Anne remarked:

The first time I wrote, I really didn’t know what I was actually doing. So even though I had a general idea, I still – cause I hadn’t started it, yet. I knew what the end result should be, but I didn’t know how I was gonna get there. But I feel like, right now, with the proposal that I just submitted, I feel like I have in my head a set...like a step by step procedure of how I envision things to work out. So it’s more like I know which direction to go, and not like I’m going here, here, and here to get to the end. I feel like I’m more narrowed now.
In effect, Anne’s proposal was considerably better. Her revised Introduction (see Figure 7, next page) still included some hyperbole (i.e., “scariest diseases”) and unnecessary explanations, but it was far more fluid and coherent than the first proposal. Later sections of the document also note her intention to work with Meijer to prepare a manuscript on her eventual findings. Though there are moments where she still falls on the side of popular science than scientific writing, the second submitted proposal reflects a student becoming familiar with the rhetorical conventions of the discourse, moving a few steps away from complete novice and toward competence.

During this time, Anne was also beginning to realize that she desired experiences that would be more relevant to her future career as a pathologist. Though she continued to volunteer at a local hospital, she also independently pursued two new avenues: applying to formal, external summer research programs and randomly phoning pathologists in the metro area to see if they would consider allowing her to shadow them. For the first activity, Anne created a spreadsheet with summer research programs located within an appropriate travelling distance. Then she parsed them for programs that are disease-based, since her interest is pathology. Once she had a list of programs that were appropriate and local, she applied to all. The result was an impressive acceptance to the summer undergraduate research program at a prestigious college of medicine to conduct biomedical research. At the same time, Anne had begun cold-calling pathologists in the metro region with the hope of setting up a job-shadow opportunity. Taken aback by such a bold move, I asked Anne where this idea came from and how she was approaching the task:

Just calling a bunch of pathologists’ numbers that I found on the internet and asking them if they can, like, employ me as their shadow. Most of them said “no.” Most of them. And then after the “no”s they were like, “Oh, continue and good luck! Good luck!” and stuff
Figure 7: The revised Introduction to Anne’s second submitted proposal, annotated. Some items (previously uncorrected) remain from the original, but improvements were made in coherency and accuracy or research.
like that. Motivational speeches. And then the others that did say “yes,” one I got an…I spoke to a guy from OCME [Office of the County Medical Examiner] about an internship there. So, he emailed me saying he’s about to leave the office because it was Friday, but he’ll get back to me on Monday….And a girl…I had called a doctor. I think it was her house phone, because she asked me, “How did you get my number?!?!?” So I told her, “The internet.” And she seemed very friendly, too. So, but she had given me a guy’s number to contact concerning it. So I have three potential people – one of them should work out, hopefully. I pray.

While I was personally speechless with her description of what she was doing and how (generating a phone list, starting with the letter A and moving alphabetically, skipping names she couldn’t pronounce), eventually her rationale began to emerge and I saw the logic. “I feel like the way the world is set up,” she explained, “you have to know people. Nobody in my family, immediately, are doctors or have anything that complicated.” And her non-familial network was similarly restricted. As a result, Anne decided to change the circumstances and create those connections for herself. To my surprise, it paid off in ways neither of us could have imagined.

When we spoke a few months later, Anne was already three weeks into a shadow experience with a fetal pathologist at a hospital across the street from the one she had been volunteering in. An “elderly” (mid-70s) White woman, Dr. Brennan had asked Anne to send her a formal letter of interest outlining her career interests and desires for the shadow experience (see Figure 8), as well as a current resume. Once that was done, Anne began volunteering in Dr. Brennan’s laboratory two days a week, for an average of 12 to 14 hours per week (incidentally, 7 to 9 hours more than she committed to Meijer’s laboratory).
My name is [Redacted] and I am a third year student at the John Jay College of Criminal Justice.

I am currently a biology major and am very adamant in pursuing a medical degree in forensic pathology. For this reason, I am specifically interested in observing you and through our time together hope to learn more about your practice. If granted permission, I would like to engage in this gratifying endeavor for the duration of three months (a few hours per week).

As an aspiring pathologist and your potential student, I would like to understand how you are able to utilize tissue samples, laboratory results and your knowledge of pathology to be able to identify, interpret, analyze and come to a conclusive diagnosis for a particular disease. It would also be a great honor to be able to learn and identify distinguishing features of particular diseases. Through this experience I also hope to be able to learn about novel developments in this very diverse field of study.

In preparation for my journey into medical school, I wish to not only gain the most insight in medicine, but also to explore a field I am most fascinated by. I have worked, though briefly, with individuals living with developmental disabilities, and am presently conducting research in an anthropology lab on the identification and retrieval of viral particles from bones. In addition to this, I do volunteer in the telemetry department at the [Redacted] Hospital Center.

I must extend many thanks for considering me for this wonderful and exciting opportunity. If you have any questions, requests or concerns please feel free to contact me. My contact number is [Redacted]. I do look forward to hearing from you.

Respectfully,
[Redacted]

P.S. I have attached a copy of my resume to this email.

Figure 8: A copy of the formal letter of interest Anne sent to Dr. Brennan, redacted, to begin her job-shadow experience.

The letter Anne sent reflects the exuberance with which she approaches the work of pathology. Her desire to learn is palpable. And it appeared that that level of enthusiasm was something that Dr. Brennan recognized and appreciated. There was no formal shadowing program at the hospital; but Dr. Brennan welcomed Anne anyway – even jumping departmental hurdles to let Anne shadow her. Once those hurdles had been passed, Dr. Brennan wasted no time putting Anne to work. As a fetal pathologist, Dr. Brennan worked entirely with stillborn
infants. In particular, she was attempting to determine if performing a postmortem autopsy provided any additional information to parents and physicians about the cause of death than the traditional ultrasound.

For five months, Anne went to the hospital to work alongside Dr. Brennan. During that time, the two worked closely together, and Dr. Brennan was a consistent source of guided instruction. As Anne explained, “I can ask her [anything]…Or when she’s looking at placenta, like microscopic slides of the placenta, she will talk and explain stuff and explain what this is and that is and stuff. Even though most of it goes in one ear and comes out the next – cause, big words… But at least something sticks.” Dr. Brennan put Anne to work collating data from 2015 and 2016, reading individual files and analyzing “for the correlation between gross defects and placental abnormalities.” Dr. Brennan told Anne early on that she wanted (and expected) Anne to create a poster about this project that could be shared with colleagues at the hospital and possibly turned into a paper for a medical journal. Anne described this project as being integral to her knowledge growth: “You learn a whole lot because I have the patient's files in front of me and I get to read their charts and read what the pathologist documents…[and] they have the pictures to correlate it with. So I can look at the pictures and be like, 'that means that and that means that.' It's really cool, like, I learn a whole lot.” Anne credited the ability to correlate images with jargon, as well as looking terms up in the readily-accessible medical dictionaries when she was stumped, as contributing to her growth as a scientist:

Now that I’m actually doing stuff, an I’m reading stuff, and I’m expanding my knowledge and the words and the vocabulary, I feel like I’m at a higher level than I was before. …. I feel like I’m actually putting stuff together and actually trying to analyze
data – and getting data…. And it’s really, like, even [if] I don’t understand much of the placenta findings, but I can see, like, repeating patterns of certain things.

Though most of Anne’s discursive activities at the hospital were focused on reading and listening, when it came time to write Dr. Brennan was equally helpful:

She showed me previous posters. She told me to look at them because they are all around the whole hospital. So she's like, 'look at it,' but she told me we are going to do an abstract [first]. We haven't actually gotten down to the writing part yet, but she just told me to look through it, read what they wrote to get an idea. And she also sent me a poster that a fellow student or a professor also presented, which is also on pediatric pathology. But it's not like a statistical thing. It's just like a T study [sic]. She also gave me that to look through.

By offering models to Anne, Dr. Brennan was providing implicit guidance on the genres and discourse conventions of science. However, as has been effectively shown elsewhere (e.g., Wilder, 2012), for many students simply providing models is not enough. Explicit instruction as to the ways in which disciplinary communities communicate is often needed for students to successfully cross the boundary from layperson/novice to proficient/expert. Anne certainly possessed the ability to understand these discourse conventions – she simply needed someone to point them out and explain how they are used. At the same time, her fit with Dr. Brennan seemed stronger than with Meijer. Both scientists are women, highly credentialed, and interested in pathology. Yet, Dr. Brennan made efforts to involve Anne in the work and draw on her interests. She went out of her way to show Anne what it means to be a pathologist, not just complete scientific tasks – including what such a role sounds like.
In one poignant example, Anne was asked to assist Dr. Brennan when a mother who had lost her child late in pregnancy scheduled a meeting to learn answers to why her child did not survive. Anne was given a copy of the woman’s file, including the autopsy report, to become familiar with the case, and then was told to “prep” the mother on her arrival (with the mother’s permission): to get her water, settled into a quiet conference room, answer basic questions, etc. For an hour, Anne and the mother sat and talked in the quiet space, discussing the type of work Dr. Brennan was doing and pulling out what the mother’s goal was for the meeting. When Dr. Brennan arrived, “the first thing she did was tell [the mother] it wasn’t her fault, because mothers tend to blame themselves when they lose a child….So that’s how she began.” While talking through the autopsy findings, Dr. Brennan emphasized for the mother the need to let her body and heart heal before trying to conceive again. Anne witnessed first-hand how to talk about complicated, sensitive topics with a grieving mother in a way that would not cause further pain. Describing the effect of the meeting on the mother, Anne said: “You could tell that her mood was lifted and she had more understanding about what happened to her son. It was very moving.” This experience helped Anne develop a strong understanding of the important social role pathologists play.

Toward the end of her time with Dr. Brennan, Anne drafted the content for the poster. Though she referred to the entire document as an “abstract,” in actuality it included each of the relevant poster subsections. The feedback Anne received on the actual abstract was that she “didn’t write professionally enough,” that it “was more story-telling” than scientific. Dr. Brennan decided to rewrite the document herself, though she did tell Anne that “in scientific writing you want to be brief and avoid words like ‘however’ and stuff that are not definite.” As is evident in Figure 9, Anne still did not have a clear understanding of her audience or the rhetorical situation
b) Introduction:
Pregnancy is a delicate moment in a woman's life. During this time, various circumstances can cause the mother to experience feelings anywhere from dejection to euphoria. As the fetus develops, an increasingly intimate bond develops, resulting in a very strong connection between the mother and the unborn child. Therefore, loss of a fetus at any stage in gestation can result in feelings of anger, guilt, depression, etc. However, understanding the reason for a miscarriage is known to both mitigate these feelings and provide guidance for future pregnancies. All relevant fetal autopsies performed in 2014 were obtained and analyzed for the correlation between gross defects and placental abnormalities. Twenty-four fetuses were identified with placental abnormalities and of them 15 displayed gross malformations of either the hands, face or feet. The remainder did not present with the three abnormal placental morphologies identified in this study but diagnoses did include abnormal trophoblasts. Hydropic dyshormic avascular villi was identified as the most commonly found anomaly within the placenta associated with irregular development of the fetus. Ten fetuses displayed none of the three abnormal placental morphologies identified in this study and of them 7 were void of any malformations of either the hands, face or feet. The three remaining fetuses all showed gross abnormalities of the face. Understanding the underlying reasons for fetal loss and early identification of aberrant pregnancies can help mothers accept their loss and take the relevant precautions during future pregnancies.

Figure 9: The Abstract Anne wrote for the poster on data from the fetal pathology laboratory. Annotations show that her understanding of the purpose for, and audience of the abstract is not on target.
the genre of the abstract addresses (an issue that had been present in coursework, as well). She focuses on one social exigence for the research (helping grieving mothers heal), ignoring the scientific relevance of the research, what was done, and what the results suggest. The abstract contains abrupt tonal shifts and the inclusion of many amplifiers (“delicate,” “dejection,” “euphoria,” etc. [Hyland, 2011]), and the methodology and implications for research are vague.

Though Anne received a negative assessment for this writing, the writing itself – the grammar, flow, organization – is actually quite effective. She includes all the necessary elements of the abstract (introduces the research, provides methods, findings, and concludes with implications), as well. But it is certainly not scientific and reflects the challenge that Anne faced all along: She is a strong writer, but she has yet to understand what makes for strong scientific writing and was unwilling to adopt the position of “scientist.” The remaining sections of text for the poster, however, were not quite so flowery or off-the-mark. In Figure 10, we can see that Anne is more succinct and utilizes the data to support her claims (though some issues remain). She adopts a passive, third person tone and handles jargon with ease. The writing, here, and the identity reflected is far more sophisticated than anything she had written prior, suggesting that strong fit and guided research was helping her develop a discursive identity as a scientist.

Though Dr. Brennan began revising the materials Anne submitted, a computer glitch caused the revisions and feedback to be lost. Dr. Brennan had not yet returned to the writing when Anne’s shadow experience came to a close – however, the two agreed to keep working together, and Anne left with an assignment to begin turning the data collected into a draft paper (using a model article Dr. Brennan supplied):
Figure 10: Remaining sections of the poster for the fetal pathology laboratory, showing a stronger grasp of the rhetorical conventions of science, a greater comfort with jargon, and a more sophisticated discursive scientific identity. As annotations demonstrate, issues still remain with regard to clarity.
She reviewed this paper and she basically told me she wants me to write [our paper] over the summer so she can submit it to her people so they can publish it. But, um, she told me just basically copy the guy’s paper, only with our data. Cause we have the real fetuses. He just did a theoretical thing. So she wants to, like, support what he’s saying but with our additional information. Kind of like that. She said it doesn’t have to be long.

Though she had only this model and Dr. Brennan’s guidance to be direct and less story-telling, Anne’s intention was to work on this paper while she was doing her summer research experience at the medical college.

It is important to take a step back, here, and draw attention to the fact that at the same time Anne was shadowing Dr. Brennan, she was also participating in a volunteer experience at the Office of the Chief Medical Examiner (OCME), volunteering in another hospital’s emergency department, continuing as part of Meijer’s laboratory, as well as taking a full load of coursework. To say that Anne was overextended would be an understatement and is likely an influence on why much of the discursive work in these different venues remained at a surface level. But I will come back to that shortly. At the OCME, much of her time was spent running toxicology tests and observing three different doctors perform autopsies to determine cause of death. The irony of this young, vivacious, bubbly woman spending so much time around corpses was not lost on either of us. But as we talked about her attraction to this field it became clear: Anne is a highly inquisitive person who is fascinated by the inner workings of the human body and loves to problem-solve, as well as someone who is empathetic and altruistic. As she noted in her first draft of a medical school personal statement,

 though our ‘patients’ [at each location] were at different stages of development, our reasons [for the work] were the same: to alleviate the pain and grief caused by the loss of
a loved one. Together we believed that by understanding the reason or reasons that lead
up to a loss of an individual or fetus, a mother, father, spouse or family member can come
to terms with the situation and if applicable, take preventative measure to eliminate future
loss, such as those cases with genetic components.

Though her development in the discursive work of science was progressing slowly, her
understanding of what kind of scientist she wished to be was being honed quite rapidly and these
external experiences provided her a space to have some ownership in science (her use of “our”
being a notable change in her discourse).

The work over the spring semester in Meijer’s laboratory continued to stall. Whether it
was because Anne needed reagents to be ordered, or because Meijer needed to be present to
show Anne the next step in the protocol, Anne seemed to be constantly hitting roadblocks that
kept her both disengaged from the laboratory and from the research itself. Interestingly, Anne
took almost all responsibility for this lack of progress.

I kind of blame myself… Because I feel like I need to do something for her to respond.
Yes, that’s how I feel. ‘Cause I had to do that the first time to get the meeting with her.
So I feel like the longer I postpone it, is the longer my time is being wasted. Which is
kind of bad on my part. But I did – like, when I talked to her earlier, she needed the
master mix. And hopefully she put in the order, but I’m going to email her and remind
her that I need that. And that she needs to be there because I don’t know what I’m doing!

Though other students in the laboratory, including graduate students, were always helpful when
she needed them, their projects were all so different that Anne really needed the guidance of
Meijer to move forward. By the time the semester came to a close and Anne needed to present a
poster for the PURS Symposium, very little research had actually taken place and she was still speaking about what was expected to happen.

Concerned that she had spent three semesters in Meijer’s lab with very little progress, I asked Anne if she planned on continuing with PURS, and/or with Meijer, when school resumed in the fall. Her answer was positive, that she wanted to continue the research and actually see it through. Her respect for Meijer as a scientist was still very strong and she knew that when she was able to sit down with her PURS mentor one-on-one she would learn “tons.” I suspected, as well, that Anne was unsure of her agency when it came to changing mentors. As she confirmed later in the study, she “wasn’t sure if [she] could do that.”

**A Change in Trajectory**

As noted earlier, Anne was accepted into a summer undergraduate research experience at a prestigious college of medicine in the city. This program provided significantly more autonomy than the placement with Dr. Brennan, the OCME shadow, or Meijer’s laboratory, but at the same time was more structured. On her first day, she was introduced to a variety of research projects and given a week to select the one she was most interested in. By default, this selection paired her with the doctoral student responsible for the project to serve as yet another mentor. Anne described her immediate affinity with this researcher, Mary, in positive terms (“friendly,” “sweet,” “engaging”) and spoke of her introduction to the laboratory as “welcoming” and “open.” In her first visit to Mary’s lab, Anne noticed a sticky note on the computer that simply said “Do complement.” When she asked what that meant, Mary explained that it was a procedural step in the research on Herpes Simplex Virus that she had been meaning to do for the past year but had yet to complete it. Because she felt “attached” to Mary already, Anne
responded, “Well, while I’m here, why don’t we work on it? Cause I can do it and you’ll actually have the [results].” In that brief moment, Anne’s summer research project was born.

Over lunch later in the summer, I asked Anne to explain what “complement” meant and was struck by the ease and sophistication in her explanation in comparison to projects she had done with both Meijer and Dr. Brennan:

The complement protein system. It’s the way our immune system fights against bacteria. So, there’s like neutralization, where the antibodies surround the virus preventing it from entering the host. There is ADCC – Antibody Dependent Cell Cytotoxicity. So, that’s basically when the antibody binds to the virus, and the antibody also binds to the host cell, and then the virus dies. But neutralization, with most vaccines, you know like before they used to put an attenuated strain of the virus inside you to create the vaccine? They are trying to move away from that because, basically, you don’t want to infect the person. So then they came up with viral proteins – the proteins of the virus creates the same response. …. So complement – they have three systems. The alternative pathway, the classical pathway, and the lectin pathway. The classical pathway is antibody-dependent, so [Mary] wanted me to see if that was another method that [the vaccine] could work by. Anne’s discussion of the research and mechanisms involved continued on for some time, with the disciplinary jargon rolling off of her tongue with ease. I noticed, too, that her posture was different. She held herself taller, more poised, and didn’t casually insert self-deprecating remarks about her skills as a scientist as she had in earlier interviews. Her confidence had risen enormously in this brief period of time.

Describing the experience with Mary as a mentor, Anne noted that “she was very patient with [her].” First, Mary asked Anne to write her own protocol – including the methods research.
Though Mary already had a protocol in place, she wanted Anne to have the experience of writing one from scratch. When Anne was done, Mary reviewed it. “I got one section completely right,” Anne laughed, “all of the others – they weren’t wrong, but they were vague.” Through this experience, Anne learned a valuable lesson: “When you are writing protocols, even a person who doesn’t know what to do should be able to repeat it. So you have to put in how much of this, how much of that – stuff I didn’t know.”

Mary went out of her way to walk Anne through the protocol, step by step – first having Anne watch, then letting Anne do the protocol while Mary watched, and then leaving Anne to work on her own (encouraging Anne’s feeling of competence). She provided Anne with her own vial of cells that she would be responsible for caring for and growing over the summer: “She showed me what they [the healthy cells] looked like, she showed me what they look like when they’re infected… And everybody was so nice to me.”

