Chapter 4. Performing Race and Gender in Science

In the previous chapter, I explored how White Institutional Presence (WIP) impacts instructor ideologies and pedagogy and the impacts this has on student experiences. I also began to explore how student orientations to research spaces in the PRISM program affected engagement with texts and impacted how and what students wrote. In this chapter, I build on that work to examine performativity in greater depth by focusing the lens more specifically on linguistic and physical speech acts.

In his book *Performativity,* James Loxley (2007) summarizes Austin's seminal theory of speech acts, which highlights the ways in which what we say (our utterances) can become performative. As Loxley put it,

> Words do something in the world, something that is not just a matter of generating consequences, like persuading or amusing or alarming an audience. The promises, assertions, bets, threats and thanks that we offer one another are not this kind of action. . . .they are actions *in themselves*, actions of a distinctively linguistic kind. They are "performed," like other actions, or take place, like other worldly events, and thus make a difference in the world; it could be said that they produce a different world, even if only for a single speaker and a single addressee. (p. 2)

In other words, how we perform language and behavior and enact habits of mind mark our place in communities within a hierarchy of belonging, because to be recognized as a member of a community requires features that mark people as belonging *here* and not *there.* "Learning," Lave and Wenger (1991) wrote, "implies becoming a different person with regard to the possibilities enabled by these systems of learning" (p. 53); it "changes who we are and creates personal histories of becoming in the context of our communities" (Wenger, 1998). Speech acts function to position individuals within institutional spaces. They enact rules and norms for behavior and language, with tangible consequences for breaking those rules and norms (Butler, 1997), and create storylines (Bonilla-Silva, 2018, p. 97) that tell us who is welcome in these spaces.

I begin this chapter with a discussion of speech acts and positioning theory, drawing heavily on Austin (1975), Searle (1969), and Harré (2009), to explain how language creates and maintains institutional spaces. This includes an examination of how this process works in STEM disciplines, with an emphasis on the physical sciences. The primary focus of the chapter, however, is to illustrate what these forces look like in practice. Drawing on the experiences of the participants in this study, I show how speech acts can create an institutional space of inclusivity

or can further marginalize (through microaggressions), marking individuals as members of the disciplinary community or not.

Speech Acts, Institutions, and Systems of Oppression

According to Austin (1975), every speech act has three parts: the locution (the phrase or sentence that has meaning and structure; the grammatical and syntactical elements), the illocution (the intention of the speaker), and the perlocution (the "uptake"; how the listener receives the statement; its effect on the listener). If I say the sentence, "Open the door for the dogs," the locution is the order of the words in the sentence to create meaning (stating, "Dogs door the open for," makes no grammatical sense), the illocution is my intent (I want the listener to physically open the door for the dogs), and the perlocution is how the listener hears my sentence (as a demand, as a request, as a suggestion, etc.). The speech act is successful for the speaker if the listener opens the door for the dog, regardless of how the listener feels about it.

Deeper still, Austin (1975) noted that there are multiple types of speech acts, which Searle (1969) expanded on and complicated. There are assertives (Austin called these constatives) that describe or report conditions or states of being. The statement, "There are no clouds in the sky today," constitutes an assertive. It is a statement that can be investigated and tested, proven true or false. Directives are those speech acts that command orders and make requests (i.e., the statement, "Open the door for the dogs, please.") Commissives encompass promises and the swearing to do something, as in the statement, "I promise that I will clean the kitchen tonight," (which leaves room for me to break that promise, if I so desire). Expressives articulate our feelings toward another or a situation, including congratulations and apologies. And declarations, Searle's final category, bring things into existence by the very nature of the utterance. In the context of a wedding, the statement, "I now pronounce you. . . ," by the officiant legally binds two individuals into a marriage contract. Telling a supervisor, "I quit," terminates an employer-employee relationship.

Speech act theory recognizes the role of speaker and hearer in the execution of an utterance and recognizes that each speech act comes with specific rights and duties. Who is allowed to speak and when? What authority does the speaker hold within a given context? In a marriage ceremony, the officiant holds the power to declare a marriage complete. A wedding guest, standing in the same place and uttering the same words, does not carry the power to seal the compact. Similarly, telling a stranger on the street, "I quit," in the absence of your supervisor does not mean you are now unemployed. Performative speech acts only work if the right person utters them and the right person recognizes them. (We all know there are times when we might pretend *not* to hear something, in which case we can pretend that it did not happen!) Convention, then, is important because it defines context-dependent elements—within the context of *this* space, with *these* actors, the speech act is performed successfully (even if it could be accomplished in a

different way, with different actors, in a different space). As such, there are rules that govern what is allowed and not allowed within specific contexts.

Within PRISM, for example, students must follow a specific format for research proposals; a template is provided by the program with guidance on what content should be presented in each subsection of the document. A student is not allowed to submit a proposal without the sponsorship of a laboratory and the signature of their mentor, and they are expected to meet the linguistic expectations of their field (adopting the language and jargon appropriately). A failure to meet these rules means that, as we saw with Anne in Chapter 3, proposals are returned for revision and, in some cases, not funded.