This feeling of camaraderie and belonging in Mary’s lab proved to be important. Of the 50 students participating in the program, only 4 of them (including Anne) were Black. All of the Black students were women, and the 3 living on campus were housed separately from the other students in a different building. When I asked if anyone commented on this, Anne laughed: “I was like, hmmm… I think they planned this.” Anne decided she wouldn’t complain because the arrangements afforded the women more breathing room. In this more intimate, private space, Anne and her peers were able to speak about their experiences in the summer program candidly. Her roommate was paired with an Indian male doctoral student that seemed to undermine the woman’s success at every turn. “He gave her contaminated cells,” Anne remarked, and he was so rude to her. He wouldn’t communicate…. My friend said (She was Jamaican.) She was like, “The only thing stopping me from cursing him was the fact that
if I curse him they're gonna be like, 'That black girl.'” She said, she was talking to me, she literally cried. She cried. How terrible he was. I was like, if it was me I probably would've quit or I would've complained a long time ago.

Anne found herself comforting her friend regularly, while at the same time being grateful for the supportive mentor she had in Mary.

During her eight weeks in the program, Anne was able to contribute significantly to Mary’s project. By “doing complement,” the team discovered that the classical pathway was involved in killing virally infected cells just as effectively as neutralization, providing insight into alternative ‘vaccines’ – ones that remove the virus through modification of the viral membrane glycoproteins. Anne was required to present this knowledge in a poster session at the end of the program. She wrote and designed the poster entirely on her own, with minimal feedback from Mary or Mary’s Principal Investigator. An excerpt of this poster is provided in Figure 11. In this excerpt, which is representative of the poster as a whole, it is clear that Anne has begun to understand the ways in which the presentation of scientific research in a poster is a balancing act between maintaining credibility as a scientist, and being understood by laypeople. She introduces the significance of the research immediately, both on an individual (how the virus presents in human bodies) and global level (the prevalence of the virus internationally). The introduction continues with more specificity on the project itself and the mechanisms Anne’s work investigated. Throughout, she fluidly balances disciplinary jargon with explanations of how the mechanisms work, ensuring that her varied audience would at the very least understand the gist of the work, if not the work in depth.
Figure 11: The introductory section to Anne’s summer research poster, written exclusively by her with minimal edits from her mentor, Mary.
A second interesting element of the poster was Anne’s decision to present the Methods section as a visual, rather than the typical numbered list. Figure 12 shows the sequence of steps in diagram that Anne included in the poster. Again, it serves to meet multiple audiences while still addressing the rhetorical situation effectively. Short descriptions of each step are included beneath each phase of the protocol, succinctly describing what took place, and her careful use of directional arrows and simple imagery help the reader see how the complement serum effected viral cells.

Figure 12: The Method section of Anne’s poster was constructed as a visual, rather than textual list. This assists readers of the poster in quickly understanding the protocol Anne followed in the project.

When speaking about the poster experience – both constructing the document on her own, as well as presenting the research in a conference format – Anne was confident and proud. “I didn’t have to do a lot of practicing,” she explained about preparing for the poster session, “I
knew the research and I understood it.” It was clear that this was Anne’s work, and that she owned it – embodying the role of scientific researcher with ease. Anne noted that PURS’s Program Coordinator wanted her to try to attend the Annual Biomedical Research Conference for Minority Students (ABRCMS) in the coming fall. When I asked if she wanted to, Anne explained that she was very interested in doing so, but that the only way she would go would be if she could present her summer research. She had no interest in presenting the poster she had done for Meijer’s laboratory because she was embarrassed about how little had been done.

When I asked if she planned to continue with Meijer in the fall, Anne was sheepish. “I don’t know,” she mumbled, “I feel bad if I just leave her. Will she feel like she’s a bad teacher? I don’t want that on my conscience.” After having had experiences elsewhere to compare to, Anne explained: “I need someone… I don’t need someone to push me, but I can’t do everything by myself.” She was realizing that she benefited when given initial guidance on new procedures, etc., and then given room to explore them on her own (as Mary had provided). She didn’t want to have to chase someone for information or supplies, or feel like a scheduled meeting would be cancelled at the last minute (or forgotten entirely, which had happened enough times to make Anne cautious). “If I have a question, I’m not scared to ask – but [Meijer] won’t reply for two weeks and by then I’ve forgotten what I asked” – and because of this, the work moves in fits and starts and increases frustration and the feeling of incompetence.

While Anne’s story is still unfolding, two poignant moments stand out as representative of how strong mentor fit contributed to her development of a discursive identity as a scientist.

14 Anne submitted her summer research abstract to ABRCMS for consideration and was accepted to present her poster at the November 2017 conference.
After completing her research for Mary, and presenting at the poster session, Mary complemented Anne’s understanding of the work she had done: “We were watching you speak and you were so fluid. You know the research.” And then later, while eating cake that Mary had made as part of a send-off party, “How does it feel to be a scientist?” The second moment was in November of that same year. After successfully presenting her summer research at ABRCMS, Anne left the conference as the holder of the Best Poster Award. She had finally reached a stage where she not only felt like a scientist, but was being recognized as such from others within the scientific community.

**What Anne’s Experience Teaches Us**

In reflecting on Anne’s experience in undergraduate research – both within and outside of PURS – insights relating to mentoring and mentor fit become salient that speak to larger considerations for mentoring marginalized members of a community. The first relates to responsibility and expectations, the second to identification, and the third to pedagogy.

When a mentoring relationship is established – particularly within the construct of a formalized program – whose responsibility is it to manage the relationship and to make sure all needs are being met? This is a particularly poignant question when it relates to programs that target underrepresented individuals who may not yet have the cultural capital to negotiate such spaces. Though PURS leaves the responsibility of finding and securing a mentor up to the students, Anne’s experience demonstrates that this is not necessarily an effective method for pairing. Anne’s selection of Meijer as a mentor was based largely on her novice interpretation of Meijer’s research, and that she “seemed nice.” It did not take into consideration what Anne might gain from the relationship, nor what she might have to offer Meijer’s lab. Likewise, the selection did not take into account Anne’s instructional needs and whether that paired well with
Meijer’s pedagogical approach. While Anne did, eventually, realize that she needed a more robust and specific experience – which prompted her search outside of PURS – it came at the expense of time and frustration.

Meijer left the responsibility for Anne’s research progress to Anne, despite her “greenness” as a scientist. Meijer’s expectations were extremely high without being explicit – relying too much on students knowing that they are supposed to take certain steps independently, rather than being guided. This left Anne stuck at the “experimentation” phase in her discursive development as a scientist. Though Meijer was the senior scientist and mentor, she left the management of the relationship to Anne. Anne had to seek out and schedule meetings, to remind Meijer to order supplies, to ask for guidance, to regularly make sure things were moving forward – practices that from a faculty point of view could be described as showing initiative, but from a students’ as evidence of not being worthy of the faculty member’s time (or, as Anne described it, as being a “benchwarmer”). This positioning is precarious, placing an enormous amount of responsibility on an individual who may or may not know what is acceptable or necessary.

Similarly, Meijer’s assumptions about who is responsible for students’ success was problematic. Though she blamed the US school system for not preparing students academically, there were unspoken assumptions about what ‘being prepared’ meant, and who was responsible for that preparation. In our conversations, I got the sense that Meijer partially absolved herself of that role and expected the students themselves to remediate gaps (again, assuming that students know such gaps exist and are not the result of some personal failure on their part).

It feels pertinent to explain, here, that my intent is in no way to cast blame or disparage Meijer’s mentoring style (it is fairly traditional, in actuality). In fact, other research participants in Meijer’s laboratory flourished under her direction. Though I do not have the space to explore
those experiences here, the students who flourished had very different cultural capital to Anne. Some were pursuing a second undergraduate degree and already had the experience of higher education to draw on; some were White and came from more privileged educational systems. What I hope to draw out, here, is that in considering the pairing of mentors with students who are underrepresented in the sciences, fit becomes even more salient than access or time. It involves ensuring that both mentor and student have clear understandings of what each brings to the relationship – strengths to draw on, as well as weaknesses to build up. It also involves making certain that the expectations mentor and mentee have are not just reasonable, but clear – How is the student expected to perform in the laboratory? What does that performance look like?

Mentors, as noted earlier, are more than supervisors. They are professional models of what it means to be, in this case, a scientist. Within this relationship, mentors have an important role of helping students develop a professional identity (one that places them already within the community, no matter how novice). They also have a responsibility to help the mentee see how their unique (intersectional) identity reconciles with and contributes to the field, and that the professional identity is one that they have access and rights to (i.e., fits with one’s sense of self).

Anne’s experience in the fetal pathology laboratory and in the summer research program serve as nice comparisons to elucidate these insights. Both Dr. Brennan and Mary took up their mentoring positions with clear intentions of being responsible for Anne’s learning. Dr. Brennan asked Anne to articulate, in writing, what her personal goals were for the experience, as well as what strengths she was bringing to the program (both in her letter and CV). This allowed Dr. Brennan to both assess whether she could meet Anne’s needs, as well as design a clear path for the experience. A specific schedule was set up for Anne’s participation that incorporated tasks she could perform autonomously, and Dr. Brennan took responsibility for educating Anne in
areas that were new. Mary ensured that Anne had low-stakes writing experiences (e.g., the protocol), while also providing guidance on effective scientific communication. She modeled techniques, while at the same time letting Anne have some autonomy and ownership of the research itself. Importantly, both Dr. Brennan and Mary made certain that Anne’s scholarly interests were being addressed. The expectations were clear, and both mentors made certain that they were accessible, present, and engaged – to the degree that they shared meals and spoke about their personal life experiences. These experiences speak back to my early claims that exposure and access to laboratory experiences are not enough to help underrepresented students build scientific identities or discursive identities as scientists. Simply offering a formal research program is noble, but insufficient; it must also include protocols for effectively pairing mentor and mentee, as well as best practices on mentoring a diverse student body. Through these experiences with mentors who were engaged and meeting her needs, Anne was able to transition from experimenting with the discourse to that of familiarization and, over time, development of facility.

A factor that, in Anne’s case, did not seem to influence her growth as a scientist (or scientific writer) was demographic identification with her mentors. Though all were female, Anne did not see it as a factor for her selection or participation. What did seem to matter (though I’m not certain Anne was conscious of it) was whether or not the mentors understood that students come to a relationship with life experiences that may or may not be similar to their own, and that their cultural capital may not align with traditional higher education expectations. Where Meijer maintained high expectations without assisting Anne in meeting them, both Dr. Brennan and Mary set high expectations and provided frameworks in which Anne could be successful. This finding aligns with research by Blake-Beard, Bayne, Crosby, and Muller (2011) that show
that understanding where students are coming from – even if only as an outsider – is more beneficial to individual development than simply being a member of specific communities (though, this is not the same as representation and research into demographic identification and good fit is a worthwhile pursuit).

This ‘understanding’ relates directly to pedagogy. How students learn is influenced by many factors and pedagogical approaches to mentoring should be taken into consideration when pairing students with mentors. Very little discussion in the literature on undergraduate research experience exists on the influence of pedagogy on the experience. Though resources exist on the development of URE programs through organizations such as the Council for Undergraduate Research, this work is not necessarily based on empirical research or social factors. Instead, it provides instruction on the institutional infrastructures needed, programmatic organization, and financial resources. As Anne’s experience demonstrates, simply putting a student into a laboratory and giving her a research project is not sufficient in developing new scientists. The relationship – the fit – of mentor and mentee are critical and part of that fit involves how the mentor guides the mentee. If a mentor approaches instruction in a way that does not meet the mentees needs – in procedural knowledge and in writing – it is the mentee who loses most. While fit ultimately benefits any student entering a URE, when working with students who are underrepresented in science, mentor fit should be a critical consideration. When good mentor fit has been achieved, learning has a fruitful place to grow.

As I will discuss in Chapter 7, during her different undergraduate research experiences, Anne transitioned from an initial newcomer’s stage of experimenting with the new discourse, which included negotiating new identities that came with it, to early stages of discoursal facility. Anne was gaining both skill in the techniques and practices of scientific research (and medical
practice), as well the *discourse* of science. Though at the time of this writing it has yet to reach a point of becoming adopted or embodied, her facility of use suggests that she is well on her way. Where she had once defaulted to writing about her scientific work in the rich, flowery language of the Poets (at times, quite eloquently) and hadn’t quite grasped the *how* of scientific communication, working with strong mentors helped speed up her development significantly – to the point of being recognized *as* a scientist by others in the community. This growth, as will be demonstrated in the next chapter, can be accelerated even more through the pedagogical practice of mentored writing. As I will show in Chapter 5, when good fit exists, and explicit instruction on the rhetorical practices of scientists is incorporated into the URE, students’ discursive development improves significantly.
Chapter 5: “It’s not like you can just write whatever you want”: Mentored Writing as a Means of Facilitating Discursive Identity Development

In the previous chapter, I examined how mentor fit, including the fit of student needs with pedagogy, can influence the development of a student’s discursive identity in science writing. In this chapter, I expand on the pedagogical factor by exploring how the use of mentored writing (within the context of a strong fit) can further increase development of rhetorical awareness and facility with the scientific discourse. After locating this research within the larger body of scholarship, I show how the explicit instruction of writing in the sciences (specifically forensic entomology) paired with a strong mentor fit contributed to a refined view of the nature of scientific knowledge and improved Amrita’s performance with, and embodiment of, scientific discourse. This case provides insight into the effectiveness of mentored writing with undergraduate science students, particularly (but not limited to) those engaged in undergraduate research. Additionally, it offers a deeper understanding into the different factors that mediate student engagement with disciplinary genres and how discourse instruction coupled with experiential learning help to clarify and solidify not only the type of scientist one wishes to become, but also the ways in which that identity is presented discursively.

As noted in my introduction, though many scholars in writing studies have prioritized the influence of time and exposure in successfully developing rhetorical awareness of disciplinary discourse conventions (e.g., Hare & Fitzsimmons, 1991; Freedman, 1993; Prior, 2001; Brent, 2012), most undergraduate science students are not exposed to authentic disciplinary texts during their four-year degree. This is certainly true for most of the students participating in this research. Such disciplinary writing instruction is more frequently addressed at the graduate level,
and mentored writing experiences are often limited (see Kamler, 2008; Thein & Beach, 2010; Burgoine, Hopkins, Rech, & Zapata, 2011; Feldon, Shukla, & Maher, 2016).

While the educational literature praises situated learning (Lave & Wenger, 1991) through undergraduate research experiences as being transformative for STEM students because of its influence on reflective judgment and professionalization, this work often focuses on the development of research skills and content knowledge, not rhetorical development. Further, my preliminary research pushes against claims such as those by Berkenkotter and Huckin (1993) and Linton, Madigan, and Johnson (1994) that “skill in writing can be learned (as one component of apprenticeship) but not taught” (p. 63). Situated learning alone does not appear to be sufficient for the development of rhetorical awareness or the development of a discursive scientific identity – particularly with historically marginalized groups. However, situated learning combined with explicit writing instruction through a mentored writing approach may help those at the threshold of their disciplines begin to acculturate to the ways of knowing, being, and communicating endemic to the discipline. In the spirit of work by Cope and Kalantzis (1993), Dias (1994), Clark and Ivanič (1997), Herrington and Curtis (2000), Kapp and Bangeni (2005), and Wilder (2012), this chapter demonstrates the importance of why “genre teaching [should] go beyond focusing on how texts function to teaching the ideological underpinnings of form (the “why”)” (Kapp & Bangeni, 2005, p. 111). The work presented here serves as an exemplar of how, as David Russell (1993) argued, writing can be effectively learned in conjunction with “the problems, the habits, the activities – the subject matter –” of the disciplinary field itself (p. 194).

The practice of mentored writing – writing that is not simply shared with a more experienced writer, but is explicitly directed – is not a new concept by any means. It is quite common, for example, to see creative writers working with more seasoned writers and peer
groups to workshop their writing in an effort to assess affect and experiment with rhetorical moves and form. This same practice undergirds much of writing center pedagogy, as well. However, in disciplinary arenas this approach is not as commonly practiced. Science in particular has a long history of collaborative scholarship, but it often falls to one or two members of the team to do the actual writing, and the communicative nature of many scientific genres creates a perception of the conveyance of facts over rhetorical approaches or conscious awareness of discourse conventions. More recently, however, the concept of mentored writing has begun to enter the scientific arena in a variety of ways. Leonpacher and Chisolm (2016), for example, describe an arts-based mentored writing course offered to first-year psychiatry students. This course asked students to view and write about visual art “to develop participants’ knowledge and skills in observation and interpretation” while simultaneously orienting students to the processes of academic writing and manuscript submission (p. 947). However, this course was offered as one 5-day rotation in the intern year separate from the practice of psychiatry. Though students reported it as worthwhile, the limitations of the course and its separation from the disciplinary activities of the field situated the practice of writing as one belonging to the humanities, and not part of the everyday practices of psychiatrists. Similarly, Jackson (2009) describes a program for nurses in Australia that allows for novice writers from the nursing profession to work one-on-one with skilled writers. In a three-day, two-night residential retreat, nurses worked to develop articles for publication based on their own research, and then actively workshopped the writing with mentors. Yet, like the previous study, the nature of the program—an activity set aside physically and temporally from the practice of nursing—perpetuates the myth that writing is something we do at the end of a project, not something that helps us think through our ideas.
An example that comes closer to a true merger of mentored writing with disciplinary practice is the teaching and assessment tool Reynolds, Smith, Moskovitz, and Sayle (2009) designed, called “BioTAP” – the Biology Thesis Assessment Protocol. BioTAP, they explain, is “a document that guides and supports students and faculty through the thesis-writing process. BioTAP includes both a rubric that articulates departmental expectations for the thesis, and a guide to the drafting-feedback-revision process that is modeled after professional scientific peer review” (p. 897). This protocol assists disciplinary faculty with providing formative feedback, and students with understanding how to ask critical questions of the text, as well as solicit useful guidance from their mentors. It serves as an effective tool for guiding and assessing capstone projects, but again, does not necessarily situate the writing within the practice of science.

Feldon, Shukla, and Maher (2016) more recently explored the influence of mentored writing through faculty–student co-authorship. Though the authors were able to show that “students whose socialization experiences included co-authoring with faculty mentors developed significantly higher levels of research skills than students who did not,” it is important to highlight that the development assessed was that of research skill, not writing (p. 185). Further, the students in question were working at the graduate level, where exposure to, and engagement with scientific genres is expected and part of coursework. In fact, a review of the literature shows most of the research into mentored writing in the STEM disciplines as focusing on Master’s and doctoral level students (e.g., Maher, 2014; Aitchison, Catterall, Ross, & Burgin, 2012; Kamler, 2008; Kamler & Thomson, 2006; Florence & Yore, 2004), and with little of it exploring this influence on underrepresented minorities or at Hispanic- or Minority-Serving Institutions.

The case presented in this chapter addresses all of these gaps. It situates the practice of mentored writing within the day-to-day practice of scientific research, as conducted within an
extracurricular undergraduate research program. As noted in the program description, the students in this program conduct novel research under the guidance of a faculty mentor and engage in various forms of scientific writing: from laboratory notebooks to data sheets; conference proposals, posters, and funding requests; for many, this writing also includes research articles for peer-reviewed journals. While not all faculty mentors in the program adopt a mentored writing approach, this chapter examines the case of one who does and the positive effects it had on the rhetorical development and discursive identity of Amrita within the program over the course of two academic years.

**Participant Profiles**

Amrita is a young woman of Indian decent (first generation American) who grew up in a relatively homogenous (White) suburban area in the southern US before moving to the northeast for school. She was raised in a middle-class family and attended a high school offering an International Baccalaureate program, of which she was a participant. Both of Amrita’s parents are practicing physicians, which had interesting effects on her career choices and professional identity (as will be seen later). Her parents were enthusiastic about her educational decisions and supportive of her choice to move so far away from home. Amrita’s undergraduate education was financed largely by her parents, though her acceptance into a prestigious scholarship program provided academic assistance and opportunities for study abroad and internships. Though she was far away from her familial support network, Amrita quickly secured a community of friends through the college and her temple who shared both her social justice ideology, as well as her drive toward professionalism. This network provided an important social structure that helped with networking as well as stamina.
From our first interaction, Amrita presented herself as a high-achieving, self-confident young woman: extremely articulate and formal in our written and spoken interchanges, a strong sense of personal agency when it came to her extracurricular activities. This academic identity was reinforced by her position in the scholars’ program and her successes as an undergraduate up to that point. Her scientific identity development, however, has been fraught with conflict in part because of her parents. As she explained,

Because both of my parents are doctors, I always rejected the idea of becoming a doctor.

So, from day one, I was like ‘I will never become a doctor. Never, ever.’…for a while I knew that I liked science and I knew I was really good at it, but I almost rejected it because I was like, ‘I don’t want to do anything with that’.

This rejection was not solely because of her parents, however. For Amrita it came more from a need to know that she was pursuing a career because she wanted it, not because of someone else’s expectations. That knowing eventually came from a combination of her undergraduate research experience and service work she did in the metro region and abroad during summers in areas of public health. These experiences ultimately led to her changing her major from Forensic Science to Cell and Molecular Biology.

Like all the participants in this study, Amrita joined the project at the same time she began her formal undergraduate research experience – in her case, she was a 19-year-old rising sophomore at the college. In the early stages of the study, Amrita often described her scientific identity by what she was not: she was not a chemist, she was not “a bug person,” she was not a writer – she wasn’t sure she was a scientist. Yet, at the same time, she was open to learning and willing to engage with mentor and program requests, and the encouragement of her academic
advisor to “get involved in research and find a mentor” helped solidify that a place existed for her in the discipline.

That first research experience, however (which was informal and took place during the second semester of her freshman year), did little to encourage Amrita. The laboratory was heavily chemistry-based, and her faculty mentor was what might best be described as aloof. As Amrita explained: “I felt like she didn’t really mentor us very much. It was much more of like…she told us what she wanted you to accomplish and you just had to figure out how to do that.” It was an experience similar to that of Anne’s with Meijer. Each week, Amrita showed up at a prescribed time on a prescribed day and completed the prescribed tasks, nothing more or less – as though a cog in a larger machine. Though Amrita was an active member of the research team, when it came time to write the results in a paper and submit it for publication, she was not part of that process, either. Though she never explicitly stated so, the fact that Amrita chose to leave that initial experience and seek out a new mentor who would “walk [her] through the steps” and actually guide her in the process of conducting research spoke to the kind of scientist she was developing an affinity for. When I asked Amrita to describe her official PURS mentor, Dr. Bianchi, whom she had made clear she admired greatly, she described her as “a very independent scientist” who (ironically) was able to “learn everything on her own.” Even at this early stage, Amrita was positioning a “good scientist” as someone who is flexible and available to colleagues, never gives up, and “knows when things go wrong, even though she may not have encountered that problem before…she is able to figure it out.”

Amrita’s rich educational experiences in high school prepared her well for the reading and writing tasks associated with higher academics in general, and volunteer activities at home exposed her to law enforcement and Forensic Science as a discipline. What was very clear from
her choice of extracurricular high school and college activities was how civic-minded Amrita is, with much of this work aimed at public health and advocacy (e.g., working with homeless AIDS patients). As such, Amrita approached the forensic science degree with a wealth of resources already in her arsenal and an ideological bent toward public service. This isn’t to say that the undergraduate experience was easy for her, though. As we will see in this chapter, despite her prior experiences, Amrita still struggled with the rhetorical conventions of scientific discourse—the genres, the language and tone, the citation practices.

Dr. Bianchi, Amrita’s mentor, was an early career faculty member at the college who specialized in Forensic Entomology—a discipline still quite young in its development. Born and raised in North America, she self-identified as White with a strong Italian cultural heritage. In our first conversation, I was struck by how cognizant Dr. Bianchi was of the rhetorical challenges newcomers to science face, particularly women, multilingual students, and students of color. She spoke of how the language of science is so particular, and of how the discourse of Forensic Entomology in particular is very much in flux. Like Anne’s mentor Meijer, the perception of poor writing and reading skill on the part of students at the college frustrated her, but Dr. Bianchi chose to take up the challenge by incorporating writing instruction into her coursework. She participated in college-sponsored WAC seminars, designed writing-intensive courses, and took a scaffolded approach to teaching disciplinary rhetorical practices within her laboratory. When I asked how she came to such a pedagogical approach, since she disclosed having had no formal writing instruction in her own coursework, Dr. Bianchi noted that it stemmed directly from the challenges she faced when completing her doctorate.

Dr. Bianchi had a challenging doctoral experience that almost derailed her dissertation, largely the result of a dissertation supervisor:
I wrote very well at the beginning and then kind of lost that because I was just so into running the experiments, so that when I got back to my thesis it was pretty…it was almost as if I had to start from scratch again. I actually had a really good committee member that took charge of, I guess, mentoring me because my supervisor was essentially non-existent, and pretty much turned out self-sabotaging at the end. So, one committee member that taught me in my undergrad kind of took me under his wing and would review my materials. Most of my, I guess, training for writing [came] from him in the last year and a half of my PhD.

This “training” at the start involved her submitting drafts and him providing feedback. Toward the end, because the committee put a timeframe on revisions, it involved the two sitting side-by-side editing because both were “tired of all the crap [Dr. Bianchi] was going through.” Dr. Bianchi described the process of earning the PhD as “ripping all of the confidence out of you,” with one of the more challenging factors being not having someone to “actually teach you how to write…to be concise.”

Though Dr. Bianchi had had a difficult time learning to write as a scientist, she was emphatic that writing is “absolutely integral” to the work of science: “If you can’t write, you’re useless as far as I’m concerned. And if you can’t write well, then you don’t succeed. I mean, to me it’s pretty clear cut. It sets apart the successful scientists from the non-successful ones.” Her educational experience directly informed the way in which she approached teaching. As we will see in Amrita’s story, Dr. Bianchi drew on her own life experiences learning to read and write as a scientist and translated them into an effective pedagogical approach of mentored writing (though she never used this term).
Amrita was the first student to join Dr. Bianchi’s laboratory and was heavily involved in setting up the space. Amrita had taken Dr. Bianchi’s biology course during her freshman year, so had a strong sense of what she was like as an instructor and a person. When she learned Dr. Bianchi was starting up her laboratory and looking for students, Amrita jumped at the opportunity. She saw in Dr. Bianchi an individual who would actually mentor her, who was interested in getting to know her as a person, who was patient, but also a strong scientist. Dr. Bianchi’s approach to mentoring also took into account Amrita’s skills and interests, leaving room for Amrita to grow at her own pace. In short, the mentor fit between Dr. Bianchi and Amrita was strong. When I asked Amrita if she felt she made a good choice with Dr. Bianchi, she responded enthusiastically: “Yeah, definitely! I’m hoping to stay with [her] until I graduate.”

**Reading and Writing in the First Research Year**

Prior to writing her first proposal, Amrita noted that she was “not actually too sure what needs to go in there” and that she had a “general idea of how it’s supposed to go, but [she didn’t] really know how to write a proposal.” Asking if she had an approach in mind for the writing process, Amrita responded: “I’ll take quotes for what I need to and then organize [an outline] based on the quotes. And that’s it. And major ideas that I need to talk about.” In terms of anticipated revision, she was expecting possibly one large revision, but nothing more substantial. These comments reflected that Amrita was neither clear on the discourse conventions of science (e.g., that direct quotations are not typical), nor on the rigor required to clarify one’s ideas in such a discourse. Though the program makes available a template for the proposal, in this initial discussion she didn’t comment on planning to use it as a resource for her writing. The impression I received was that she was simply going to start putting ideas on paper (like she might for an English essay assignment) and then talk to Dr. Bianchi about what she should do next. Like
Anne, Amrita was doing little more than experimenting with the discourse at the start of her URE.

Whether Amrita was aware of it at the time or not, though, Dr. Bianchi had already started her on many of the prewriting tasks required for the successful writing of proposals. In particular, Dr. Bianchi assigned a series of scholarly materials related to the work being done in the laboratory for Amrita to read – mostly journal articles, but interestingly also Dr. Bianchi’s doctoral thesis. In addition to the thesis, some of the articles had been written by the mentor herself. This was largely due to the fact that forensic entomology is a “baby field,” as Dr. Bianchi described it, and there simply isn’t much scholarship to reference. Dr. Bianchi’s research was breaking new disciplinary ground. But as I learned later, Dr. Bianchi expected (and explicitly directed) Amrita to use her thesis as a model as well as a content resource. In one-on-one meetings, Amrita had the opportunity to ask questions about the content and processes, as well as bring up any elements she didn’t understand. The primary challenge in this reading, Amrita noted, had to do with language: “I didn’t really know the language that they used and I wasn’t too sure how they were doing things.” Adding to this complication was the fact that the terminology used in Forensic Entomology (including some she would need to use) is still evolving and under great debate.15

In addition to the research articles and thesis, Dr. Bianchi required Amrita to review disciplinary textbooks, which included a significant amount of imagery – particularly

15 At one point later in Amrita’s experience, Dr. Bianchi directed her (for fun) to a series of “Letters to the Editor” in the journal Ecology Letters where key figures in the field engaged in strong arguments about the accurate definition of the term “precolonization interval.” As Dr. Bianchi explained to me, the arguments in the field over the use of this term had repercussions that built animosity and spread to conference boycotts.
photographs. Since Amrita was going to be observing insect growth, it was critical that she understand the various stages of development and what these actually looked like. Dr. Bianchi followed this reading up by personally taking Amrita into the lab and showing her specimens for reference. As Dr. Bianchi noted, the practice of reading coupled with discussion of those readings and first-hand exposure to the process itself (e.g., looking at the stages of development), helps students to pick out the important things and [gets] them to critically evaluate work that’s out there. So, kind of mold them and get them to pick out things like: “What makes a good experiment versus what makes a not good experiment?” And, “You know in the Discussion section – Do you think that maybe they should have considered this?” And “Going through the experimental design, where do you think some more errors could have been?” So all of that kind of comes up in discussing the paper, and [the students] usually evolve and are able to pick up things like that on their own after a couple months.

In the early stages of research, Dr. Bianchi put a heavy emphasis on reading rather than writing, though she did take time to instruct students on how to create and complete data sheets and keep a “side notebook” to document everything they notice. Though she did not describe it in these terms, it was clear that Dr. Bianchi saw the data sheets as a “fuzzy genre” (Medway, 2002) and made sure her students saw it as such, as well:

What I’ve learned is you have a data sheet and you really don’t know if it works properly or not until you are halfway through the experiment and you realize that it doesn’t. So, at least you have your notebook that you’re writing down the additional information. So if you have to run the experiment again, you update your data sheet and make it more functional.”
To that end, Dr. Bianchi provided students with a binder in which she expected them to put a paper copy of each article they read related to the project, the data sheets, and then additional notes and observations. She would also keep a stack of Post-it™ notes handy for drawing Venn diagrams, life cycles, and points to remember that could easily be attached to a page in the binder. These practices directly mirrored her own document collection and writing practices. These papers, data sheets, and notes all formed the basis for the students’ research proposal because, as was noted in the description of the proposal process, students are often well into research before funding proposals are submitted. Dr. Bianchi did not guide the initial writing of Amrita’s proposal except to note that she should use Dr. Bianchi’s thesis as a model for form (not length). As such, Amrita was left to synthesize the information she had learned as a mentee and translate it into a document. Though Amrita had anticipated one, possibly two revisions of the proposal before submitting it to the program, in reality she went through five significant drafts.

In the first version, the abstract was excessively long, did not follow typical discourse conventions, and was overly specific with regard to her proposed methodology (see Figure 13). While she had successfully adopted a passive, third person tone – e.g., “Larval behavior of blow flies is becoming an increasingly important area of research due to its applications in forensics.” – and had the correct IMRaD structure for the proposal, she struggled with language and terminology. For example, in the abstract (and throughout the proposal as a whole), she used the less formal “maggots” rather than the preferred “larvae or larval instars.” The introduction to the proposal, likewise, lacked appropriate organization and depth, offering matter-of-fact statements as to what was being proposed – “This experiment will consider the development affects and the retention time of four different fluorescent dyes on Lucilla sericata larvae, one of the first
a) Abstract:

This experiment will investigate the developmental effects and the retention time when exposing *Lucilia sericata* larvae to four different types of fluorescent fingerprint powder. This research will help to analyze coexistence mechanisms on maggots, such as temperature and species competition, which impact PMI estimation. The null hypothesis is that *Lucilia sericata* larvae will show no developmental effects and no fluorescence when exposed to fluorescent fingerprint dye. The alternative hypothesis is that the fluorescent fingerprint powder will affect the development of the *Lucilia sericata* larvae, and that the larvae will show fluorescence when exposed to the fluorescent powder. Development will be observed every 12 hours during the course of the experiment by randomly sampling 3 maggots from each of the experimental groups and 3 maggots from the control group. The development of the maggots from the experimental groups will be compared with the development of the maggots from the control group in order to identify any developmental effects of the fluorescent powder. Fluorescence will be recorded during the experiment by taking pictures of the maggots under ALS. The images will subsequently be quantitatively analyzed for fluorescence using ImageJ, a program for image manipulation. Statistical analysis will be conducted in order to quantify data about the retention time of maggots exposed to the fluorescent fingerprint powder.

Figure 13: The initial abstract Amrita wrote for her first PURS proposal. My annotations indicate areas in need of work.
species often found on carcasses” – without sufficient context. While the abstract was an appropriate 215 words, the introduction was a mere 205. The Hypothesis and Methods and Equipment sections were likewise challenged by specificity and terminology. In effect, the first draft of the proposal had a little bit of each section in each section, which would later require parsing.

Amrita submitted this draft to Dr. Bianchi, who commented heavily on the document in the margins, as well as line-edited the text (see Figure 14). When I asked Amrita how she felt when she opened the digital file, full of blue text edits and comment boxes, she responded:

So, I did not expect that. Like, I would not expect that heavy of edits. And especially the first submission that I submitted for the abstract was like – basically every words was edited, pretty much every single sentence. So, I didn’t expect that at all. But it was great. It was great to be able to compare what I did to what she rewrote and how she rewrote it. My content was there. It was my delivery of it that was what she tweaked a lot of.

Though many students would understandably be intimidated and, possibly, disheartened by the amount of edits on that first draft, Amrita’s strong sense of self and self-positioning as a learner helped her to look past any rejection and to the substantial learning opportunity available. This was bolstered by Dr. Bianchi’s positioning of the discourse itself. Dr. Bianchi’s comments and edits were rich with information about the discourse community of forensic entomology and genre of the research proposal in general. For example, in response to Amrita’s initial claim:

Larval behavior of blow flies is becoming an increasingly important area of research due to its applications in forensics. In particular, the developmental stages of blow fly larvae on carcasses are often analyzed in order to estimate the post-mortem interval (PMI).
a) Abstract:

Understanding the development and larval behavior of larval blow flies (Family: Calliphoridae) has become an increasingly important area of research within the field of entomology, due to its application in forensics. The developmental stages of blow flies, in particular, are often analyzed in order to estimate the minimum time of colonization (MTC), which can provide information regarding the post-mortem interval (PMI). The developmental stages of blow fly larvae on carcasses are often analyzed in order to estimate the post-mortem interval (PMI). However, there are many mechanisms that can alter larval development and behavior that remain unknown due to the inability to distinguish larval species from each other. The incorporation of a biomarker would allow for the investigation into the role of intraspecific (within a species) and interspecific (between species) interactions. This experiment will investigate the developmental effects and retention time of four different types of variations of fluorescent fingerprint powders during the development of Lucilia sericata larvae, while ensuring that there are no adverse developmental effects. To quantify the null hypothesis is that L. sericata larvae will show no fluorescence when exposed to fluorescent fingerprint dye. The alternative hypothesis is that the larvae will show fluorescence when exposed to the fluorescent powder. Developmental effects, larvae will be of the fluorescent powder will be observed, checked every 12 hours for developmental stage and mortality. Upon emergence, adult flies will be measured (bial, thorax, and wing length) to determine if there are any adverse effects on fitness. To quantify retention time, larvae will be fed labeled liver for various time periods (24, 48, 72, and 96 hrs). After removal from the labeled liver, larvae will be checked for fluorescence every 24 hrs until they reach the pupal stage of development. Larvae will be exposed to an alternative light source (ALS) at 450 nm, photographed, and the images will be analyzed, comparing the development of the maggots from the experimental groups to the development of the maggots.

Figure 14: Amrita’s abstract, heavily revised by Dr. Bianchi, with comments in the margin.
Dr. Bianchi first edited the two sentences to read:

Understanding the development and behavior of larval blow flies (Family: Calliphoridae) is becoming an increasingly important area of research within the field of entomology. The developmental stages of blow flies are often analyzed in order to estimate the minimum time of colonization (MTC) which can provide information regarding the post-mortem interval (PMI).

This was followed by an explanatory comment in the margin: “In FE [forensic entomology], we are shifting our terminology to reflect that we don’t estimate PMI directly, all we can do is estimate the minimum time of colonization.” In modelling the discourse and providing an explanation for the changes, Dr. Bianchi was providing insights into how the discourse of Forensic Entomology is evolving, what that means in terms of scientific practice, and importantly how such approaches are conveyed through language. The specificity in terms of the inclusion of the family name, as well, and the shift from “forensics” to “entomology” as a discipline was similarly an important, if subtle, orientation in the text. Throughout the first edited draft there are similar comments, sometimes explicit instruction into practices such as using species names (“The first time you mention a species in a paper you need to include the full name and who named it”), sometimes clarifications on techniques or tools (“You are going to use containers, not jars.”), and sometimes on needed additions to the text (“State here how the larvae and liver are placed on filter paper…”).

Importantly, while Amrita was writing this proposal she was also writing an abstract for a professional conference, on which she received similar levels of edits and comments. Yet, as she points out, writing these two genres at the same time worked in her favor:
I think what helped me specifically about writing the [conference] abstract was being able to write the [proposal] introduction. Because kind of in, like, the abstract I submitted was essentially all the introduction information. And then I went into a little bit of my methods and then what I hypothesized, oh the implications of the research, right? So a lot of it was information that I would put in my introductions. So going back to the proposal, writing the introduction, I tweaked a lot of the introduction and stuff. Even in the methods section – my initial draft was …I thought it was kind of vague. Like it wasn’t too specific of a methods section. But from the abstract, when she edited it she outlined very specific – like every single thing – so my methods section became really a lot more detailed.

During the revision of this first proposal, Amrita was tasked with doing additional reviews of the scholarly literature independently to flesh out various aspects of the proposal. Though this was at times challenging, she felt the recursive process of writing and reading was helping her to become an expert on her own. And the work certainly paid off. In the second revision of the proposal submitted, much of the new text Amrita added to flesh out the introduction was unedited by Dr. Bianchi (excepting comments on the need to cite certain claims). In this second version, Dr. Bianchi’s focus shifted from large-scale organizational requests to adding greater specificity and additional examples to the literature review, and the inclusion on definitions where necessary. The feedback had moved from larger genre concerns to more narrow disciplinary conventions. By the fourth draft, the edits requested were limited to small line edits on two different pages, focusing on preferred semantics that improved sentence flow, but did not change meaning. The final (fifth) version submitted to Dr. Bianchi was approved without edits.
Amrita submitted the proposal to the program coordinator for funding consideration and received a research stipend along with the following feedback:

Very well written, you display good knowledge of your subject. Adding figures to your Appendix will make for a stronger case: science is evidence-based. Therefore, if you mention in your appendix that you “found the best way to mix liver and the fluorescent powder to ensure maximum exposure for the larvae” you should present the data in a figure.

After successfully receiving her first research stipend, with a strong positive response from the program coordinator, I asked Amrita how she felt about the Forensic Entomologist “voice” and if it was something she felt comfortable with or if it was awkward. Her response was one of laughter, followed by seriousness:

Um, I think it’s not necessarily either one of those. I think it’s just like foreign. It’s like, it’s not…I feel like after I’ve gotten used to it, after I understand it, it will make more sense. It’s starting to make sense after these two writings that I’ve done. But, like, I’d never read any forensic entomology things or like written anything with that [before now], so it’s just like, you know, I didn’t know what to expect. I didn’t know how to write it, that’s all. I feel like once I get used to it, once I do more of them, it’s not going to be as big of a deal.

By positioning scientific discourse as a foreign language that had to be learned, systematically, rather than as an extension of typical academic writing in English, Amrita successfully managed to side-step a situation in which she might consider herself as deficient or underprepared. Similarly, Dr. Bianchi’s mirroring of this position through the types of comments and instruction offered positioned Amrita as a burgeoning scientist that simply needed explicit instruction in the
discourse of Forensic Entomology rather than someone who was incompetent or unable to handle the work.