In his work on positioning theory, Harré (2009) notes that the forces of speech acts and the positions the speaker and listener (and writer and reader) occupy are *themselves* embedded in storylines that are being lived by actors at any point in time. Adopting or being assigned a position in an interaction has an immediate effect on the way speech acts are interpreted and internalized. There is a difference, for example, between the sentence "Girls are terrible at science" being uttered by a casual stranger on the street and by a faculty member in a classroom because of the differences in authority that each individual holds; for the listeners, there is a difference in the perlocution (the uptake) between the students within that classroom who identify as girls and those who identify otherwise. Similarly, there is a difference between a friend reading your proposal and noting grammar issues and a faculty mentor circling all those errors in red pen. One does not have the power to fail you, while the other does, and you may feel their judgements quite differently.

The storylines individuals are raised with are assertions of possible futures. These assertions act on the world on an individual-by-individual level. If people are told throughout their entire lives—by teachers, books, public messaging—that girls do not grow up to be scientists, then these assertions create storylines by which people will view the world. These individual messages accumulate over time to regulate the parameters of an institution. In this way, speech acts present "institutional facts" (Searle, 1969) that create meaning for expected patterns of behavior and communicative norms. They create an ontology through which members of the community view the world and regulate both how the community members behave and how things are done in the community (Searle, 1969). Speech acts regulate bodies performing within the space.

It is important to pause, here, to apply a critical lens and recognize that intentionality is not a driving factor in the impact of the speech act as it is perceived by the listener. Whether someone *meant* to imply that another person did not belong, was attempting to police behavior, and so on, is irrelevant. The force on the listener—the listener's *felt experience*—is the speech act coming to fruition. These differences between how a speech act is perceived by a speaker and how it is perceived by a listener is one of the ways in which biases are enabled broadly in society. The reality of multiple perspectives contributing to interpretation can be distressing to many when discussing microaggressions (particularly related to race and gender)

because it suggests that one is "damned if you do, damned if you don't." An individual may make what seems to them to be a harmless comment based on their own cultural background and experiences and, in the process, offend or harm another who does not share that same orientation. For some, such a realization could result in a throwing up of hands and a "why bother?" attitude. Recognizing that intentionality does not matter, though, can be liberating because it means that people can focus instead on the ways that social norms, disciplinary expectations, and discourses reify patriarchy, White supremacy, and classism systemically and work to do better. It provides an opportunity for people to critique and modify.

In today's U.S. society, it is widely understood that to comment on another person's physical appearance (clothing, weight, beauty, etc.) can be construed as inappropriate, depending on the context and speaker. Similarly, most understand that using racist, gendered, or ablest jokes or analogies can offend—to the degree that one may lose a job over such comments. These are not the kinds of speech-acts-as-microaggressions I examine in this chapter (though they certainly occur regularly enough in academic spaces). Instead, I look at ways behaviors, languages, social norms, and more are gendered, White-washed, and classist and how they have been institutionalized in a way that makes them hard to be seen *as* problematic unless looking at both the immediate effects of the interchange and the long term, cumulative effect of such acts.

Positioning theory recognizes the power of speech acts. In every context there are things that one is capable of doing or saying and things that one is permitted or forbidden to do. (The experiences of Anne and Madalyn in Dr. Meijer's laboratory, discussed in Chapter 3, are excellent examples of this.) These two elements of being capable and being allowed dictate what people *actually* say or do. How a speech act is understood depends on the power dynamics at play: It is an intersection of speaker, listener, and storyline because adopting or being assigned a position within an interaction has an immediate effect on the way speech acts are interpreted (United Nations University, 2015). As Butler (1997) notes, performativity "works itself out through the body: 'social conventions' can be seen as animating the bodies, which, in turn, reproduce and ritualize those conventions as practices" (p. 155). Speech acts are not simply creations in the mind of the hearer—they are actualized institutionally through vectors of oppression and privilege and have very real physical consequences (Butler, 1997; Crenshaw, 1991).

Performativity of "Scientist"

In 1975, Margaret Mead and Rhoda Métraux asked high school students in the US to draw what they saw in their mind when they heard the word "scientist." The composite result was telling:

> The scientist is a man who wears a white coat and works in a
> laboratory. He is elderly or middle aged and wears glasses . . .

> he may wear a beard . . . he is surrounded by equipment: test
> tubes, Bunsen burners, flasks and bottles, a jungle gym of blown
> glass tubes and weird machines with dials . . . he writes neatly in
> black notebooks . . . . One day he may straighten up and shout:
> "I've found it! I've found it!" . . . Through his work people will
> have new and better products . . . he has to keep dangerous
> secrets . . . his work may be dangerous . . . he is always reading
> a book. (pp. 386–387)

To see if this "man of knowledge," Einstein-like stereotype persisted over time, David Wade Chambers (1983) expanded on this study to ask nearly 5,000 young children (in the second and third grades) over the course of 11 years to "draw a scientist." The results were consistent with Mead and Métraux's (1975) findings. The standard image students created included a lab coat, eyeglasses, facial growth of hair, symbols of research and knowledge (e.g., beakers, books), technology, and captions to illustrate discovery (e.g., word bubble with "Eureka!"). Only 28 of the children in Chambers' (1983) study (0.6 percent) drew a female scientist.

Since then, other researchers have replicated the "draw-a-scientist test" in various contexts. In 2018, David I. Miller and his colleagues published a meta-analysis of scholarship that had used this model to illustrate if and what had changed over time. Drawing on 78 studies (involving over 20,000 children cumulatively), their work shows that, though children's representations of "scientist" have become more gender diverse, they "still associate science with men as they grow older" (p. 1943). The meta-analysis identified that

> girls on average drew 30% of scientists as male at age 6 (early elementary school. . .). However, girls switched to drawing more male than female scientists between the ages of 10 and 11 (fifth grade; end of elementary school). By age 16 (high school), girls on average drew 75% of scientists as male. In contrast, for boys, the mean percentage of male scientists changed from 83% to 98% between ages 6 and 16. . . . (p. 1950)

Considering these representations from the perspective of speech act theory, what is the received message (perlocution) of such images? Laboratory coats, typically white, function as protection, but they also represent purity, sterility, and *objectivity.* They reinforce the ontology that anyone, at any time, can don the coat, repeat the experiment, and gain the same results, so the individual behind the work is not relevant to the knowledge discovered. Such an ontology also necessitates a lack of emotion and humanity. Eyeglasses send a message of both intelligence and intense focus. Beards are often associated with wisdom and knowledge (i.e., King Arthur's Merlin) but also rigor—as Mead and Métraux (1975) note, scientists are seen as working long and unusual hours and beards can be seen as "deviation from the accepted way of life" (p. 388). Whiteness of skin and male-ness

are illustrative of authority and origins of knowledge. Taken together, this common representation of "scientist" is that of a middle-to-old-age White man with exceptional innate intelligence who works alone in the lab for long periods of time and performs secretive, complicated tasks. If we laminate onto this his use of jargon-heavy, technical language, the "scientist" becomes someone whom only an elite group of people can become.

The question that arises, then, is what happens when individuals who do not fit this mold attempt to become part of the scientific community? The simple answer is that they are positioned as deviants. Elaine Seymour and Nancy M. Hewitt (1997) demonstrated in their three-year study of women and other underrepresented groups in science that attrition from STEM disciplines is a direct result of masculine norms and values (e.g., placing students in direct competition with one another, unfriendly professors, "weed out" courses). As they explain,

> We posit that entry to freshman courses in science, mathematics or engineering suddenly makes explicit, and then heightens, what is actually a long-standing divergence in the socialization experiences of young men and women. . . of all ethnicities [who] are entering an educational system which has evolved to support the ongoing socialization of only one group—namely, white males. (pp. 258-259)

Those who persist in STEM education are considered an exception to the norm (even tokenized) and typically adopt the language and behaviors of the dominant group. Yet, even if seen as an exception, such individuals are not necessarily welcomed.

In their study of 15 women of color, Heidi B. Carlone and Angela Johnson (2007) noted that performance was a critical dimension of scientific identity: "One cannot pull off being a particular kind of person (enacting a particular identity) unless one makes visible to (*performs for*) others one's *competence* in relevant practices, and, in response, others *recognize* one's performance as credible" (p. 1190). One must do the right things, in the right ways, in the right contexts, in order to be seen by others as belonging to the group—often with a higher performance threshold for visibility. Such restraints mean that, for women and BIPOC, they cannot develop just *any* kind of scientific identity; they need to align with the "larger and more pervasive meanings of 'science people' derived from sociohistorical legacies of science" (Carlone & Johnson, 2007, p. 1192), and they must do so perfectly and exceptionally. To demonstrate anything that does not align with those sociohistorical legacies marks one as problematic and may lead to microaggressions (Pierce, 1974) from dominant groups. Many of those in their study who pushed against dominant constraints

> felt overlooked, neglected, or discriminated against by meaningful others within science . . . they felt that established mem-

bers of their science departments recognized them not as science people but, instead, as representatives of stigmatized groups. They perceived that their behaviors, or even just their appearance, triggered racial, ethnic or gender recognitions that overwhelmed their chances of being recognized as good science students. (Carlone & Johnson, 2007, p. 1202)

In what follows, I examine how performative aspects of race and gender in science disciplines impacted student participants' experiences in undergraduate research, both within PRISM as well as in external summer programs. Importantly, I will examine the ways "the subtle, mini assault" of racism and sexism (Pierce, 1974, p. 516) plays out in scientific spaces and its subsequent effect on participants' self-concept.