**Writing and Speaking in the Second Research Year**

Amrita’s second proposal was simply a resubmission of the first without edits or addendum. This allowed her to continue the research into the summer. A more significant third proposal came in the Fall of 2016, after she spent the first part of summer completing her data collection on Project 1, and then participating in a study abroad experience with a non-governmental organization. When we spoke after her trip, she was in the process of putting together her data so that she could run statistical tests and then begin writing a paper, with the hopes of submitting for publication by spring. At the time of our interview, Amrita wasn’t sure what her fall project would actually be, only that Dr. Bianchi offered her a place as part of a team on a more substantial endeavor, but would require a little less of her time. Though she had submitted an abstract to a conference during the late spring (and had been accepted), various extenuating circumstances prevented her team from attending. However, she had submitted the same abstract to another professional conference and had been accepted there, as well – suggesting that her abstract had successfully employed the conventions of scientific discourse. Because she was still in the process of analyzing her data, Amrita had not yet begun thinking about her conference presentation (which was just over a month away).

After having so much success and time to work on her own research project in the lab, I was curious whether Amrita was headed into her second research year and first professional conference feeling like a scientist:

Um, I think I didn’t for a long time because I often… I think for a while now my trajectory has sort of been to become a doctor. But, because both of my parents are
doctors, I always rejected the idea of becoming a doctor….I tried to pick every other possible career for myself besides being a doctor and so I think for a while I knew that I liked science and I knew I was really good at it, but I almost rejected it because I was like ‘I don’t want to have anything to do with that.’ But I think now that I have sort of overcome that stupid idea and so [have] actually accepted the fact that that’s something that I really want to do. It wasn’t just that my parents were doctors that I rejected the idea. For me it was, again – it’s this idea of knowing…. I needed to come up with a reason myself besides, like, “Oh, my parents are doctors, I’ll become a doctor, too.” And then once I came up with that reason for myself and I realized that a doctor is what I want to do, I think then again that identity comes with that.

Much of this identity clarification came from the extracurricular activities Amrita was involved in – internships with hospitals, public health non-governmental organizations – as well as the opportunities in the laboratory. During the early summer and into the fall, she not only conducted research, she also mentored incoming undergraduate research students, helping her to see that she enjoyed teaching as an aspect of science. This identity clarification caused her to change her major from Forensic Science (FOS) to Cell and Molecular Biology so that she could avoid taking the extra courses required of FOS majors that would be of no help for medical school.

During those first few weeks of the fall semester, Amrita was busy wrapping up her data analysis from Project 1, taking classes, and simultaneously doing an internship with a local hospital while trying to work with the new project team to work out the details of the trials. As she put it, “I feel like I waited until the last minute to do it because I was just like, ‘I don’t know what to write’.” Despite having meetings with the team about the project (which was focused on
identifying chemical cues to flies laying eggs), her experience was that the writing “was a lot more vague.” The specificity of her first proposal was such that she “knew exactly what [she] was doing [and] could take that proposal and use it to conduct that experiment again.” But the second project turned out to be much more about the “big picture ideas of what [the team was] doing and leaving out the specifics, because [they] didn’t really know what the specifics were” – a reality that is far more common in the work of professional scientists. Despite the imputed vagueness, Amrita’s second proposal was much more succinct and the feedback from Dr. Bianchi was closer to the later drafts of Proposal 1 than the earlier – Amrita was successfully engaging with the genre of the proposal on this second major attempt and the amount of editing was noticeably low. Most of the mentor comments and edits focused on noting areas where Amrita could add some content, additional citations, and could take the diction down (see Figure 15). The Materials and Methods section was virtually untouched, and following the program coordinator’s suggestion on the first proposal, the appendixes included appropriate visuals to offer evidence for claims Amrita made. Rather than five drafts, this time around there were only three, with only minor edits between each.

The biggest challenge Amrita noted with this second proposal had to do with citations – in particular, finding appropriate sources to use. As she remarked, “I think forensic entomology is such a small… like it’s a very specific field and it’s hard to find good sources if you’re not already familiar with the key players in the field.” Because Dr. Bianchi both highlighted areas where additional citations were needed and provided some guidance on who to cite, Amrita was then able to build her understanding of both the appropriate way to cite evidence, as well as get a sense of which scientific authors are considered credible. Amrita’s second proposal was accepted
a) Abstract:

 Blow fly oviposition on decomposing matter forms the foundation for the use of insects during forensically related investigations. However, there is much debate over the particular cues that can attract blow flies to a particular resource or can influence female oviposition behavior. Research has supported both the presence of a bacterial cue on the resource or a chemical volatile released from the resource itself. In order to determine the role of chemical and visual cues on blow fly oviposition behavior, two forensically important blow fly species will be examined. This experiment will investigate the behavioral effects on Lucilia sericata (Meigen) and Phormia regina (Meigen) adult flies when exposed to chemical and visual resource and oviposition cues. This is part of a collaborative project with the Musah lab at SUNY, Albany. The Musah lab will be responsible for determining the chemical nature of the cues which will be used in a series of behavioral assays to determine if these chemical elicit a behavioral response in L. sericata and P. regina. Cages containing Lucilia sericata and Phormia regina adult flies will be prepared with 250 males and 500 females per cage. The flies will be exposed to a medium spiked with a specific mixture of chemicals for one hour, both with and without the presence of visual cues. To quantify the behavioral effects, the flies will be checked every 10 minutes during the one-hour exposure period, and any significant behavioral changes (i.e., flies probing the resource, aggregation towards the chemical resource, or oviposition) will be recorded. Pictures will be taken during the course of the trial in order to document the behavioral observations. Statistical analysis will be conducted to determine the significance of the results. This research will be used to further develop the hypothesis that oviposition in blow flies is stimulated by chemical cues, as opposed to bacterial cues.

Figure 15: The edited version of Amrita’s second proposal abstract, with Dr. Bianchi’s directions for revision.
without changes – though this time she did not receive any feedback from the program coordinator (which is largely understood to be a positive sign for continuing research students).

Two important changes during this second year occurred that influenced Amrita’s professional identity development, which in turn had effects on her discursive identity. The first was that she took on a significant mentoring and management role for the lab, ensuring that the seven new lab members were properly oriented and trained on the equipment. This positioned Amrita as a leader and less of a newcomer than the other students, and solidified her affinity for teaching. It also put her in a position where she had to translate complicated techniques and jargon into language newcomers would understand. The second change was that the new project involved working in partnership with a doctoral student and faculty member at a separate institution. Though Amrita was still under the supervision of Dr. Bianchi and had a partner in her laboratory work (another undergraduate student), Dr. Bianchi gave the two of them space to conduct their half of the research without having to look over their shoulder. Though not explicitly stated, this positioned Amrita as a scientist at a level higher than is typically thought for undergraduates.

This last element became important when, in the fall semester, it became clear that something in the preliminary trial protocol was not working as it should have theoretically. Despite the fact that the protocol was failing, the team continued to try the same approach over and over and over again. For Amrita, this was frustrating. “It’s not exactly how I would describe ‘good science’ work,” she explained.

I think sometimes when you want something to work – like, you know theoretically it should work, but something is not working, you look for it to work…. If I have to look at
what we’ve been doing so far, I would say this is not working…. It could work, but we have to make some sort of change.

And make a change is what she did. As she and her partner were conducting yet another preliminary trial according to the protocol, they began to talk. In addition to realizing that they had to overtly tell the team that they were spinning their wheels, Amrita and her partner began to assess. They went “back to square one” and tried to work out where the trial was going astray:

So we set up our own trials and things like that, that was kind of separate from what they had been doing this entire time, and we were able to run some things, which gave us some clarity on what’s going on. And that was really exciting, ‘cause it was like, you know this has been such a mess the entire time, and like it was good to finally take a step back and kind of go back to the basics.

Amrita and her partner took their insights, refined written protocol, and detailed notes with results to Dr. Bianchi, who was incredibly impressed. At the time that we spoke, Dr. Bianchi was actually at the partner institution presenting the materials to the other half of the team. Amrita’s professional scientific identity seemed at this point to be getting stronger in that she didn’t question whether she was allowed to pursue this alternative line of inquiry – she just did it, trusting the knowledge that she had acquired over time, and it paid off. She also demonstrated an understanding of the importance of documenting this knowledge in a way that the other team would be receptive to and understand. This experience solidified for her one aspect of being a “good” scientist: “I think the biggest thing is to not get up on the fact that you think you’re supposed to be right.”

Amrita’s feelings about scientific writing had also shifted over time, but was influenced by her writing-intensive biochemistry course (taught by another faculty mentor who embraced
explicit instruction) as well as the laboratory. This course required full-length laboratory reports each week, and though there was no variability in the genres required, it reinforced for Amrita that there were commonalities across genres:

I think scientific writing is interesting in that there’s almost a template that you follow. It’s not like normal writing. You know, like A, B, C, D, E, F, G needs to go in your Introduction. Right? It’s not like you can just write whatever you want… You have key things you need to include that can be generalized over any sort of experiment, over any sort of scientific discipline.

This ‘generic template’ idea was strengthened by her belief that there really was no room for creativity in scientific writing: “The purpose of the paper is to say what you did, it’s to describe the research. And I think putting creativity in sort of distracts from that purpose.” So while she was becoming more facile with the scientific discourse and genres, Amrita had not yet grown to a point where she could see the rhetorical, suasive aspects involved. Scientific writing had more to do with documenting data and reporting information in the IMRaD format than anything else.

This thinking carried through to the presentation she gave at an important professional conference during that semester. After analyzing a considerable amount of data from her first project, Amrita put together a PowerPoint presenting her results. In this preparation, rhetorical situation became salient:

I think the proposal needed to be detailed and needed to be what you’re doing and why you’re doing it. Whereas, I think that in the actual presentation, it was a lot of explaining the use of forensic entomology and then narrowing down to my research in particular, how that contributes to the field, and then actually describing my research.
Her presentation followed this same convention of IMRaD; however, it was implemented for a much broader audience – forensic scientists in general. The first draft of the presentation opened with an orientation to Forensic Entomology as a discipline, situating its place in Forensic Science as a whole, and explaining the use of blow flies in estimating post-mortem interval. This was an important rhetorical move because Forensic Entomology as a discipline is relatively new (approximately 40 years old) and is greeted with suspect by both the forensics and entomology communities. This introduction also included information about variables that affect fly behavior, which is a critical factor in the research Amrita was conducting. This introduction was followed by a discussion of the materials and methodology used, incorporating appropriate specifics, such as species and trademark names, as well as the research protocol. Finally, the bulk of the presentation focused on results, utilizing a series of graphs, diagrams, and photographs, wrapping up with a bullet-point list of conclusions.

The feedback Dr. Bianchi offered during the composing of the presentation was largely focused on imagery – the inclusion of specific images (“Put some images here, images break up your slide and keep the audience’s interest. Just be sure to cite the images if you take from image searches…”; “Put a picture here of your set up if you have any”), as well as attention to formatting (“Try to put the y axis to only one decimal”; “Format this graph like the previous one”). Later drafts of the PowerPoint presentation focused not on the slides themselves, but on the points Amrita should make sure to talk about, organizing the oral aspect of the presentation. Interestingly, both Amrita and Dr. Bianchi opted for an extemporaneous approach to the presentation, rather than preparing a script in advance. In this way, they both seemed to privilege the data on the slides over the words Amrita would use to present them.
The spring semester’s proposal to PURS was virtually unchanged, noting only preliminary results the trials had generated in an appendix. Due to the problems with the other laboratory team’s protocol and Dr. Bianchi’s maternity leave, work in the laboratory slowed considerably. Most of the Amrita’s work focused on keeping flies alive, mentoring other students in the laboratory who were prepping for future experiments (including Natalia, who we’ll meet in the next chapter), and keeping on top of the few trials that were still running. Though she was eager to begin drafting a paper for publication based on her first project, finding a model proved challenging, and she decided to wait until Dr. Bianchi returned from maternity leave and “things return[ed] to normal” to take on that writing project. However, Amrita used this time to her advantage, drafting personal statements for medical school applications, preparing to take the MCAT, and identifying dual-degree MD/MPh programs that were suitable to her particular line of interest: public health. She also used this time to draft the poster she would be required to present at PURS’s annual Symposium at the start of May.

Though she worked with her partner on constructing the poster, Amrita took on much of the work. Visually, the poster is rhetorically effective, with a balance of relevant imagery, bulleted points for ease of reading in a tight timeframe and physical space, and a nice balance of color with black text on a white background (which is, again, pleasing to the eye and eases reading). (See Figures 16 and 17 for the initial and revised [final] poster.) Textually, the poster is also rhetorically effective, which is reflected in the comments Dr. Bianchi provided. Much of the commentary was directed at the inclusion of additional imagery (i.e., graphs). The only textual notes related to the Methods section, where Dr. Bianchi explained:

You don't want to go out and form the hypothesis in support of a theory. You have a have a null hypothesis and then your alternative, with your experimental design worked out to
Figure 16: The first draft of Amrita’s PRSIM Symposium poster, with feedback from Dr. Bianchi in the “Comments” section.

The primary feedback on this draft was on the use of imagery, with textual edits to the Methods section alone.
Figure 17: The final version of Amrita’s PURS Symposium poster, with edits. Important changes include the division of imagery into Methods and Results, as well as the inclusion of bar graphs.
confirm/debunk the bacterial or chemical theory. The way this is stated indicates that we have a set theory in mind and are designing experiments to support it. Though this is what we think is happening, we only come to this conclusion after we analyze everything.

Table 3 (next page) shows the original text alongside the edits Amrita made. These edits demonstrate a move toward a more passive, objective approach, reflecting Dr. Bianchi’s notes about not attempting to develop a hypothesis in support of a theory. None of the text in the remainder of the poster was revised, as it adequately addressed the audience in both content and form, demonstrating how Amrita’s discursive development in science had improved.

At the Symposium proper, Amrita used the poster as a reference when speaking to visitors about the research. As with the forensic science conference, she spoke extemporaneously, answering visitor questions with ease and adjusting her discourse accordingly. This last aspect was important because visitors to her poster included peers, faculty members and administrators, outside scientists, graduate school recruiters, and parents of students. She had to effectively “read” her audience every time someone approached her poster.

**Encountering Scientists Outside of the College**

During the spring semester, like the other women in this dissertation, Amrita applied to summer research experiences in science. She did so half-heartedly, she confided, because she was tired from the rigor (and paperwork) of applying on medical schools. Her strategy was to apply only to things that were paid. Much to her surprise, she received an enthusiastic offer from a physics laboratory in the Midwest that was part of a Department of Energy project connected to a larger summer URE program. The director of the project selected Amrita specifically based on her entomology research, as well as her programming experience in R. The team of researchers working in the laboratory were made up of physicists, statisticians, and computer programmers
Table 3: Amrita’s initial Methods section on her PURS Symposium poster, alongside her revised version in response to Dr. Bianchi’s comments

<table>
<thead>
<tr>
<th>Initial Methods Section</th>
<th>Revised Methods Section</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preparation of Trial Colonies:</strong></td>
<td><strong>Preparation of Trial Colonies:</strong></td>
</tr>
<tr>
<td>1. Eggs were collected from core colonies of L. sericata, P. regina, and C. vicina.</td>
<td>1. Pork liver was placed into core colonies cages of L. sericata, P. regina, and C. vicina.</td>
</tr>
<tr>
<td>2. Eggs were reared at room temperature with pork liver and aspen shavings in a mason jar until emergence.</td>
<td>2. Eggs were collected from the pork liver within 24 hours.</td>
</tr>
<tr>
<td>3. Adult flies were released into separate cages based on species.</td>
<td>3. Larvae were reared at room temperature with pork liver and aspen shavings in a mason jar until emergence.</td>
</tr>
<tr>
<td>4. All cages contained equal amounts of water, sugar, and protein powder.</td>
<td>4. Adult flies were released into separate cages based on species.</td>
</tr>
<tr>
<td><strong>Preparation of Lysine and Cadaverine Samples:</strong></td>
<td><strong>Preparation of Lysine and Cadaverine Samples:</strong></td>
</tr>
<tr>
<td>1. Over 100 different chemicals isolated through preliminary trials based on headspace analysis of decomposing matter</td>
<td>1. Over 100 different chemicals isolated through preliminary trials based on headspace analysis of decomposing matter</td>
</tr>
<tr>
<td>2. Chemicals were isolated by Dr. Rabi Musah from SUNY Albany</td>
<td>2. Chemicals were isolated by Dr. Rabi Musah from SUNY Albany</td>
</tr>
<tr>
<td>3. 15mg/mL experimental solutions of the chemicals was obtained from Dr. Rabi Musah’s lab.</td>
<td>3. 15mg/mL experimental solutions of the chemicals was obtained from Dr. Rabi Musah’s lab.</td>
</tr>
<tr>
<td><strong>Exposure of Chemicals to Adult Blow Flies:</strong></td>
<td><strong>Exposure of Chemicals to Adult Blow Flies:</strong></td>
</tr>
<tr>
<td>1. 5uL of prepared solutions of the chemicals were pipetted onto sterile filter paper disks</td>
<td>1. 5uL of prepared solutions of the chemicals were pipetted onto sterile filter paper disks</td>
</tr>
<tr>
<td>2. The disks containing the chemical was placed on a petri dishes, along with a water control disk.</td>
<td>2. The disks containing the chemical was placed on a petri dishes, along with a water control disk.</td>
</tr>
<tr>
<td>3. The petri dishes were placed in high-density cages of L. sericata, P. regina, and C. vicina for one hour.</td>
<td>3. The petri dishes were placed in high-density cages of L. sericata, P. regina, and C. vicina for one hour.</td>
</tr>
</tbody>
</table>

Behavioral changes of the flies were observed and recorded every five minutes for the duration of the experiment.
and were attempting to build a predictive computer model that could connect climate change to vector species of insects.

“I had no idea they’d read my résumé so closely,” Amrita laughed. But it was clear that her resume not only contained the background the research team was seeking, but was also conveyed in a way appropriate to science. The team saw Amrita as possessing valuable knowledge and skills that the team lacked. She described the first interactions with the other members of the team as being positive and enthusiastic, but also daunting:

I get to the first meeting and, like, I was beyond confused. I was, like, “I don’t know what’s happening.” There were four people. One of them was an environmental engineer. Another one was this computational mathematician. Another one was a statistics lady – a statistician. Another one was a meteorologist. And then there was me. ….. They were basically, like, “We don’t know anything about mosquitoes. We don’t know anything about how environment changes mosquitoes. So that’s what we need your help to do: background research.” ….. The first meeting I was so confused, they were putting calculus equations up on the board and like all these crazy things. And they had all of these questions for me. It was great because I knew – I was the only person on the team that knew the stuff that I knew – the entomology part of it. I was explaining things that I usually take for granted.

The team of experts, of which Amrita was now one, were among some of the top in their field. But, as she clarified, “they hadn’t taken a biology course since college” and so she found herself having to explain things that seemed simplistic to her (for example, what “genes” are). Where Amrita had to “go the extra mile to understand their perspective” and re-familiarize herself with calculus and computer programming, the rest of the team spent time educating
themselves on the areas of biology that Amrita was discussing. “They would come in the next week,” Amrita explained, “and be, like, ‘I did a bunch of research on genes!’ and such. And I was, like, ‘Wow. You were trying to learn my area.’ To understand what I work on.” In this way, the power-dynamic was equalized and everyone, regardless of professional level, was performing – embodying – important, unique roles. They were recognizing her as a member of their interdisciplinary scientific community.

Amrita spent the summer deeply involved in this research, presenting a poster at the URE’s culmination (which was positively received), and interacting with high-caliber scientists and student interns from other laboratories. Many of these students (a high proportion of males, but widely diverse ethnically) came from elite undergraduate programs, yet interacted with Amrita as their equal. Though there is much to discuss about the impact of this experience on Amrita’s developing scientific identity (including a new-found love of physics and a job offer), I include these moments from her summer experience to highlight the fact that the mentored writing and research experience she had with Dr. Bianchi went a long way in helping Amrita to develop a discursive identity as a scientist. Not only had her writing improved, but her speaking and reading/listening skills, as well. This development was significant enough that complete strangers already well-situated in scientific fields saw her not as a newcomer, but as a competent researcher.