Microaggressions in Academic Spaces

Though John Jay and PRISM actively highlighted the multicultural nature of the institution (including publishing program documents in both English and Spanish), microaggressions that functioned on the interpersonal level still existed. The term "microaggression" was coined by Chester M. Pierce in 1974 to describe the subtle, everyday oppressions BIPOC experience and its definition has since been extended to encompass oppressions based on gender, sexual orientation, and other considerations. Important to recognize is that microaggressions are not the conscious, overt forms of racism often thought of when discussing inequity (e.g., police brutality or marching in the street with Tiki torches). Rather, microaggressions are the internalized, systemic, unconscious verbal and physical cues that tell individuals that they do not belong. Similarly, the prefix "micro" does not correlate to impact, as the felt impact of such aggressions can be enormous. Some of the myriad ways microaggressions materialize in STEM education and in other educational spaces include positive discrimination narratives, practitioner identity work (e.g., having to reaffirm expertise), the use of male pronouns or diminutives to describe scientists as a group (e.g., nerds), higher performance thresholds for visibility, tokenization, and the organization of physical spaces (e.g., the exclusion of artifacts that represent racial or gendered groups). Microaggressions erode confidence over time; they are layered assaults that accumulate and take a toll on the physiological, psychological, and academic aspects of the receiver (Pierce, 1974; Sue, 2010).

Despite John Jay's status as a HSI and MSI, many of the students in this study experienced positive discrimination narratives in the pursuit of academic and professional growth opportunities. On more than one occasion, Natalia—a high-achieving Latinx woman—wondered aloud about some of the programs, including PRISM, that focus on increasing diversity in STEM. For example, she said, "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!'" Though Natalia's academic achievements were more than enough evidence of her competence, she had internalized a feeling that her accomplishments were tainted by institutional desires to "perform" equity and inclusion.

Both John Jay and PRISM made active efforts to highlight the diversity both in the institution in general and in its STEM disciplines in particular so as to help students feel included and not tokenized. Yet, such representation does not mean that it was not sometimes seen as a marketing trope. When discussing representation, for example, Madalyn (a White woman) noted how posters hanging throughout John Jay and her department highlighted a wide variety of ethnicities and genders. "I think that the school is very enthusiastic about minority students in the sciences," she explained. She continued,

> They're the ones that get their pictures on the posters and on the website and stuff like that. The high-achieving minority students—and that's great. I feel like it's something that's coming from the administration. It's just diversity, diversity, diversity.

Though well meaning, Madalyn's description of these marketing activities revealed two things: that the experience of these promotional materials felt somewhat contrived and that she saw these individuals as exceptions (showing only the "high-achieving minority" students). Madalyn's articulation of the purpose of these promotional materials serves as an excellent example of what Sue et al. (2007) define as "microinsults," microaggressions that include "subtle snubs, frequently unknown to the perpetrator, but [that] clearly convey a hidden insulting message" (p. 274). Though Madalyn's expression of bias was unintentional, it nevertheless was there and had the potential to cause harm.

Despite John Jay's and PRISM's outward-facing marketing approaches, inclusion within laboratory spaces was not always actualized. Anne, for example, was allowed to observe in the laboratory during her first semester of undergraduate research. Her explicit role was to watch what other students were doing and help them accomplish their goals. While this role was described as part of the apprenticeship model, it nevertheless conveyed to Anne, an anxious, young Black woman, that she was not capable or trustworthy enough to engage in even the most entry-level research activities—particularly because other students (like Madalyn) who entered PRISM in the same cohort and who joined the same laboratory were given far more responsibility and autonomy. Though Anne made formal appointments with her mentor to discuss next steps on creating her own research project, as Anne put it, "every time I would make an appointment, something would come up and the appointment would get [canceled]." Anne often

described tasks her mentor gave her as things "to keep me busy" rather than as things to help her learn. Even when her own research began, Anne found herself frequently being taken off her project to work on other people's research. Cumulatively, these experiences in the first year of undergraduate research conveyed to Anne that her value in the laboratory was considerably less than others'. Her value was in helping others accomplish their goals, not in pursuing goals of her own.

Amrita's first experience in undergraduate research was similar. Prior to joining Dr. Bianchi's laboratory, she was in another that was heavily chemistry-based, and her faculty mentor at that time 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 Anne's. 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. Though she never stated so explicitly, 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.

These two laboratory experiences represent what is often justified as simply the way in which science works—the apprenticeship model described by Lave and Wenger (1991). In this model, students enter a space as novices. Through time and exposure, they pick up the procedural knowledge, discourse conventions, and habits of mind embedded in the disciplinary space and, ultimately, move toward becoming experts in the field. Yet, how this apprenticeship experience is enacted has significant consequences on the student. Natalia, Ruben, and (eventually) Amrita had very different experiences than those described by the traditional apprenticeship model precisely because of the orientation to science that their mentors held.