**What Does Amrita’s Experience Teach Us?**

In contrast to Anne’s rocky experience in undergraduate research, Amrita’s shows us not only how tensions are alleviated with a good mentor fit, but as importantly how a mentored writing approach within the context of a URE can help students develop rhetorical awareness and
performance with scientific discourse to the degree that it starts to become embodied. This in turn assists students in developing a discursive identity as a scientist.

Despite challenges noted by other scholars regarding disciplinary faculty’s ability to teach the discourse of their community (e.g., Smit, 2004, Bransford, Pellegrino, & Donovan, 2000), Dr. Bianchi’s own experience learning to read and write as a scientist led to her strong awareness of the needs of students coming to the discourse as newcomers. As such, she developed an explicit, scaffolded approach to teaching the genres, rhetorical conventions, and critical reading necessary to successfully engage with others as a scientist. She began with reading practices, providing Amrita with selected articles meant to orient her to the research she would be involved in. This included her own work, which allowed Amrita to see how Dr. Bianchi engaged with the community discursively. Importantly, Dr. Bianchi discussed the readings with Amrita to ensure that she was understanding the content, learning how to identify important take-aways, and also critically questioning the material.

Significantly, Dr. Bianchi reinforced the recursive process of scientific writing. From the data sheets that would be revised experiment to experiment, to the back-and-forth of writing and sourcing additional literature, Amrita was able to see that there is flexibility in scientific writing, and that the work and the discursive elements are intricately connected. Dr. Bianchi also ensured that Amrita understood that scientific sub-disciplines have their own unique ways of communicating, including jargon and terminology, and that these ways are not natural. They require time and acculturation, and are both shaped by and reflections of the ways in which members of the community perform their roles as scientists. As was evident from much of the feedback Dr. Bianchi offered, modeling the discourse was critical. But even more critical was
explaining why she made the changes that she did, and (again) how that was reflective of the forensic entomology community.

This pedagogical practice of mentored writing combined with the URE had important effects on Amrita’s development as a scientist. Not only did it assist her growth in the engagement with and performance of scientific writing and speaking, it also helped her understand what kind of scientist she wanted to be. Our identities as members of a community are reinforced or refuted by other members of the community based on the ways in which we communicate. It is not simply what we ‘talk’ about, but the ways in which we do so. This certainly involves syntax, terminology, and structure; it also involves ideological orientations. In the second year of research, Amrita was beginning to articulate how she defines “good” science and what that looks like in practice. This orientation directly influenced her interactions with the other half of the team who were resistant to changing protocol – leading her to engage with scientific genres (i.e., constructing a new protocol) in an effort to demonstrate effective, alternative ways of answering their questions. It also influenced the role she would eventually occupy in the summer research program.

As is clear, the pedagogical approaches to mentoring – including the discursive aspects of science – between Dr. Bianchi and Meijer could not be more different. Where Meijer expected Anne to somehow pick up the rhetorical conventions of the field, Dr. Bianchi consciously and explicitly guided Amrita in understanding not just what these conventions are, but why they exist. As a result, Amrita was quickly able to synthesize her emerging scientific identity (and authority) with her discursive practices, while Anne continued to struggle.

As we will see in the next chapter, Amrita’s response to mentored writing is not unique. Natalia, who also joined Dr. Bianchi’s laboratory, had a similar positive response to this
pedagogical approach. In Natalia’s experience, however, we see how the addition of extensive prior experience in scientific research and writing allows for an even more sophisticated engagement with the genres and conventions of the discipline and its effect on discursive identity development.
Chapter 6: “They Offered So Many Opportunities to Me”: The Influence of Prior Knowledge and Experience on Discursive Identity Development

Writing studies research into the role of prior knowledge in transfer has surged in the last decade. Though the work of scholars such as Prior (2001), Carroll (2002), Beach (2003), Sommers and Saltz (2004), Smit (2004), Beaufort (2007), and Wardle (2007) have all contributed to our understanding of the ways in which students use (or don’t use) knowledge of writing from one context to another over time, as Yancey, Robertson, and Taczak (2014) note, the explicit focus on prior knowledge is relatively new to writing studies (p. 14). Beginning with Reiff and Bawarshi’s (2011) “Tracing discursive resources: How students use prior genre knowledge to negotiate new writing contexts in first-year composition,” and expanding to Yancey, Robertson, and Taczak’s (2014) collective and individual work on transfer (see, for example, volume 26 of Composition Forum), the writing studies community has only recently begun to understand, through empirical research, the ways in which prior experience and writing knowledge can transfer across spaces and the factors that facilitate or disrupt such transfer.

We know, for example, that students’ prior knowledge and use of genre in high school settings can transfer to the work completed at the collegiate level, and that these early experiences can influence whether they become “boundary guarders” – “those students who were more likely to draw on whole genres with certainty, regardless of task” – or “boundary crossers” – “those students who were more likely to question their genre knowledge and to break this knowledge down into useful strategies and repurpose it” (Reiff & Bawarshi, 2011, p. 314). We also understand that students will draw on prior knowledge through “assemblage” – “adding a limited number of new key concepts to this critical knowledge base;” “remix” – “reworking and integrating prior knowledge and practice with new knowledge as they address new tasks;” and in
encountering a “critical incident” – “a failed effort to address a new task that prompts” (Yancey, Robertson, & Taczak, 2014, pp. 103-104). These understandings align with insights from Wardle’s (2012) introduction to Composition Forum’s special issue on transfer, highlighting the important role educational contexts play in students’ transfer of prior knowledge by encouraging “particular dispositions in individuals” (or identity positions), causing students to creatively repurpose knowledge to suit new demands.

In this chapter, I use Yancey, Robertson, and Taczak’s work on prior knowledge in transfer to examine Natalia’s sites of transition and her use of prior knowledge in addressing rhetorical tasks within two UREs. In particular, I aim to examine how Natalia’s discursive identity as a scientist developed in and through her transitions from high school to college, into the URE, and to research experiences outside of PURS. While some of these insights might seem like ‘common sense,’ particularly in light of what transfer research has shown, what I am attempting to do in this chapter is to show – in granular detail – the various stages that take place in terms of developing discursive identity and how different factors mediate that development.

Natalia’s story is interesting because of her exposure to science writing and research before coming into college, and because of this exposure she was able to demonstrate a different level of rhetorical dexterity than Anne or Amrita when approaching the program and mentor’s writing requirements. In effect, she entered the program already at a level of facility with scientific

16 Here, I am concerned with how Natalia takes knowledge and skills learned in one space and uses them in another – e.g., how she uses her high school science writing knowledge in the URE and ways in which she manipulates and modifies that knowledge and skill. In writing studies, there are differing opinions on whether the term “transfer” or “transition” is most appropriate for this process. In this study, I am drawing on Beach’s (2003) argument that “transition” is more appropriate when we seek to “understand how knowledge is generalized, or propagated, across social space and time” (p. 42) In Natalia’s case, this is particularly important as her transitions are “consequential” – she “consciously [reflects] on, [struggles] with, and shifts [her] sense of self or social position. Thus, consequential transitions link identity with knowledge propagation” (Beach, 2003, p. 42)
discourse and, over time, moved into the adoption and critique stages. Her experience suggests that being able to effectively transfer knowledge and practices opens up space for developing identity discursively. Because her attention was not devoted to trying to work out genre or discourse conventions, or understanding what type of content to include, she was able to focus on the ways in which she presented herself and her research, allowing her to develop her own voice and identity.

**Participant Profiles**

Natalia joined this research project in September 2016 after having completed the required research training workshop during the summer. She was 18 at the time; a sophomore Forensic Science student who had yet to decide on a track – though was leaning more toward Criminalistics than Toxicology or Molecular Biology. When I asked her how she identified ethnically, Natalia hesitated. “There’s always like two choices,” she explained, “I usually check ‘Hispanic slash Latino’,” explaining that she deferred to whatever option “on the form” was closest to this category. Spanish being her first language, she was fluent and comfortable in both Spanish and English.

Natalia came to the college from an inner city high school that focused specifically on STEM through health and human services. Her high school was also part of an initiative to provide early college exposure to students historically underrepresented at the collegiate level. As will be discussed, the opportunities provided through this initiative became important factors in developing Natalia’s prior knowledge of research practices and scientific writing. Though as an adolescent and young adult she thought she would be a detective, her time at this high school introduced her to a variety of advanced sciences and research, including Forensic Science. “Chemistry,” she explained, “I took chemistry and I thought ‘Wow!’ Like you know, this is
what’s going on, this is pretty cool…it kept me wanting to take more classes. Senior year, I ended up taking a forensic science course because I thought, I still want to be a detective, but I want to play like this science thing into it.” This piqued interest caused Natalia to seek out additional opportunities, including a forensics course offered to the students at the high school through a partnership with a state university, as well as a research course focused specifically on the sciences.

Other than this early experience, Natalia had no direct exposure to scientists in her friend or family network. It was simply a passion that was ignited and fostered through her educational experiences. Natalia has a strong family network, including significantly younger brothers and an older sister, who supported her in pursuing opportunities. She described her parents as having a lot of influence on her sense of self:

They would always motivate me to do things that sometimes…I may not even think I could do them. And just applying to these programs, I always thought, I always kept that in mind, you know? I don’t lose anything with applying. I can only gain so much….

There are so many opportunities out there and if you don’t apply, you’ll never know if you would get them. But if you do, and they say ‘no’, then you know at least you tried. But if you do [get it] then even better. So there it is.

In our conversations, it became very clear that Natalia was aware not just of the competitiveness of the sciences, but also some of the racial and gender biases that exist and that could be potential obstacles for her. She spoke about high school professors who pushed the female and minority students to compete in STEM competitions and apply to colleges with STEM programs, as well as commented about the diversity of the PURS program and the strong female presence within it (both with students and faculty):
I was speaking to my advisor about this, that [PURS] is very diverse. Which I really like, but it’s also a lot of minorities (or how we’re seen as). And it’s just pretty cool because usually you, you would think like “minorities in college, that’s really hard [to find],” but at [L UPC] it’s like, “not really.”

In this way, it seemed that being a Latina scientist was already becoming a strong aspect of Natalia’s identity. Yet she didn’t consider herself a scientist at that point: “An essential part, at least for me, to call myself a scientist would be doing my own research…I’m on the road to that because of PURS, but I feel like only then I could be called a scientist.”

In Fall 2016, Natalia approached Dr. Bianchi and asked to join her laboratory. Like Amrita, Natalia met Dr. Bianchi through an early biology course and responded positively to her teaching style and research interests. Also like Amrita, Natalia found in Dr. Bianchi someone with whom she was comfortable and respected, describing her as “a really welcoming and really caring mentor who is passionate about her research.” When Natalia joined Dr. Bianchi’s laboratory, Amrita was taking on a peer mentoring role and, as such, became an important resource and guide for Natalia in the URE. As was discussed in the previous chapter, Dr. Bianchi adopted the same scaffolded, mentored writing approach with Natalia as with Amrita. The only difference for Natalia was that Amrita took over some of the direct instruction that took place in the laboratory regarding rearing larvae and identification.

Because the purpose of this chapter is to explore the ways in which prior knowledge influenced Natalia’s discursive identity development as a scientist, it seems prudent to spend some time discussing the experiences in scientific research and writing that Natalia brought with her to PURS. For that reason, rather than adopt the semester-to-semester approach used in the previous two chapters, here I will start with Natalia’s account of her high school and early
college experiences before moving into her encounters with the reading, writing, and presenting requirements of PURS and Dr. Bianchi’s laboratory.

**Natalia’s High School and First-Year College Experiences**

The New York City public school system provides opportunities for students in the five boroughs to attend high schools that are specialized and/or provide early college experiences for students historically underrepresented in higher education. Though part of the public school system, these specialized schools do require students to go through an application process, and occasionally enforce other gatekeeping strategies to manage enrollments (e.g., entrance exams or auditions for arts-based institutions). Natalia applied to and was accepted into one such institution – a high school focused specifically on health and human services that partnered with a state university to provide college-level course work later on in her high school career.

The school’s approach to curricula and pedagogy embraces project-based, experiential and interdisciplinary learning, with a focus on providing “students with opportunities to learn about and understand how our independent global community functions and interacts” (Urban High School, 2017). At the same time, it makes explicit the expectation that students will enter higher education after graduating and supports this expectation “by maintaining challenging academic standards and integrating education into professional settings so that they [the students] acquire scientific knowledge, ethics, integrity and compassion” (Urban High School, 2017). As we will also see through Natalia’s experience, the institution’s commitment to diversity permeates not only the school’s “Belief Statement and Expectations for Students,” but the coursework itself. The institution advocates for respect for self and others, active listening and participation, critical thinking, and personal responsibility.
When I asked Natalia about her high school experience, her energy level raised and her voice became animated: “Whenever I talk about high school to people, I always get really excited because they offered so many opportunities to me.” These opportunities included specialized course work as well as summer internship opportunities with NYC-area professionals and institutions. During the summer between 10th and 11th grade, Natalia took a course offered by the high school that focused on researching fruit flies. This summer course involved time in the laboratory working with the flies directly, and then an equal amount of time learning how to read peer-reviewed journal articles, how to search for scientific research in scholarly databases, and how to communicate as a scientist. This communication included laboratory notebooks, tracking the experiments with the fruit flies, reports on research, presentations to the class, and then a final paper and presentation discussing their research and experience in the program. The following summer, between 11th and 12th grade, Natalia was able to shadow a pathologist at a well-known NYC hospital. She spent every day in the laboratory working alongside the pathologist, learning about practices and procedures. It was this experience that Natalia credited with motivating her “to do more research and be part of a lab,” shifting her career ambitions away from detective work and more toward scientific research.

During the academic school year, Natalia gained experience with some of the gatekeeping strategies common to higher education. As noted earlier, the high school offered college-level courses for students later in their academic career. These courses were not a given, however. As Natalia explained, some, like Forensic Science, “you just had to let your guidance counselor know you wanted to take that class.” But for others, like Scientific Research, “you had to apply; there were certain requirements you had to meet in order to get into that [course].” In addition to providing important content knowledge and training in research methodologies, these
courses also offered an important ideological lens to science that seemed poignant for an inner-city school:

My teachers would always tell us, like, you know “Here are opportunities that you can take, so take them because this is the time when you’re going to learn more and see.” [....] I remember being told, like, women in science was just starting to emerge now. Like, it’s usually men who are in the field, who are in abundance, and then a really – few women are able to succeed in the field. And, I thought, like, “Wow, why?” And, you know, that question has always been on my [mind]…like, why is it that women aren’t able to progress in STEM fields? And me, since I’m a woman, too, trying to pursue a science major…That question is just in my head. Why is it that women are underrepresented in the STEM fields?

One of Natalia’s teachers in particular would emphasize the competitions students at the school were eligible to participate in. As Natalia explained, “she would want to get a lot of us into competitions…and there were some that were only for women…She would always motivate the females in the room to participate in these competitions and not let that stop us from expanding our wings.” At the same time, this teacher emphasized discrepancies in race/ethnicity: “I guess that was just her way of motivating us to keep going with our research. [She pointed out] the minorities…how they, how we, would be called in the STEM fields” and encouraged participation. Interestingly, Natalia did not recall instances where discussions of the double bind of gender and race/ethnicity were explicitly discussed, nor did these arise in her high school internship experiences. By the time she and I began to speak, though, Natalia had grown quite aware of the double-challenge she faced as both a woman and a Latina.
These high school experiences had interesting effects on Natalia’s identity as a scientific researcher and as a writer. Despite doing “pretty well in my writing courses,” Natalia saw writing as a weakness:

I always think it’s not my thing. Like, it’s not my strength; I have always felt like I struggled with it. Now, scientific writing – maybe it’s because I learned about it early in high school that I feel a little bit more confident with it. Um, but, I still feel like it’s a weakness of mine.

Though she did “pretty well” in her second semester at LUPC, the first year was not without its challenges. In her first semester, Natalia encountered what Yancey, Robertson, and Taczak (2014) describe as a “critical incident” – her previous approaches to writing were ineffective in the new academic context:

I remember my [Literature] professor telling me, “I know what you have to say, and I know you have potential, but you’re not showing it in your ideas. You’re not putting it across how you would like to.” And I think just that itself, like, I know it, and I don’t know what else to do. This past semester I actually learned a little – I feel like I learned a whole lot on how to improve my writing, especially like syntax and grammar itself because, um, what’s funny is that I always thought usage was the strength of my weak writing. But, it turns out that there was so much more that I didn’t even know. So, I thought, “Ok, maybe just start by fixing that part of my writing.” In high school, I was pretty good. But then in college, I realized, noooooooo. That feeling that I always had that my writing was weak is real and it shows.

What is interesting about this experience was that the course in which Natalia struggled was an English Literature requirement. In the research on transfer, so often the focus is on taking
knowledge from humanities-based and first-year composition courses into other disciplinary contexts. In Natalia’s case, however, she was trying to apply disciplinary-based writing knowledge to a humanities course – and it was equally ineffective. Though Natalia was conscious that “the writing itself is just constructed differently” from discipline to discipline, she still internalized mechanical errors as a marker of poor writing skill.

In her disciplinary coursework, however, the high school experiences worked more in her favor. In some of her early science courses, students were “still learning how to break down a peer-reviewed journal article,” which was something Natalia had learned to do in high school. She was already quite comfortable with navigating articles to “see if it relates to your [research] topic” and how to find what she needed in the various sections. This prior experience also helped with her writing-intensive science courses that involved pre-laboratory and post-laboratory writing, formal reports, and summarizing articles. In her disciplinary course work, it seemed that Natalia was embodying more of an assemblage approach (Yancey, Robertson, & Taczak, 2014), where she was layering more complicated knowledge onto an established base:

It’s just a little bit harder....My [high school] teacher, she was really harsh on us. Like, especially for citations, trying to get every period where it belongs, and all of that stuff. I know especially when writing for Orgo [Organic Chemistry] now, and Physics when needed, I don’t have a question for every single thing. Like, I remember things on methods, on how to remember the order of how to put it. And even when reading articles themselves, like which parts to look at and which parts to kind of skim over and leave for later.

In addition to making the writing process a bit smoother and faster, this prior knowledge and experience seemed to make Natalia a more confident scientific writer.
Transitioning into the URE

Natalia based her selection of Dr. Bianchi as a mentor on her experience with her as an instructor. In early September 2016, Natalia scheduled a meeting with Dr. Bianchi to talk through the possibility of joining her laboratory as a PURS student. Natalia described Dr. Bianchi as “so willing to tell me about the projects and what’s going on.” At the same time, Dr. Bianchi made sure to let Natalia know that she wasn’t expecting her to understand everything she was “throwing” at her, reassuring Natalia that she’d send her everything she’d need to get ready for research and training:

When I was hearing her tell me all of these projects, inside of me I just thought, “How am I going to do this?” Because, I don’t know all of this that is going on. Like, I’ve done a bit of research, but it hasn’t been enough for me to understand all of these projects in detail. But when she told me, “I’m going to give you all the information you need,” I was a lot more calm and like, “Okay, I can do this. I can do this.”

As with Amrita, Dr. Bianchi’s first step was to send Natalia scans of a textbook and copies of research articles that were relevant to the research being conducted in the laboratory. She instructed Natalia to “just try to comprehend as much as [she could] about what would be in her research, because…those are the basics that [she] would need.” Dr. Bianchi explained that once Natalia had a chance to read through the materials, they would sit down together and talk through the research and then decide on next steps for the proposal. Though there was only a month from this initial meeting until the time the proposal was due to the PURS office, Natalia was confident: “I feel like once the positive environment is set with a mentor even if the deadline’s coming up, the contact with the mentor will help get that proposal done.”
At this early stage, Natalia wasn’t sure how she was going to approach the proposal writing process because she wasn’t sure which project she would be working on. But she was confident that once they had formally decided on a topic for research, “the writing part will be easier.” Though she had prior experience with scientific research proposal, this would be the first proposal Natalia would write for PURS. She had reviewed PURS’s guidelines, noting that “they looked pretty intense.” At the same time, she saw in the guidelines a useful template. She explained that her process would involve creating an outline using the requirements as a guide, drafting the sections throughout, and then revising the proposal as a whole so that it’s more cohesive – “that way there is a flow in my writing.”