When Natalia met with her mentor, Dr. Bianchi, to discuss working with her in undergraduate research, Natalia described Dr. Bianchi as "so willing to tell me about the projects and what's going on." The interaction she described was one full of both enthusiasm and transparency. Dr. Bianchi made clear to Natalia that this was a hands-on learning process and that she was not expected to know much as she entered the experience but that she would be provided all of the tools and resources she would need to be successful. These included pairing Natalia with a peer mentor, providing a variety of resources on the research that was taking place in the laboratory already, meeting with her regularly to discuss readings and procedures, and working side-by-side in the lab to show Natalia what the techniques she read about looked like in practice. Natalia was engaged in her own research activities from the start, helping her to build confidence and autonomy as a researcher. Amrita experienced the same incorporation into the laboratory

when she left her first URE and started working with Dr. Bianchi. One critical aspect of both women's experience was that issues of gender equity in science were never hidden, which was important for Natalia given her early orientation to race and gender inequity in STEM disciplines in high school. Toward the later period of both women's UREs, Dr. Bianchi became pregnant, and she modeled positively what balancing family and a career in science could look like.

Though both Natalia and Amrita understood the rigor that scientific research entails, it was eye-opening for each of them to see how an established female scientist could juggle the demands of pregnancy and family life with the work of the laboratory. For Natalia, this was a critical experience. She and her fiancé had begun talking about their future plans and their mutual desire to have a large family. Doubt as to whether she could be both an attentive mother and a scientist had crept into Natalia's mind over time, and she worried that the two were mutually exclusive. Seeing someone she respected model the balance showed her a possible future for herself. Because this balance was sometimes messy, Natalia was also reminded that science is a human endeavor and that humans are not always perfect.

Ruben's experience was similar to Natalia's and Amrita's. His mentor, Dr. Martinez, created a scaffolded entry into the URE that allowed Ruben to be involved from the very beginning. She provided readings, met regularly to speak with him about the texts, offered guidelines for note-taking, and gave hands-on instruction within the laboratory. Importantly, as a native Spanish speaker, she and Ruben conversed regularly in both Spanish and English. The language affinity he shared with his mentor was important to Ruben when he joined Dr. Martinez's laboratory because it was a point of connection. Even though their ethnicities were different, they shared a language. In both laboratories, students were made to feel welcome. The masculinized, competitive nature of science was set to the side in favor of helping students feel welcome and capable. Students in these spaces were acculturating to science, not assimilating—both their home cultures and lived experiences *and* the culture of science were embraced.

From Inside to Outside the College

In addition to engaging in undergraduate research at John Jay, many students in PRISM are encouraged during the summer months to pursue internships and other research opportunities outside the institution. Such additional experiences can build exposure to the field while also making students more competitive for graduate programs and employment opportunities. As a result of feeling marginalized within her URE, Anne opted to seek external opportunities to build her resume and research experience during both the academic year and the summer months. In addition to working alongside a fetal pathologist who helped her feel more competent as a scientist (for a detailed description, see Falconer, 2019a), she pursued summer research opportunities at a variety of institutions.

In the spring before her final year, Anne was accepted into a summer URE at a prestigious college of medicine in the city. Of the 50 students participating in the program, though, only four of them (including Anne) were Black, which led to her feeling tokenized in a direct way. All of the Black students were women, and the three living on campus were housed separately from the other students in a different building. When I asked if anyone commented on this, Anne laughed and said, "I was like, hmmm. . . I think they planned this." Anne decided she would not complain because the arrangements afforded the women more breathing room—but the physical isolation marked them as "special." They were admitted into the program but physically separated from the other 46 participants. In their more intimate, private space away from the other students, Anne and her peers were able to speak about their experiences in the summer program candidly. Her roommate was paired in the laboratory 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 was fortunate, unlike her roommate, in that she was paired with two female researchers who were supportive and understanding. On her first day, she was introduced to a variety of research projects and given a week to select the one in which she was most interested. By default, her selection of a project paired her with the doctoral student who would serve as her 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." By creating an inclusive space where Anne was able to choose a project that seemed interesting to her and by making clear that Anne was both welcome in the lab and belonged in the space, Mary fostered an environment that meant Anne felt comfortable owning her agency.

In her first visit to Mary's lab, Anne noticed a sticky note on the computer that simply said, "Do complement." When Anne 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. 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" means and was struck by the ease and sophistication of her explanation

in comparison to projects she had done with both Dr. Meijer and Dr. Brennan (the fetal pathologist):

> 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 her tongue with ease. I noticed, too, that her posture was different. She held herself taller, seemed more poised, and did not 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 said, "She was *very* patient with me." First, Mary asked Anne to write her own protocol, including the Methods section. 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." Mary discussed with Anne the places where more specificity was needed and offered guidance in revision (suggesting alternative language, for example). 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 was responsible for caring for and growing over the summer: "She showed me what [the healthy cells] looked like, she showed me what they look like when they're infected. . . . And everybody was so nice to me."

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 4.1. In this excerpt, which is representative of the poster as a whole, it is clear that Anne had 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 immediately introduced the significance of the research, both on an individual and global level (how the virus presents in human bodies versus the prevalence of the virus internationally). The introduction continued with more specificity about the project itself and the mechanisms Anne's work investigated. Throughout, she fluidly balanced disciplinary jargon with explanations of how the mechanisms worked, ensuring that her varied audience would at the very least understand the gist of the work if not the work in depth.