Natalia and Dr. Bianchi met again not long after this initial meeting and discussed the research papers and potential projects. They decided that Natalia would be part of a “keying” project for flies collected in Manhattan. Dr. Bianchi had a series of five-gallon buckets in the laboratory, each one filled with small boxes of dead flies that had been collected in traps throughout the borough. These flies were part of a project to identify what species are found in Manhattan and if there are environmental conditions associated with each. The hope was that some correlations between flies and environment would be found that would assist in determining location of death for individuals.

Before starting to write, Natalia met with PURS’s Program Coordinator to talk about the writing expectations:

I don’t want to seem like I’m laid back about my scientific writing….So, he said, “Oh, you know, don’t worry about it. Write as if you’re writing to me or if you were writing to a couple of friends who don’t know what’s going on, so you have to be…you have to explain it.” …. He told me, “As long as you’re able to communicate to me what the
experiment you’re doing [is] and how it’s important to your community, then I’m pretty sure you’re going to do a good job with it.” […] I took his words into consideration and I thought, “Ok, let me just write it like as if I was writing to a friend rather than, I guess, the scientific community,” because that’s what [he] was talking to me about doing. So I did that, but I wasn’t – I wasn’t satisfied with what I did. So I tried to incorporate a lot more scientific terms and like the, specifically the names of the flies that we’re specifically looking at. Then I changed it a lot.

Though Natalia had gotten clear direction from the Program Coordinator about the audience and tone for the proposal, it was in direct opposition to what she had already absorbed as appropriate scientific discourse. As noted earlier, Dr. Bianchi had provided all of the students in the laboratory with a copy of her doctoral thesis to act as both a content reference and a writing model. In approaching this first proposal, however, Natalia wanted to start more autonomously:

I thought, “Okay, let me do a draft on my own without taking a look at hers…at her thesis.” So I wrote down, you know, the basics of me being in the lab and keying out the flies or the species that we – that [Dr. Bianchi] – had collected. But then I thought, “Okay, this needs to have a lot more information that I wouldn’t be able to get if I didn’t look at her thesis. Then I realized, it wasn’t just traps. It was wasp traps, and there were beetle traps…..It was keying specifically, it wasn’t just identifying, because keying also involves labelling them, positioning…to pin them, label them, and make sure to put them in the right section that they belong. So I think “keying” involves the whole process, which I wasn’t taking into consideration when I was writing on my own. […] It’s one word, so I wouldn’t think that it would be much of a difference. But it is.
As she worked through the proposal writing process, Natalia drew on her metacognitive skills about science writing – continuously checking what she was being told by the Program Coordinator and the proposal guidelines with what she knew from experience, and then comparing these to the models of writing Dr. Bianchi had provided. Yet, despite drawing on this rich writing-knowledge bank, Natalia was still unsure about whether she was composing for the appropriate audience. Though she sent the first version to Dr. Bianchi for review, she did so with the explicit caveat that she was aware that this was not “100% scientific” and was pretty “bare.” Dr. Bianchi agreed with Natalia and assisted her in revising the proposal to include even more specifics about the flies themselves, the purpose of the research, and the methods and materials used. Dr. Bianchi’s guidance to Natalia, however, did not focus on discourse conventions as it had with Amrita early on – instead it encouraged Natalia to do what she already knew how to do: “She was like, ‘Oh, why don’t you try to be a little more specific…and she put some suggestions on the draft” (such as trap names and distinctions about procedures).

Approaching the revisions, Natalia attempted to embody Dr. Bianchi’s voice: “I thought, ‘Ok, this is something [Dr. Bianchi] would say.’ Part of this drew on her time speaking with and listening to Dr. Bianchi, and part of it drew on the thesis Dr. Bianchi provided as a resource and model. When Natalia completed revisions, Dr. Bianchi reviewed the draft and responded, “That one’s pretty good. Let’s leave it at that.”

Table 4 shows a comparison of the first abstract to the second, submitted version. Despite seeing the revised version as a combination in voice of hers and Dr. Bianchi’s, Natalia’s attempts at writing the first proposal demonstrate a student who already has a solid sense of what
Table 4: Comparisons of Natalia’s first and final abstracts for her first PURS proposal.

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<th>First Draft</th>
<th>Second, Final Draft</th>
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<td>Flies, frequently playing a big role in forensic entomology, are key evidence used to determine the postmortem interval (PMI) in forensic cases (Michaud, Schoenly, &amp; Moreau, 2012). Thus, the close observation and identification of common carrion species is crucial. The experiment proposed will contribute to the creation of a database that forensic entomologists can refer to when working on a case. Flies, specifically blow flies, collected from wasp traps placed in Central Park during the summers of 2015 and 2016 will be closely observed and identified into species. Data will be collected to determine the frequency of particular species to appear at a carcass and thus analyze for diversity in species as well as species density and species abundance. This data will then be used to create and publish the planned database that will provide information on flies that could be found in the Manhattan region of New York City.</td>
<td>Blow flies (Family; Calliphoridae), given that they are among the first insects to arrive to colonize a decomposing resource shortly after death (Michaud et al. 2012, Greenberg 1991), are one of the most forensically important insects in the field of forensic entomology. As a result, blow flies are often considered to be key evidence used to determine the postmortem interval (PMI) in forensic cases where the time of death exceeds 72 hours (Michaud et al. 2012). Due to changes in the distribution of insect species over a landscape or geographic region, a local database of forensically important insects should be created. The experiment proposed will contribute to the creation of a database, which is lacking for the Manhattan and surrounding regions. To date, flies have been collected from wasp traps that were baited with pork liver and placed in Central Park during the summers of 2015 and 2016. This project will include processing those preserved samples and sampling during the summer of 2017. Insect samples will be identified to</td>
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species and community indices will be determined such as species richness (number of species), species diversity (Simpson’s Index of Diversity [D], Shannon’s Diversity Index [H]) and species evenness (Simpson’s Evenness Index [E]). This data will then be used to create and publish the planned database that will provide information on the blow fly community that is present within the Manhattan region of New York City.
scientific writing looks and sounds like. In the first abstract, she attempted to meet a rhetorical situation that did not feel authentic to her – writing a proposal for someone who was, as the Program Coordinator described, “a friend.” Her initial abstract introduces the subject of the research generically (flies) and their use in Forensic Entomology, as well as situating the research within the larger body of Forensic Science and its potential use in investigations. Though she was self-conscious of mechanics, this initial draft does not display problems with punctuation or syntax, nor does it display a lack of clarity. If anything, what it lacks is the specificity that scientific writing requires – but which goes against the audience the Program Coordinator guided her toward. The revised abstract maintains the rhetorical outline of the original, but is fleshed out more to include specific details about species names and applicability, as well as details in methodology and data analysis.

Natalia was particularly conscious during this writing-period of the identity she was putting forth, and that the scientific writing she was sharing would be a marker of her scientific identity. In reflecting on this experience, she noted, “I feel like once you give a title to yourself, you’re also being put to higher expectations.” In particular, Natalia was conscious (and glad) that Dr. Bianchi did not know she was part of the same prestigious Scholars program as Amrita:

I feel like, if she did, then she would have even higher expectations. So I think it’s also like the names that you come with. Because if you put a name to yourself, you have to meet – you should meet those standards. […] I was rethinking sending this [first draft] to her because I thought, you know, what if she’s like “she wrote this and it’s not really good,” so you know her whole perspective of me changes.

But Natalia’s fear was for naught – Dr. Bianchi was quite pleased with the proposal Natalia produced. In reflecting on this writing experience, I asked Natalia what she might take away
from the experience for the next proposal: “I have to keep in mind the standards put upon me and also that voice not just in my head, but the voice that I should be portraying. […] I also have to keep in mind I am writing to my professor who is reading it and to others that may actually see it. […] For the spring semester, I really want to make it more of my own.”

It was interesting that, despite writing these drafts primarily by herself, drawing on Dr. Bianchi’s thesis made Natalia feel as though the writing voice was not her own. It was almost as if she was trying on another’s identity to see how well it fit. For Natalia at this time, there was a direct connection between a writer’s voice and their experience:

I’ve seen a few things [since submitting the first proposal] that I feel I could incorporate into my [next] proposal that would actually make it a little bit more of my own. […] I think good scientific writing also requires experience. Even though I haven’t written this new [spring] proposal, I feel like it’s going to be…I have a good feeling about it. Like, I feel like it’s going to be better just because I actually lived everything that I proposed last semester... I know what specifically is going on. So I understand, and if I understand, I can probably explain it better.

In discussing the tone of the proposal, and scientific writing in general, Natalia was conscious not just of what scientific writing should sound like (“it’s all seriousness, you’re talking about this serious topic [and] the experiment that’s going on”), but also about the flexibility that exists in writing within this discourse community:

I’ve taken a look at papers that are like 40 years old and those are pretty…pretty monotone. And then I’ve taken papers that are just, like, 2 years old and I feel like the wiggle room is increasing. Especially because the paper I’m talking about that was published recently was [Dr. Bianchi’s] paper. I don’t know if it was because she’s
female, but I felt like her writing was pretty…was not direct monotone. When she spoke about her writing [in meetings], too, it was pretty…not laid back. I don’t know, it was more of a welcoming tone rather than, you know, “Okay, this is what it is and that’s it. I’m moving on now.” Which I thought was interesting.

That Natalia was making a connection between Dr. Bianchi as a person (including gender) and scientist and her voice as a scientific writer was an important moment in our discussion. It suggested that Natalia was becoming even more metacognitive in her writing process and aware of the various “selves” (Ivanič, 1998) one can present in text. Now that she was comfortable and understood the affordances and constraints of the proposal genre, and had a firm grasp on the language and jargon used to communicate as a forensic entomologist, she was turning her attention to ways that she could make the writing her own.

The second proposal Natalia wrote for PURS – which was to continue the research she had started the previous semester – involved very little revision. Natalia was balancing her work in Dr. Bianchi’s lab with work as a tutor and her own heavy course load, and as such took advantage of the flexibility PURS offers with continuing projects. The bulk of her proposal remained the same, with the exception of the inclusion of an appendix. This appendix was an update on the work that had happened in the Fall term and how it would be continued through the spring. Natalia described this proposal as “an adaptation” of the first, but was particularly excited about the appendix itself:

I tried to change things at the beginning because … I felt like it wasn’t really me writing. It was almost like [Dr. Bianchi] was like, “Okay, here’s your material, here’s what you should write, and here’s…” Like, a great influence on what I came up with. But in this section [the appendix], it all came completely from me and when [Dr. Bianchi] took a
look at it she…I think she just added a sentence and that’s it. So, I felt like, I actually felt like, “Okay, great! This is all me.”

An interesting rhetorical move that Natalia adopted in this appendix was the use of the pronoun “I.” She was conscious that “in any scientific writing piece you avoid all of the “I’s” and “We’s” and it’s not in that first person point of view.” But in the appendix, she opted to use it in the first sentence to introduce the work she had done, and then switched to the third person for the remaining. This approach seemed to free her up for writing – “It just came to me just by me writing that first sentence.” – and allowed her own voice to shine throughout without the need for further first-person pronouns. Remarking on how good the experience felt, she noted,

I was reflecting on all the work that I did and what I got from…out of that work. What the results were. I was almost thinking, like, because it’s my results and when you’re doing an experiment there is no such thing as right or wrong results. So, I guess knowing that I couldn’t be wrong in what I was saying almost made me feel a little bit more comfortable in what I was writing…. So when it comes to what you’re doing, you can’t make stuff up. This is what you did and this is what you got and maybe it’s what you expected, maybe it’s not what you expected, but that’s what happened. So there’s no way of saying, “No, this is wrong, you need to somehow change it or move it around of look it up to fix it.”

The process was not just about meeting a program requirement, it was an opportunity to reflect on the work done and, as Natalia put it, “embrace” what she had accomplished over the previous semester and become a little “nostalgic” for the experience. Part of that process allowed her to own the writing. Though she was still questioning her skill as a writer, this questioning forced her to be more self-conscious of the writing she was doing and, as a result, her writerly
confidence – her willingness to take risks and make it her own – was growing. This growth, interestingly, coincided with Natalia’s acceptance into a highly competitive summer undergraduate research opportunity at a university in another state.

**Transitioning to an External URE**

Like Anne and Amrita, Natalia was accepted into a summer program that would allow her to conduct research outside of LUPC. Rather than pursue something related to entomology, however, Natalia used this opportunity to explore different research interests. “I was really excited about immunology for some reason,” she told me: “It wasn’t something that I would have thought of. I knew I wanted to do something that had to do with disease – trying to find something having to do with the pathogenesis of the disease, or how can a disease be prevented, or [something else].” She saw this as an opportunity to do something different, to try on a new disciplinary persona, and see how it felt. Notably, the program as a whole was relatively diverse. Though Natalia “expected to be the only Latina there,” her two roommates were also Latina and there were many people of color and women both as participants and mentors. The support she received from her parents and from her peers in the summer program helped assuage her discomfort about being away from home for the first time.

Though Natalia did not have any experience or background in immunology, her summer mentor provided readings and foundational training to help orient her to the work in the laboratory. At the same time, weekly seminars presented research into a wide variety of fields to help students see the diversity of research being conducted at the institution. The lab Natalia was placed in focused on “retroviral elements in RNA” to discover if they play a role in the presentation of lupus. Her aim was to learn whether the presence of these elements contributes to the development of lupus, or if the presence of lupus leads to the increase of these retroviral
elements. Through cell cultures of healthy patients, Natalia attempted to “mimic the environment of lupus in a cell with different immune stimulants that were also found in high quantities in lupus patients.” This effort was meant to help discover if the researchers could use those “stimulations” as a model for lupus cells. The study found that this was possible and led to new lines of research for the team as a whole.

Despite having had no training in immunology prior to the summer experience, Natalia was able to draw on her skills and experience in research to effectively navigate the research protocols and be a functioning, contributing member of the laboratory. At the same time, when it came time to write and present her work in both poster and oral presentation form, Natalia had her prior experiences to draw on. The program held, first, a poster presentation at the institution for the 40 summer participants, and then required all participants to travel to another state to present their research orally with three other programs of equal size and scope.

Natalia felt comfortable composing the poster on her own, having a solid approach to the writing based on her PURS poster. Her mentor provided feedback, letting Natalia know what she liked, and what she thought could be changed: “What I really liked was that she wasn’t looking at it and saying, ‘Okay,’ and then that’s it.” In her poster, Natalia was able to effectively communicate what her project was and what was accomplished:

I wanted to make sure that – What I want to leave people with is no doubt. That’s why a poster should be done, right? And that really made me think about posters that I had done before, and also posters that I’ll do in the future. I want to make sure that the main idea of what people should get is out there. Even captions and small things like that. I knew the basics…I didn’t have a blank slate. I knew what sections had to go on. I didn’t feel lost
when it came to the poster….It wasn’t too frustrating or nerve-wracking, like the oral presentation was.

The oral presentation was a new experience and worried her because of her shyness. Though she had presented beautifully and competently in the PURS Symposium earlier in the year, the idea of standing up in front of a room and discussing her research was deeply uncomfortable. However, PURS’s Program Coordinator went out of his way to travel to the session and attend Natalia’s presentation. The presence of a familiar face helped ease her nerves, giving her “someone to look at.” In the end, both the Coordinator and her summer mentor congratulated her on a job well done.

**What Natalia’s Experience Teaches Us**

In many ways, Natalia embodies the ideal undergraduate student – one who is able to transfer knowledge and experience from one context to another so as to effectively engage with the discourse of their discipline. She was able to take what she learned in high school, summer internships, and undergraduate coursework and transfer it successfully to the rhetorical situations PURS presented. But this is not necessarily new – it’s what most writing educators hope students will do after leaving their classroom. Where Natalia’s experience opens things up for us is in looking at how this happened, and how it allowed her to engage rhetorically with scientific genres in a manner more sophisticated than her peers in this study.

First, Natalia’s high school experiences, including the summer internship experiences, provided her with regular, consistent exposure to a wide variety of scientific genres and practices. The repetition allowed Natalia to focus on different elements each time – first structure, then language, then citation conventions, etc. The pedagogical approach of her high school teachers was equally important in this exposure, as they explicitly walked students
through how to read scientific articles, the connection between a genre and its purpose, and the role of writing in research.

Second, Natalia’s understanding of the nature of scientific research and the dynamics of the scientific community (again, rooted in her high school experiences), as well as her parents’ instilling of a growth-mindset from early on, meant that Natalia was not afraid of making mistakes in science or in science writing. She was willing to take chances, try on new styles, and play with modeling of others’ (notably, Dr. Bianchi’s) voices. Because she had a strong understanding of the ways in which different scientific genres worked, and because she drew heavily on her metacognitive skills to consistently question what she was doing and whether it was effective, she was able to find her own voice. At the same time, because she has high regard for her mentor and for the program, and is acutely aware of the relationship between how one sounds and how others perceive them, Natalia’s strong work ethic meant that, despite “playing” with language, she took calculated chances that drew on her understanding of scientific communication.

What this suggests is that regular exposure coupled with explicit teaching leads to a stronger foundation for students later on in their academic and disciplinary careers. Because she had this strong foundation, Natalia was able to focus on higher-level thinking and skills earlier in her PURS experience than other students in this research. The effect on her scientific and discursive identity is best summed up by a late-stage comment: “I feel comfortable where I am and what I’m doing. It’s not like…there’s no fear of, let’s say, being wrong, or getting…or looking at the results and, you know… I think I’ve become more accepting of the fact that I’m doing this work and that makes me a scientist.”
Chapter 7: Discussion and Conclusion

In this final chapter, I want to return to the overarching, guiding question for this project: What do these experiences tell us about how women of color develop discursive identities as scientists? As noted in the introduction to this dissertation, in asking this, what I have been interested in discovering is how these three particular women of color learned to present themselves as scientists in written and spoken discourse, and how their reading and listening practices changed to be more or less in line with the practices of professional scientists. By taking a granular approach to these experiences, I have endeavored to uncover what influence various mediating factors – “push” and “pull” factors – have had on this development. The aim, of course, is to offer new pedagogical paths to those interested in WAC/WID and equity pedagogies, particularly those working with underrepresented groups in STEM disciplines. What these experiences demonstrate, however, I believe spans disciplinary boundaries and is applicable to anyone interested in building inclusive learning environments. While specific pedagogical practices discussed here could significantly help women of color in developing discursive identities as scientists, they hold equal potential for all students and may work to leverage knowledge and experience not typically valued in academia.

Before exploring the push- and pull-factors that influenced each woman’s discursive development as a scientist, it is necessary to revisit the model of discursive identity development that I presented in Chapter 2. Discursive identity, I argued, is the embodied identity of an individual as reflected in discourse. This stretches beyond the words placed on a page; it is the degree to which specific discourses become a natural extension of the individual – the ways in which they are blended with other discourses and ideologies. In my conceptualization of this model (Figure 18), I argued that successfully developing a discursive identity within a specific
Figure 18: A conceptualization of discursive identity development and the various factors that influence that development.
discipline (e.g., science) involves a transition from a place of dissociation, or complete separation, from the discourse to one of embodiment. Embodiment is not a matter of assimilation, where the individual dissociates from other discourses to take on the new. Rather, it is a matter of identifying that the new discourse is one that the individual has rights and claims to – which involves power and agency to critique and manipulate. The transition from dissociation to embodiment involves various stages that can be disrupted or sped-up by various push- and pull-factors, which I will now explore in greater detail through the case studies proper.

Anne’s Development

Anne entered her college experience with no prior knowledge of the ways in which scientists read or write. Though she had a strong academic identity, she was unable to transfer those successful rhetorical skills in academia to new disciplinary contexts (i.e., the laboratory). Anne was, unfortunately, at an additional disadvantage in that she selected a mentor who was, at best, absent and, at worst, dismissive. After seeking out alternative, external experiences, she was able to gain some ground in understanding what it means to “sound” like a scientist. However, it was not until her summer research experience with a mentor who explicitly walked her through some of the reading and writing practices of scientists that real growth was had.

Anne’s growth in terms of discursive identity development is illustrated in Figure 19. Factors that pulled Anne away from the discourse (and the discipline) included Meijer’s positioning of her as remedial and assigning Anne tasks that caused her to see herself as a “benchwarmer.” As is evident from all three case studies, mentors hold an enormous amount of power over the success or failure of their mentees. Not only do they play critical roles in the students’ research and practical science education, how they reflect a student back onto themselves can influence whether a student sees themselves as a competent individual new to a
Figure 19: An illustration of Anne’s discursive identity development over the course of this study. While “remedial” and “not-scientific” positioning from mentors pulled her away from the discourse, explicit instruction and modelling helped pull her back into it and propel her forward. Meijer’s instruction did little to help Anne move past the experimentation stage; Dr. Brennan’s pedagogical approach did build familiarity, though little more; Mary’s guidance has the most profound effect. Helping Anne develop facility with the discourse and compose almost independently.

field, or a deficient individual who does not belong in the field. Anne’s struggles were not solely related to preparedness; they were sociocultural, as well. She did not have the cultural capital early on to understand that her negative experience in Meijer’s laboratory was not what mentoring “was supposed to look like,” and she did not believe she had the power or agency to challenge or critique Meijer in any way. Anne entered PURS with a Freirian mindset that Meijer
would deposit “bricks” of knowledge into her over time. When this did not happen, she internalized Meijer’s lack of response to writing and failure to progress as somehow a flaw in her. This led to a lack of motivation in seeking out her mentor’s support, as well as disengagement with scientific reading and writing practices.

As Mayes (2010) has noted, “power relations are constructed at the micro level of moment-by-moment interactions” and specific behaviors by a mentor (e.g., ignoring meeting appointments, late replies or being non-responsive to emails) can be interpreted by a student as micro-aggressions, reinforcing for that student that they are unworthy of that mentor’s time or attention (p. 192). For students with a great amount of cultural capital (e.g., Amrita) such responses may signal a need to simply change mentors. For students with less (like Anne), such responses can be interpreted as though they do not belong in the discipline as a whole.

Dr. Brennan’s feedback that Anne didn’t write “scientific enough” caused her to feel like an outsider to the community, as well. Yet, Dr. Brennan’s procedural instruction combined with directing Anne to complete rhetorical tasks (i.e., collect and record data, write up findings, construct a poster) gave Anne the opportunity to experiment with the scientific discourse and become familiar with its conventions. These activities pulled Anne back into the community and helped propel her forward. When Anne had the opportunity to work under the guidance of Mary, who explicitly directed her in both task-oriented and communicative genres and positioned her as an active member of the scientific community, Anne’s rhetorical development excelled.

While Anne’s discursive identity development over the course of this study did not advance to a stage where she adopted the discourse fully as her own, her facility with it had advanced to the point where she could write and converse in a way that others recognized her as a member (albeit a junior member) of the scientific community. Tensions remained in her
execution of scientific texts in that she tended to use, as she called it, “more laid-back terms” when initially describing the work, and then revised to “make it more scientific.” The fact that Anne recognized this last step as necessary, however, suggests that she was becoming metacognitive about her scientific writing process and, with time and practice, might begin to compose at a more advanced level.

**Amrita’s Development**

Like Anne, Amrita entered her college experience with no prior exposure to, or instruction in scientific genres. Though both of her parents are doctors, her resistance to becoming a doctor kept her pre-collegiate activities focused on social justice and community efforts. Though Amrita’s previous academic and extracurricular experiences set her up well for a strong academic career, generally, they did not necessarily place her in a stronger position for engaging with scientific texts at the outset. Figure 20 illustrates Amrita’s discursive identity development over the course of this project.

Where Amrita’s prior experiences in high school did seem to play a role was in how she positioned herself as a learner, recognizing that scientific discourse can easily be approached as a new language and culture that requires orientation. Her mentor, Dr. Bianchi, supported this positioning by teaching her explicitly how to engage with the texts, what the discourse of Forensic Entomology “sounds” like, and the conventions of the genres. This explicit teaching paired with Amrita’s strong academic identity allowed her to quickly adopt the appropriate scientific voice, though it would be some time before she was able to modify this voice to sound unique to her.
Amrita’s Discursive Identity Development

Figure 20: Illustration of Amrita’s discursive identity development over the course of this project. Amrita did not report experiencing anything that pulled her away from the discourse. Dr. Bianchi’s positioning of the discourse as another language to be learned, rather than something she should know, removed tensions and provided a clear path for learning.

Amrita flourished in Dr. Bianchi’s laboratory in large part because Dr. Bianchi made a point of learning what Amrita needed both academically and disciplinarily, and then made a plan to meet those needs. Dr. Bianchi’s approach to mentoring, and specifically mentored writing, seemed to have a strong impact on Amrita’s discursive identity, both through guidance in laboratory procedures, as well as explicit orientation to the reading and writing practices of forensic entomologists. By modeling the way forensic entomologists write – through examples,
such as her thesis, as well as through textual edits on Amrita’s materials – and explicitly calling attention to discourse conventions, she helped position science as a language and culture unto itself and not something that Amrita should “know” as a newcomer.

An important aspect to call out in Amrita’s experience is the influence of repeated exposure to disciplinary genres – both as a reader and writer. Amrita was guided early in her work with Dr. Bianchi on how to read scientific content – which included scientific articles, as well as laboratory notebooks and Dr. Bianchi’s doctoral thesis. She was also tasked with writing synopses of the literature, protocols, research proposals for PURS, scientific posters, conference presentations and proposals, and (at the end of this study period) drafting a scientific paper. This regular, repeated exposure assisted in building familiarity with scientific genres, and Dr. Bianchi’s explicit instruction on how to read and write them help clarify each genre’s structure and purpose. As Amrita’s familiarity and facility grew, she became metacognitive in her composing processes. For example, understanding the commonalities across scientific genres (i.e., the prevalence of the IMRaD structure) assisted Amrita in engaging with new/other genres later in her research experience – particularly the conference presentation. Because of her understanding of these conventions, she felt more free to work within the constraints to make the presentation “sound” like her (to the degree that she used talking points rather than a script to give the oral presentation). This suggests that metacognition may play an important role in those later stages of moving from familiarization toward critique and manipulation.

While I am hesitant to speak, here, regarding any of the participants’ internal motivations to succeed as scientists, what is noticeable – particularly in relation to Anne – is the difference in power and agency Amrita had as a student researcher. This power and agency may be related to her identity as a high-achieving student within the US system (being invited into the Honor’s
program), having role models in accomplished fields (parents in medicine), her experiences in social work and study-abroad, or something else entirely. Regardless, this power and agency was noticeable early in the study. In our third interview, I commented to Amrita that I was impressed by her sense of knowing who she is and what she will and will not tolerate. Her response was telling:

I’ve always been a little bit stubborn… When I know what’s good for me, I know what’s good for me… I would say it’s primarily been because of these last two years. I’m living [500 miles] from home. Living away from home gives you a whole different perspective on everything else. When your parents aren’t there to tell you what’s good for you and what’s not and you have to decide for yourself – because of that, I’ve been able to, you know… Once I came up with a reason for myself and I realized a doctor is what I want to be, I think then again identity comes with that.

This comment on parental oversight stood out mainly because of Anne’s markedly different conditions – living at home, very little independence, and her comfort in the role of “child.” (Even while living away from home, Anne’s mother brought her a week’s worth of meals on Sundays so Anne “wouldn’t starve.”) These relationships may differ because of geography or culture, but the potential impact on each woman’s ability to see herself as an independent person – and as a member of a new discipline – is worth further exploration.

Natalia’s Development

Of the three women in this study, Natalia was by far the most prepared for entering the undergraduate research program. Natalia was fortunate to have had a rich experience in high school that provided explicit, in-depth rhetorical practice situated within research experiences. She was taught how to engage with scientific articles to draw out the information she needed,
was provided detailed instruction in writing proposals and reports, as well as presenting the research she had completed. These experiences provided her with a bevy of knowledge to draw on when it came time to engage with scientific genres (both reading and writing) in her coursework and in undergraduate research, and provided a space for her to experiment with language and find her own voice. Figure 21 illustrates Natalia’s discursive identity development over the course of this project.

Figure 21: Illustration of Natalia’s discursive identity development during the course of this project. Natalia experienced some tensions with the program’s guidelines for writing the research proposal, which conflicted with her existing (correct) knowledge of scientific discourse conventions and the genre of the proposal.
Because Dr. Bianchi recognized Natalia as a competent scientific reader and writer, her guidance in those areas focused less on discourse conventions and more on giving Natalia the space to develop her own voice. In this way, Dr. Bianchi reinforced for Natalia that she was engaging with the discourse correctly and effectively and made adoption of the discourse a natural next step. Natalia, with her strong understanding of the various scientific genres and their functions was able to engage with the writing demands of the program effectively and understand where she could “write against the grain” and where she could not. Understanding the affordances and constraints of each genre allowed her to focus less on the form and content, and more on interpreting an appropriate response (via style) to the situation, indicating a growing understanding of genre as a social action (Miller, 1984).

All of this is not to say that Natalia did not experience conflict in her scientific writing experiences. As was highlighted in her case study, the program’s requirements are relatively loose with regard to disciplinary conventions. In many ways, the verbal guidelines for proposals does students a disservice by diluting the discourse conventions – Natalia was told to “write to a friend,” which may be an effective strategy for an early career researcher or doctoral student, but not for an undergraduate at an inner-city, public institution. Natalia’s experience to see through this because of her prior experiences and stage in her development helped her produce a more scientifically-appropriate proposal. However, this was accomplished with noticeable personal conflict.

In many ways, Natalia’s power and agency as a student researcher could be placed between Anne and Amrita. Her confidence wavered when joining the laboratory, despite her mentor’s enthusiasm:
Hearing her tell me [about] all these projects, inside of me I just thought, ‘How am I going to do this?’ because I don’t know all of this that’s going on. I’ve done a bit of research, but it hasn’t been enough for me to understand these projects in detail. But when she told me, ‘I’m going to give you all the information you need,’” I was more calm and, like, ‘Okay, I can do this. I can do this.’

Natalia attributed this “I can do this” thinking directly to her prior exposure in high school to the scientific field, writing practices, and culture. She was acutely aware of the position of being a double-minority in science – as both a woman and Latina. Yet, her high school experiences had already proven to her that she was capable, and her instructors’ explicit discussions of gender and race discrepancies in science had prepared her for moving forward. The influence of her specialized high school experience speaks to the potential of such programs for addressing gender and racial discrepancies in STEM.

Natalia’s family support also proved important in helping her push through doubts. Both of her parents have strong work ethics that they imparted to Natalia and were explicit in that she could do anything she set her mind to. They also instilled the idea that you “don’t lose anything” with trying new things, “[you] can only gain so much….There are so many opportunities out there and if you don’t apply, you’ll never know if you would get them.”

Like Anne and Amrita, metacognition played an important role in Natalia’s discursive growth. Not only did she compose while consciously drawing on her prior scientific writing experiences, she did so with an eye toward how others would perceive (and position) her in response to that writing: “Even just knowing that Dr. Bianchi was going to read it, I felt like – Should I send it to her? Or should I change it more? ….What if she’s like, ‘Oh, she wrote this and it’s not pretty good’? So, her whole perspective of me changes.” Yet, as was demonstrated in
Natalia’s chapter, Dr. Bianchi didn’t perceive her as inadequate. On the contrary, Dr. Bianchi’s response to Natalia’s strong scientific writing was to give her room to find her own voice as a scientist. When Dr. Bianchi took leave to have her child, Natalia was further entrusted to continue her research with little supervision, suggesting Dr. Bianchi saw a correlation between Natalia’s writing skill and her scientific skill.

**Procedural Knowledge, Discourse Knowledge, and Discursive Identity**

In reviewing these cases, an important question arises: How much of this student success can be attributable to an increase in procedural knowledge, as opposed to disciplinary discourse knowledge? Can we effectively parse the various mediating factors that influence a student’s growth as a scientist, as a scientific writer, and their development of a discursive identity as a scientist?

Anne’s experience serves as a nice exemplar to explore the relationship between procedural knowledge and discourse knowledge and whether one was more profound in influencing her success. The three different research experiences required Anne to engage with disparately different content areas. In asking her whether that knowledge transferred from one experience to another, she responded:

No, every one of them I started blank. I think I learned more [with Mary, though]. I felt confident in myself, to do stuff by myself. And I could have explained it to someone – like, if I had an underling, I could have taught them how stuff worked and where to get certain things. I felt happier there. Once you get the hang of things, you don’t need someone to hold your hand all the time. I think [my success] relates to my mentor. Because [Mary], she was so very helpful, so that was easier. And then [with Dr. Brennan], she was also very helpful. (She loved to talk, so she explained a lot of things to
me.) With Meijer, she doesn’t really explain much to me, so I don’t know if I should be doing things on my own or what. I felt most comfortable [with Mary].

Anne’s experience of the content itself was mediated by mentor pedagogy, as was her understanding of scientific discourse. Her experience reinforces findings from Amrita’s case in that teaching the content alongside disciplinary writing has powerful effects for student growth, but that growth is also heavily influenced by the fit of the mentor and mentee with one another. Anne’s procedural knowledge was no less than Amrita’s entering the laboratory, and while Natalia may have had more preparation in terms of scientific research and writing practices, she had absolutely no content knowledge in the field of Forensic Entomology. Yet, the different mentors and their respective pedagogies had markedly different effects.

Similarly, we cannot rely on general composition instruction to help students in disciplinary contexts. Like Beaufort’s (2007) study of Tim, a graduate student in history, these case studies demonstrate that ‘basic writing skills’ (if such things actually exist) do not necessarily transfer to other contexts. They also demonstrate that traditional writing in disciplinary coursework (i.e., laboratory notes) do not necessarily assist with composing in other disciplinary genres. Both Anne and Amrita had strong skills in composing when they entered their PURS experience, and they each had in-depth experience with laboratory notebooks and reports through coursework. Yet, when encountering new scientific genres (abstracts, proposals, posters, etc.), this knowledge base was inadequate for successful composing.

Because we, as educators, will never be able to anticipate what each of our individual students will pursue in terms of career, it is improbable to suggest that we should be creating more disciplinary-intensive experiences at the K-8 levels so that students engage more effectively in higher education. However, what I believe Natalia’s experience in particular
demonstrates is that effective, explicit writing instruction within high school and college disciplinary coursework, as well as undergraduate research experiences, has the potential to help traditionally marginalized students boundary-cross and effectively navigate through the experimentation and into the familiarization stages of development. The greater the exposure students have to disciplinary genres within disciplinary contexts, coupled with explicit rhetorical instruction, the more likely they are to effectively engage with disciplinary discourse conventions.

This exposure and instruction requires careful thought, however. It is not enough to say (as the Program Coordinator does yearly) ‘you’re going to write a proposal – it follows this format.’ If that was enough, Anne would not have struggled as much as she had. Instead, it requires a deeper look into the purposes behind the genre and discourse. What is the genre meant to accomplish? Who is the audience and what do they know (or not know)? In short, exploring the rhetorical situation and appropriate ways of meeting it. Similarly, perspectives on writing process and individual growth proved important. Where Meijer’s thinking aligned with Carroll’s (2002) faculty research subjects, “[fantasizing] writing as a stable skill that can simply be applied in different circumstances” (p. 23), Dr. Bianchi saw writing as malleable and relational – her expectations for Amrita and Natalia were to invoke high standards while “[assuring] the student’s personal capacity to reach those standards” (Cohen, Steele, & Ross, 1999, p. 1310). Dr. Bianchi saw her mentees in a state of transition, while Meijer (consciously or not) faulted hers for not already being an expert. This view of transition over fixation and how it, in turn, positions students appears to be a critical component of discursive identity development.

These findings above align with the work of Wilder (2012), Wolfe, Olson, and Wilder (2014), and Purcell-Gates, Duke, and Martineau (2007) whose research each demonstrate that
situated practice with “high degrees of authenticity along with explicit explanations of the [discourse] features” are efficacious in language and discourse learning (Purcell-Gates, Duke, & Martineau, 2007, p. 41). By consciously drawing attention to the specific discourse conventions of a discipline (e.g., jargon, citation style, genre, structure, tone), students are able to see the relationship between the aims and purposes of the disciplinary genres and the actual writing of the documents. By positioning the discourse as a language that is not natural to any group other than scientists and thus must be learned, such instruction shifts some of the power from the community of science to the student – there becomes a clear entry-way to the community (an access-pass, if you will), rather than a reinforcement of barriers. This ‘pass to discourse,’ however shaky, by extension becomes a ‘pass to identity’ by mitigating beliefs about who is allowed to ‘speak like that.’ What this research shows is that the further away a student is from the discourse (by education, culture, class, etc.), the more powerful the effect of exposure and explicit instruction.

Among the more salient insights this research yielded was the entwined nature of disciplinary and discursive identity. Though it seems common sense to say that the more an individual knows and is immersed in their discipline, the more they will sound like a member of that community of practice – what this research also demonstrates is that there is a reverse influence. Understanding the discursive practices of a community and the rationale for those practices can positively influence a student’s understanding of the practical applications (i.e., research methods, epistemological orientations) of the discipline. The discursive identities of the women in this study, as reflected in their speech and text, were deeply entwined with their embodiment of the kind of scientist they saw themselves as and working toward becoming –
evidenced by two of the three women choosing external summer projects that would broaden their scientific repertoire rather than focus it.

**The Role of Societal Markers in Discursive Identity Development**

In this final chapter, I have intentionally given the questions related to societal markers (gender, ethnicity, socioeconomic class, etc.) their own section because what has stood out consistently in this research is the power of the program site. As a Minority- and Hispanic-Serving Institution, with a highly diverse faculty in terms of ethnicity, gender, and language, the issues of representation seemed to become moot – each student felt a sense of affinity with the institution and program. As Amrita asserted in a late-stage interview when I asked if ethnicity or gender ever came up as an issue or discussion point:

I think it's lucky that we're in a school like [this]. I think [it] probably has one of the most, like, diverse, you know, [faculty], .... I think actually [diversity] becomes somewhat of an issue when students are applying to outside graduate programs or … I don't know about jobs, but graduate programs are like... From what I hear like it's rare for a student from [LUPC] to be accepted into like Harvard, Yale, or you know one of those [Ivy] colleges. Similarly, Natalia was deeply aware of the unique situation she was in attending LUPC: “It’s pretty cool because usually, you would think, like, ‘minorities in college, that’s really hard...difficult to find. But at [LUPC], it’s like, ‘Not really’!” She allowed herself to just be in a space “where everyone is different.” At the same time, however, Natalia was not naïve. On more than one occasion she wondered about some of the programs, including PURS, which focus on increasing diversity in STEM: “Just me being Hispanic, you know, just being a minority – I just have that intuition. Like, ‘Oh, is it because I’m Hispanic [that I got this opportunity]?’ So, you’re thinking twice about it. And it’s awful.” She felt guilt at being able to apply for summer
programs that friends who were not “considered a minority” were ineligible for: “Am I getting something just because I’m a minority and they want to show, like, ‘Our percentages for minorities are getting higher!’” This critical awareness, interestingly, translated into her dedication to my research. At some point in every conversation we had, Natalia would comment about how excited she was to be part of this project that would “help students like [her]” in the future – to improve science education for students of color and women. Though she was excited to see how her own growth as a writer would play out, she seemed more excited about the implications for the research. Importantly, the social climate during this period had palpable effects on her advocacy and dedication to science, as well. She saw the results of the 2016 presidential election as “pretty much supporting white male supremacy” and anti-science, and though she feared for her safety as a Latina and her career opportunities as a scientist, her positive attitude carried her through:

I could drown in fear, but that does not help at all. … What I’ve been thinking about is just, like, I’ve worked so hard or this and someone has to recognize that. And I’m going to keep working hard for this so that – it should happen, at least. And not just for me, because I’m not the only person doing this. There are so many other people trying to get an opportunity to [do] research and [pursue] a career in science.