A second interesting element of the poster was Anne's decision to present the Methods section as a visual, rather than as the typical numbered list. Figure 4.2 shows the sequence of steps in a diagram that Anne included in the poster. Again, Anne met multiple audiences while still addressing the rhetorical situation effectively. Short descriptions of each step were included beneath each phase of the protocol, succinctly describing what took place, and her careful use of directional arrows and simple imagery helped the reader *see* how the complement serum affected viral cells.

When speaking about her experience with the poster—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—she embodied the role of scientific researcher with ease. Anne noted that PRISM's program coordinator wanted her to attend the Annual Biomedical Research Conference for Minority Students (ABRCMS; now the Annual Biomedical Research Conference for Minoritized Scientists) in the coming fall. When I asked if she wanted to attend, 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.[8] She had no interest in presenting the poster she had done for Dr. Meijer's laboratory because she was embarrassed about how little she had contributed to that project.

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8. Anne submitted her summer research abstract to ABRCMS for consideration and was accepted to present her poster at that year's conference.

Introduction

Situates the research appropriately

Herpes simplex virus infection is a major global health problem. HSV-1 and HSV-2 cause painful recurrent oral and genital lesions and establish latency in the sensory neurons of the host. HSV type 1 is more commonly associated with oral mucocutaneous lesions whereas HSV type 2 is more commonly associated with genital lesions and is linked to the HIV epidemic. According to the World Health Organization, in 2015 two-thirds of the world's population under the age of fifty were infected with HSV-1 and over 400 million people with HSV-2, with its highest prevalence (70%) in sub-Saharan African women. Despite the large HSV infection burden, no successful subunit vaccines have been developed. The Herold and Jacobs laboratories collaboratively developed a novel live, single-cycle HSV candidate vaccine, by deleting glycoprotein D (gD) on the viral envelope, a protein necessary for viral entry into host cells. This vaccine, designated HSV-2 ΔgD, protects against both HSV-1 and HSV-2 infection in mice and guinea pigs. Protection is mediated by antibodies capable of inducing antibody-dependent cell-mediated cytotoxicity (ADCC) through activation of the murine FcγRIV. However, in contrast to other vaccines that have been tested in the clinic but failed to protect, ΔgD elicits very low levels of neutralizing antibodies in vitro.[1,2] These neutralization studies were conducted with heat-activated serum without the addition of additional complement.

Identifies the novelty and significance of the project

Succinctly explains how vaccine works

Complement-dependent cell lysis and complement-dependent neutralization are other antibody-dependent mechanisms by which the immune system might protect against infections. Complement proteins interact with the Fc component of antibodies to elicit a cascade of protein interactions that ultimately result in the formation of a membrane attack complex (MAC), a protein complex that lyses an infected cell through the formation of pores in the membrane[3]. In complement-dependent neutralization, complement proteins interact with neutralizing antibodies preventing viral entry into the cell. We sought to determine the role of complement in the function of antibodies generated by ΔgD vaccination – both in terms of direct lysis of infected cells and to investigate whether neutralization activity of HSV-2 ΔgD immune serum would be enhanced in the presence of complement. We hypothesized that complement would enhance both infected cell lysis and neutralization mediated by ΔgD immune sera. A dose-responsive increase in percent cell death was observed upon the addition of complement in the complement-dependent cell lysis experiment and, though not definitive, preliminary results of the complement-dependent neutralization assay suggest that complement might increase the neutralizing ability of the antibodies. These results suggest that the activation of complement by antibodies generated HSV-2 ΔgD immune serum help mediate cell death in the complement-dependent cell lysis, and enhance neutralization activity in complement-dependent neutralization.

Utilizes appropriate disciplinary jargon

Hypothesis clearly stated
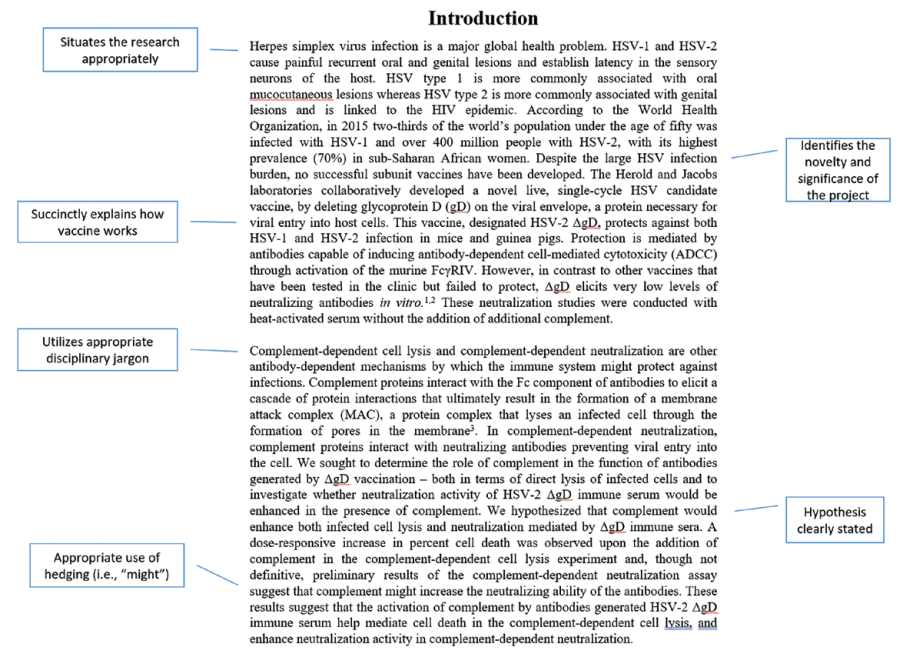
Appropriate use of hedging (i.e., "might")

Figure 4.1. The introductory section to Anne's summer research poster. This poster was written exclusively by Anne with minimal edits from her mentor, Mary.

Methods

Complement-Dependent Cell Lysis

Vero cells were allowed to grow to confluency overnight → Cell were infected with HSV2 SD90 → Immune or control mouse serum was added to the infected cells → 11 µL rabbit complement was then added to infected cell + serum mixture → Cell death was measured using an Lactate Dehydrogenase Assay

Complement-Dependent Neutralization

Mouse serum dilutions were prepared → Complement was added to mouse serum → Virus was added to complement + mouse serum mixture → Vero cells were allowed to grow to confluency overnight → Mixture of antibodies, virus and complement was added to cells → Viral Plaques were counted

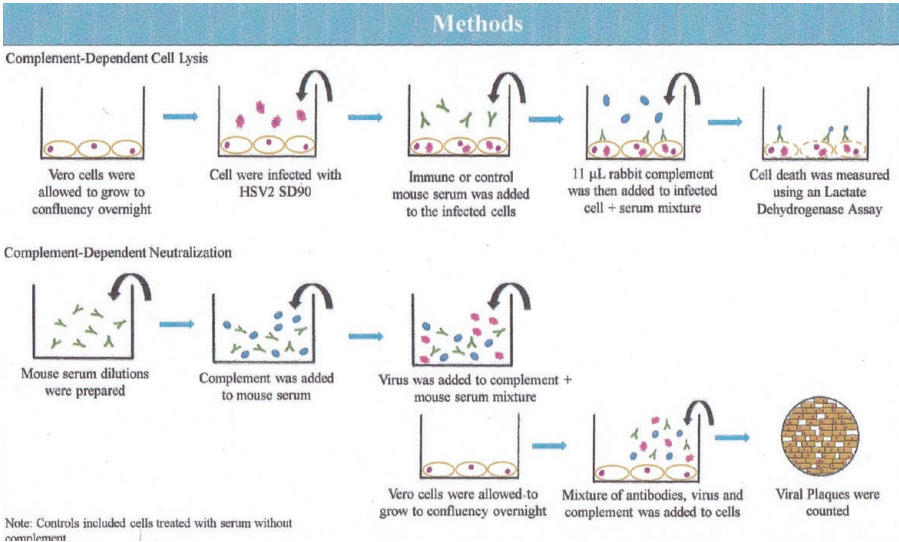Note: Controls included cells treated with serum without complement

Figure 4.2. The method section of Anne's poster. This section was constructed as a visual, rather than as a textual list, which assisted readers in quickly understanding the protocol Anne followed in the project.

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 and then given room to explore them on her own (as Mary had provided). She did not want to have to chase after someone for information or supplies or feel like a scheduled meeting would be canceled at the last minute (or forgotten entirely, which had happened with Dr. Meijer enough times to make Anne cautious). "If I have a question, I'm not scared to ask—but [Dr. Meijer] won't reply for two weeks and by then I've forgotten what I asked," and because of this, she found, the work moved in fits and starts and increased her frustration and her feeling of incompetence.

Two poignant moments stand out as representative of how strong mentor fit contributed to Anne's development and performance as a scientist. After completing her research for Mary and presenting at the poster session, Anne's understanding of the work she had done was complemented by Mary, who Anne reported said, "We were watching you speak and you were so fluid. You *know* the research." And then later, Anne reported, while Anne was eating cake that Mary had made as part of a send-off party, Mary said, "How does it feel to be a scientist?" The second moment occurred 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.

Self-Efficacy, Social Factors, and Persistence

People's levels of self-efficacy, as Albert Bandura (1997) defined and described, are reflections of how much they believe in their own ability to control their motivation, behavior, and social environment. How people see themselves—how they *position* themselves—and the storylines they believe influence the ways in which they experience given moments and contexts and are predictors of how much energy they might be willing to expend to reach their goals. In the US, the "build-yourself-up-from-the-bootstraps" storyline has effectively ingrained institutions with White meritocratic discourse. If people work hard enough, *if* they put the time and labor in, *then* their just rewards will come. This discourse, however, makes invisible systemic barriers related to class, gender, and race. For example, practices such as school districting and the funding of public schools, which make funds available based on the district's socioeconomic resources (e.g., taxes), disproportionately affect BIPOC communities and have impacts on school resources, public services, and more.