Because Anne lived what she described as a “sheltered” life – she had never lived away from home, always travelled with family, didn’t participate in too many extracurricular activities until later in her academic career – her conception early on of the demographics of science were relatively naïve. Her placement at LUPC, with its diverse faculty and student body, did nothing to change her ideas that scientific disciplines were anything other than inclusive. This reality came much later, during the summer of 2017, when she left the safety of the college and her
home to participate in an eight-week undergraduate research experience. There, as noted earlier, she was one of 4 Black students out of 50, and housed separately from the rest of the population. At this summer program she also attended weekly seminars discussing ethics and cultural considerations in which she learned for the first time about “health disparities” among racial and economic groups. This exposure ignited an activist flame inside of her. As she wrote in a medical school essay,

   My existence as a woman of colour in a white, male dominated field only fuels my passion to be a successful doctor and has motivated me to not only try my best every step of the way but also to become a role model, not only for my mom, but for women who have an innate appreciation for science and higher-level education, but feel intimidated for any reason.

   Attempting to parse the influence of societal markers from the data proved to be methodologically difficult – after all, how can I definitively attribute Anne’s lack of cultural capital to any one thing. She was a high-performing student academically, but at the same time was unaware of what Meijer’s expectations were and, as such, struggled to successfully navigate that undergraduate research experience. She was aware of racial and gender disparities in society loosely, but not in science specifically, and (like the other women) did not experience issues related to this at the college. She was deeply religious, but saw forensic pathology as a means to contribute positively to society. What may have had the most influence on her development was the fact that she was a first-generation college student and simply had not inherited resources for navigating academic spaces fully. Though she performed well in classes, this was only one context for performance and the ways of being, thinking, and communicating did not translate across borders. Anne had not had enough exposure to understand that different contexts demand
different approaches, and because of this her discursive identity development in science was restricted.

Natalia was also a first-generation college student. However, she credited her high school experience as providing her with the capital (my words) she needed to understand not just the differences between disciplinary writing, but also the epistemological differences between disciplines. That knowledge assisted her in navigating the collegiate space in a manner similar to Amrita, who had both a rigorous high school experience and a family with strong academic orientations.

By the time data collection concluded for this dissertation, all three women were acutely aware of their unique positioning as women of color in science. All three women, also, had incorporated this positioning into the type of scientist they are working toward becoming – one that draws on their uniqueness, and one that critiques hierarchies that may work to suppress them. For Anne, this has translated into wanting to work in low-income communities and communities of color, as well as serving as a role model for others. For Amrita, this means pursuing a degree in public health so that she can work toward eradicating disease and improving quality of life for those less fortunate. For Natalia, this has transformed into both contributing to our understanding of what it means to be a woman of color in science (through this research), but also to a future as a forensic toxicologist and immunologist. Because these individual women are only in the early stages of their career path, their discursive identity development is likewise in transition. Yet, as I believe has been shown, it is already becoming uniquely defined in part because of appropriate fit with mentors, explicit rhetorical teaching, and regular exposure to disciplinary genres and discourse conventions.
Conclusion

Anne, Amrita, and Natalia’s stories are far from over, and our understanding of what factors may prove important in mediating their discursive identity development as female scientists of color is still incomplete. The research presented in this dissertation is only one small part of their larger experiences. Still, I do believe that it gives us as educators – both within writing studies and disciplinary arenas – more insight into the ways we can make our classrooms and laboratories more inclusive.

First, we should be mindful of meeting students where they are, as well as being mindful of our own assumptions and preconceived ideas about who these students are and what they are capable of. No two students are identical, and generalizing based on race/ethnicity, socioeconomic status, or gender is harmful. What seemed critical in this research with regard to how students transitioned through their experiences and developed discursive identities was the strong influence of how student participants positioned themselves (consciously or not) and how they were positioned by others. Preconceived ideas both of what they believed themselves capable of and what others believed them capable of influenced the power various push- and pull-factors had on their transition from outsider to insider. This is where positioning theory and intersectionality make strong contributions to writing studies scholarship and pedagogy. Some students – such as Amrita – while being a woman and a person of color, will possess the power and agency to advocate for themselves in academic and professional contexts, while others (like Anne) will not recognize that there is power or agency to wield. We must be careful of not viewing the success of one as evidence that all can succeed; positioning students within hierarchies of potential through the recognition of some identities (i.e., gender or ethnicity) may unintentionally mask other identities that influence academic performance (i.e., socioeconomic
class and prior schooling influences). Viewing these case studies through the lens of positioning theory and intersectionality allows us to see that writing (and discourse) instruction is more than about teaching students to take a linguistic stance – it is about taking on an identity as a particular kind of member within the community.

The second consideration that has risen from this research is that we should work toward educating non-writing specialists how their respective discipline’s epistemological and ideological views are reified in text and speech so that, together, we can make these transparent to newcomers. This involves disciplinary instructors becoming, if not experts, proficient in the rhetorical conventions and genres of their discipline. In my opinion, this is one of the next big challenges the WAC/WID community faces. Deeper scholarship into working across epistemological and ontological divides is needed, as is preparing junior scholars (particularly those likely to serve as supervisors) in the underpinnings of their discipline’s discourse. In that way, when they are in a position of power (as a laboratory supervisor or new professor), they adopt strategies such as Dr. Bianchi’s and Mary’s to make the disciplinary discourse accessible to as many students as possible.

Finally, when designing programs to assist underrepresented individuals, particularly those that include mentoring, we need to remember that not all mentors are appropriate for all students. What represents “good mentoring” for one student can be highly detrimental to another. Though undergraduate research experiences are highly beneficial to students from all backgrounds, simply placing a student in a laboratory and expecting them to learn the ways of being, thinking, and knowing in that discipline is unfair and serves to further marginalize students who do not possess the cultural capital of the White, middle-class. At the writing of this final chapter, I have just submitted a co-authored proposal to the National Science Foundation
that aims to study the impact of such program modifications on student scientific identity. Modifications to PURS include diversity and inclusion workshops, as well as writing workshops, for faculty; a requirement that new students complete a learning preference self-evaluation, which is used in interviewing student researchers in laboratories of interest; and the development of a science writing tutoring initiative as part of a new bridge program aimed at partner community colleges. The aims of these modifications are to improve faculty awareness of the unique opportunities and needs a highly diverse student population bring to the teaching of science, improved pairing between mentors and students to ensure fit, and early exposure and improved access to disciplinary discourse (through reading and writing instruction).

In conclusion, Hispanic- and Minority-serving institutions – though typically underfunded – have enormous potential to diversify the STEM workforce if the educational experience at such institutions considers the various intersectional identities its students bring to the institution. At the same time, Predominantly White Institutions also have a responsibility in considering how the identities of their students intersects with curriculum. As I noted in my introduction to this research, if we as a nation are truly interested in increasing the number of women and minorities not simply studying, but also working in STEM disciplines, we must critically examine the conditions of schooling for all so that we are not unintentionally excluding, and also obscuring, areas ripe for reform.
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Appendix A: Student and Mentor Consent Forms

Student Consent to Participation

You are invited to be part of an ongoing case study of students participating in PURS. The purpose of this study is to gather insight into the reading and writing practices and experiences of students during their time in the Program and how that helps in your development of a scientific identity. If you decide to participate, you will be asked to consent to two interviews – one at the start of the semester and one at the end – of approximately 90 minutes in length. You will also be asked to share writing that you do as part of the Program (for example, lab reports, posters, and research proposals). Participation in other elements, such as a reading exercise, are optional.

There are no foreseeable risks or harms associated with your participation. While you may not receive a direct benefit from participating, you may find sharing your college experiences to be a valuable experience. Also, what you have to say may impact the way reading and writing instruction in the sciences is designed and delivered to students both at [LUPC] and nationally. The information collected in this research may be published in the educational and composition studies literature, however anonymity of all participants will be maintained.

Your participation in this study is completely voluntary. If you decide to participate, you may discontinue participation at any time. You may refuse to answer any specific questions at any time during the interviews. Withdrawal or refusing to answer specific questions will not affect you in any way.

All interviews will be audio recorded for transcription purposes and to validate the answers to questions. Your name and personal information will not be recorded and you will be provided an opportunity to review the interview transcripts for accuracy. All materials (interviews, writing samples, etc.) collected as part of the study will be coded on receipt to maintain anonymity; the codes will be kept in a separate location. The recorded material will be encrypted and kept in an offline location.

Your signature below means that you have read this consent form, that you fully understand the nature of your participation, and that you have had all questions regarding participation answered satisfactorily. If you have further questions about this research, please feel free to contact Principal Investigator Heather Falconer at hfalconer@XXXXXX.edu or h.falconer@neu.edu.

If you have any questions regarding your rights as a research participant, please feel free to contact the LUPC Institutional Review Board Office at XXXX@jjay.cuny.edu, or (212) 237-8961.

_________________________          _______________________
Participant Name                  Participant Signature

_________________________          _______________________
Principal Investigator/Research Staff Date
Faculty and Staff Consent to Participation

You are invited to be part of an ongoing case study of students participating in PURS. The purpose of this study is to gather insight into the reading and writing practices and experiences of students during their time in the Program and how that contributes to students’ scientific identity. If you decide to participate, you will be asked to consent to two interviews – one at the start of the semester and one at the end – of approximately 90 minutes in length. You will also be asked to share comments that you make on work students do as part of the Program (for example, posters and research proposals). Participation in other elements, such as a direct observation in the laboratory or lab meetings, are optional.

There are no foreseeable risks or harms associated with your participation. While you may not receive a direct benefit from participating, you may find sharing your experiences as an educator to be a valuable experience. Also, what you have to say may impact the way reading and writing instruction in the sciences is designed and delivered to students both at [LUPC] and nationally. The information collected in this research may be published in the educational and composition studies literature, however anonymity of all participants will be maintained.

Your participation in this study is completely voluntary. If you decide to participate, you may discontinue participation at any time. You may refuse to answer any specific questions at any time during the interviews. Withdrawal or refusing to answer specific questions will not affect you in any way. Your participation in this study cannot in any way be used for performance evaluation.

All interviews will be audio recorded for transcription purposes and to validate the answers to questions. Your name and personal information will not be recorded and you will be provided an opportunity to review the interview transcripts for accuracy. All materials (interviews, writing samples, etc.) collected as part of the study will be coded to maintain anonymity; the codes will be kept in a separate location. The recorded material will be encrypted and kept in an offline location. The Principal Investigator (Heather Falconer) will be the only individual with access to codes.

Your signature below means that you have read this consent form, that you fully understand the nature of your participation, and that you have had all questions regarding participation answered satisfactorily. If you have further questions about this research, please feel free to contact Principal Investigator Heather Falconer at hfalconer@XXXXXX.edu or h.falconer@neu.edu.

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_________________________  _______________________
Participant Name        Participant Signature

_________________________  _______________________
Principal Investigator/Research Staff  Date
Appendix B: Student Interview Question Guide

**NB:** Semi-structured qualitative interviews are not meant to be prescriptive or rigid. They require the interviewer to ask open-ended questions in an effort to generate conversation; subsequent questions result from that conversation specifically. While the questions that follow are specific in focus, they are merely a guide for the discussion. The Interviewer (Heather Falconer) will allow the conversation to diverge from these questions provided that the conversation remains relevant to the project. Should the conversation diverge too far afield, the Interviewer will return to the questions listed below in an effort to focus the conversation.

Student interview questions – Semester 1:

Demographics

1. Name
2. Class-standing
3. Major/Track and research area
4. Ethnicity (self-identify)
5. Gender
6. First language (spoken at home)
7. Primary language for reading, writing, and speaking

Brief overview of the project – what is the purpose of the research, why PURS, what possible benefits are there to the rest of the world.
Start-of-Semester

1. Tell me about how you came to study science.
   
a. High school: You self-identified as ____________. Was your high school ethnic demographic similar?

2. Do you have scientists in your family?

3. Why did you choose [LUPC]?

4. Have you done any science-related internships or non-[LUPC] activities?

5. Do you have ideas, yet, about what you’d like to do after you graduate from JJC? (Grad school? Job? What kind of program/job?)

6. What brought you to PURS?

7. How would you describe the “culture” of PURS and your laboratory in particular)? How does this compare with the “culture” of your disciplinary area (professionally, outside of PURS)?

8. To what degree do you fell the knowledge you bring to the lab is used (such as life experience, knowledge from coursework, unique perspective)? Valued? Does it feel inclusive and welcoming?

9. Can you tell me about the Research Training Workshop? What kinds of things did it cover? What was that experience like for you?

10. Tell me about your mentor.

   a. How did you connect with him/her?

   b. What was important to you in that selection?

   c. What are they like personality-wise?

   d. What kind of scientist do you view her/him as?
e. Do you feel like you made a good choice with your lab and mentor? Why/why not?

11. Before you came to [LUPC], what types of reading and writing did you do? (for school, for fun…)

12. Do you *like* to write? Do you *like* to read? What sorts of things interest you?

13. Have you had classes here at the College that involved significant writing?
   a. Which classes have they been?
   b. Describe how they were significant.

14. How do your reading and writing experiences at [LUPC] compare to what you did before?

15. You said you had/had not done scientific writing before. What kind of writing and speaking do you imagine professionals in your field do?
   a. What types of scientific writing are you familiar with (scientific articles, posters, lab reports, etc.)?
   b. Have you read these? Written them?

16. What do you see the role of the scientist when writing? What about reading? What should/do you look for when reading scientific papers, for example?

17. So you’ve just started/completed your first semester – how was it overall?

18. You had to write a proposal to receive funding, right?
   a. Had you done any scientific writing before?
      i. In what context?
      ii. Describe the writing process.
   b. What was the proposal writing process like?
      i. How did you approach it?
      ii. What was MENTOR’s role in the writing?
c. How did the research process and end result turn out in comparison to that proposal? How do you feel about that?

d. Was the writing segment in the research training course helpful in that proposal process? How so/not?

19. Did you review scientific literature for the proposal? What did that look like?
   a. Did MENTOR tell you what to read, etc?
   b. Did you take notes? How/what kind?

20. How did the reading and writing you did in the laboratory compare with what you’ve done in the past? Did you read or write materials that were new to you?
   a. What strategies did you use to do that reading and/or writing?
   b. Are these strategies you have used before?
   c. Where did you learn them?

21. What relationship, if any, do you see between writing/speaking and the way scientists think and/or conduct research?

22. What are your expectations for writing and reading in your undergraduate research experience this coming semester?

23. Do you see those experiences as being the same as what professionals do? How so/not?

24. Do you consider yourself a scientist? How so/not?

25. Did you find yourself using social media, like Twitter, in relation to your work or experiences in the laboratory? If so, what hashtag(s) did you use?
**Questions for semester 2 onward:**

1. Thinking about the research proposal – why do you think the program requires students to write these?

2. Of the articles that you have read in class of for lab, what percentage would you guess are by men? Do you have a sense of what gender or ethnicity authors are? Why/Why not?

3. What have you heard back from others (teachers, parents, mentors, etc.) about yourself as a writer? As a speaker? As a reader?

4. What do you think makes a “good” writer? A “good” science writer?

5. What do you think makes a piece of writing good? Scientific writing?

6. How does your family feel about science as a field/career for you?

7. What tensions, if any, have you experienced between the culture of your upbringing and the culture of science?

8. What were some of the most difficult experiences you had when you first entered the college/PURS (as well as the years following)?

9. What were some of the most pleasurable experiences you had when you first entered the college/PURS (as well as the years following)?

10. Is the scientific life what you expected? If not, how has it differed? Did you know what to expect? How?

11. What are the most rewarding aspects of your scientific life? Most frustrating? How do you think these correspond (or not) to your personal life?

12. What relationships in your life have changed as a result of becoming a scientist? What’s the nature of these changed relationships?

13. What other changes have you experienced as a result of your achievements?
14. What does it mean to be a “good scientist”? How well do you fit with this description?

15. Has your understanding of what is valued or understood as constituting a good scientist changed over time? If so, can you point to any key events or factors affecting this shift?

16. Are there any parts of yourself that you put away or keep hidden in your personal relationships?

   In your scientific work relationships?

17. What do you want others to know about your experience as a woman in science? As a woman of color?
Appendix C: Coding Schema

*Positive Identity Association.* In coding for this category the speaker must self-select as part of a group – professional, cultural, or social. Generalizations about groups as being *other* than the speaker are not coded. The following are examples that qualify:

Internal
- Refers to themselves as a member of a group: “As a scientist, I think …”
- Describes self as owning particular traits: “I’ve always been a bookworm.”
- Discusses moving *toward* an identity: “The program is helping me become…”

External
- Refers to someone else putting them in a group: “My advisor said that for students like me this won’t be a challenge.”
- Imposed traits from outside: “My teacher called me an ‘advanced reader’.”
- Implied from outside that speaker is moving *toward* an identity: “My mentor says that my research will help graduate schools see…”

*Negative Identity Association.* In coding for this category the speaker must self-select as *not being* part of a group – professional, cultural, or social. The following are examples that qualify:

Internal
- Refers to themselves an outsider to a group: “Many of the non-PURS students don’t …”
- Describes self as *not* owning particular traits: “I’ve never been a go-getter,” or “I’m not a bug person.”
• Discusses moving away from an identity: “I’ll earn my masters degree, but I’m not interested in the PhD…”

External

• Refers to someone else putting them in a negative group: “My advisor said that for students like me it will be a huge challenge.”

• Imposed traits from outside: “My teacher called me an ‘struggling reader’.”

• Implied from outside that speaker is moving away from an identity: “My mentor says that I’m not thinking like a scientist.”

Genre Awareness. In coding for this category the speaker must be speaking specifically about forms of writing, whether or not they use the term “genre.” Areas where they are discussing writing in a general sense are not coded (see Writing Process). The following are some examples that qualify:

• Discusses specific genres: “I wrote an abstract for the conference …”

• Discusses structure of genre: “There is always an introduction, methods…”

• Discusses purpose of a particular form of writing: “The lab notebooks need to be very detailed…”

Accurate – subcategory where speakers are accurately discussing the genre according to the discourse conventions of science. E.g., “Papers tend to have an IMRaD structure.”

Inaccurate – subcategory where speakers are inaccurately discussing the genre according to the discourse conventions of science. E.g., “The abstract is just a summary.”
Writing Process. In coding for this category the speaker must be speaking specifically about the ways in which they approach writing, what strategies they use, and/or what challenges they face as writers. Discussions of forms of writing are not coded (see Genre Awareness). The following are some examples that qualify:

- Discusses specific experiences: “I started with an outline of the article …”
- Discusses revision processes: “I tend to just write everything I’m thinking down…” or “My mentor asked me to be more specific about measurements, so…”
- Discusses feelings about writing/revising: “I have to psych myself up to write the first draft…”

Current – for experiences as a student in the laboratory or in current coursework.

Prior – for experiences before coming to college or in pre-PURS coursework.

Mentor Involvement. In coding for this category the speaker must be speaking specifically about their mentor’s involvement in their learning (positive, negative, or neutral). The following are some examples that qualify:

- Discusses specific experiences: “He/she walked me through the procedure once …”
- Discusses writing involvement: “He/she basically ripped my proposal apart.”
- Discusses feelings about mentor role: “He/she kind of leaves us to figure it out on our own, which can be stressful.”

Mentor expectations. In coding for this category the speaker must be speaking specifically about their mentor’s expectations (positive, negative, or neutral). The following are some examples that qualify:
• Discusses specific experiences: “He/she asked a lot of questions, so I had to be prepared …”

• Discusses writing/reading expectations: “He/she gave me a template and told me to edit it to include my project details.”

• Discusses feelings about mentor expectations: “He/she expects me to work on this one part and that’s it. I don’t get to help out or really learn about the larger project.”

Quotes. Text that is poignant and has the potential to be used as a quote.
## Appendix D: Organizational Structure of PURS

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<thead>
<tr>
<th>PURS</th>
<th>Criminal Justice Academy (community college)</th>
<th>Junior Scholars Program (1st &amp; 2nd year LUPC)</th>
<th>Undergraduate Research (3rd through 5th LUPC)</th>
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<tr>
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<td>Academic advising for CC students in For. Sci.</td>
<td>Special events and outings</td>
<td>Support for professional conferences</td>
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<td>Mentored research (un-funded)</td>
<td>Post-graduate preparation</td>
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<td>Mentored research (funded)</td>
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<td>Research supplies and equipment for mentors</td>
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<td>Reimbursement for exam fees (MCAT, SAT, etc.)</td>
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