When examining the impacts of race and gender performativity in institutional spaces, it is challenging to parse where learning disruptions occur because of racism, because of sexism, because of classism, or because of something entirely different. Yet, it is precisely this invisibility and elusiveness that allows systemic inequalities to persist and why taking an intersectional approach is important to the dismantling of these oppressions. In most instances, vectors of oppression rarely operate in isolation; they intersect to create added layers of oppression onto some individuals and mask oppression for others. For example, because socioeconomic class and race are so intricately tied in the US, when educational inequity is noticed along racial lines, it is explained away as something else because low-income White people experience similar challenges.

These oppressions are hidden when students enter college classrooms. Educators do not know what the students' educational backgrounds are; they can only know that the students performed well enough to arrive in the educators' spaces. Thus, the narrative of "grit" continues, assuming everyone to be on a level playing field—as the story goes, if you show up and put the time in, you will succeed. However, individuals' understanding of cultural norms and expectations strongly influences how they interact with others and build personal and professional connections, and their self-efficacy within specific contexts (i.e., science) can also impact their persistence and retention despite academic performance. Kyle M. Whitcomb and coauthors (2020) noted in their study of engineering students that self-efficacy was not necessarily correlated with grades—women often reported having lower levels of self-efficacy despite high performance. Doing well in a discipline does not necessarily correlate with feeling like a member of the discipline. Drawing on self-reported data, in this section I expand on that discussion to incorporate self-efficacy, showing how it intersected with social factors and influenced engagement with scientific discourse.

As discussed in Chapter 2, Ruben chose to pursue a science-related career based partly on altruistic reasons—he wanted to "be useful"—and partly because he saw the field as ripe with economic and personal opportunity. Similarly, he enrolled in PRISM because he saw it as helping him reach his end goals of acquiring a master's degree and finding solid employment. Despite these ambitions, Ruben had doubts about his ability to do the transactional and discursive work of the laboratory. He reported that he "was afraid at the beginning" because he was intimidated by math and science at the advanced level. In reading scientific articles for his first review of the literature, he noted that "the words and the instruments are challenging," that his notebook was "a mess," and that he felt like "a beginner scientist." This sense of self at the start of undergraduate research is not uncommon and not noteworthy in itself. Almost all students in this study reported being nervous as they approached the research aspect of their discipline for the first time. What is worth paying attention to is if and how Ruben's sense of self changed with exposure over time, what factors played roles in any change, and whether there were similar trajectories within the reading and writing practices of the lab.

As Ruben engaged in undergraduate research (typically five hours per week), he interacted not only with his mentor but also with other student researchers in the laboratory. From these peers, he learned how to organize his notebook so that "everything is in order and [it follows] the steps of the procedure that we're doing." In his reading practices, though, he struggled in that first year to make sense of the texts, often getting lost in terminology and methods. Like many students engaging with difficult texts for the first time, he grabbed onto the parts that made sense to him—mostly descriptions of methods that were familiar from lab work—and glossed over the rest. It became clear in my discussions with his mentor about this early period of time that coursework had not prepared Ruben for the ways in which scientists find and mentally engage with knowledge. Though his mentor noted repeatedly in our discussions that so much of scientific research is *reading,* Ruben had not quite grasped this after the first year. "He had no idea," his mentor explained, describing his unfamiliarity with the search engine PubMed or how to find and read relevant academic articles.

I have written elsewhere in detail about the impact of this mentoring relationship on Ruben's scientific writing (Falconer, 2019b) as well as about how faculty and family expectations effected Ruben's discursive development (Falconer, in press). What I wish to focus on here is not how Ruben's mentor guided him through his reading and writing practices but on his self-efficacy as a scientist and how that impacted his performativity as an undergraduate researcher and his engagement with scientific writing. Despite starting undergraduate research with enthusiasm, Ruben's engagement with the laboratory work slowly and steadily faded over the course of the three academic years covered in this study. This was in part because of the multiple demands placed on him from within and outside of John Jay (family, work, coursework, etc.), partly to unforeseen hurdles, and partly because the pace of research was much slower than he had expected.

In our first discussion, Ruben talked excitedly about how, if his research project worked, he and his mentor would write and submit a journal article about the project (three months later). That did not happen; in fact, the work took longer than expected and had a change in trajectory partway through. The research in the lab shifted toward an extraction method that another student had developed. At the end of the first complete year of research, Ruben's energy level had dropped considerably. When I asked how he juggled all of the different commitments, he let out an audible sigh and said, "Yeah, I mean—I just have to do it. It's hard, but it's okay. I've survived so far, so I can't just quit now." In reflecting on his academic progress, Ruben was proud of himself, noting how his hard work, "hours of studying and studying, practice and practice" had helped him achieve things he previously thought he would "never be able" to do. But his enthusiasm for his research and schooling was very low, and he declared himself still "a beginner scientist."

When discussing WIP, racism, sexism, etc., it is easy to default to discussions of harm or inequality as the result of overt bias (the lead scientist who claims that

all women cry in his lab, for example, or the instructor who asks the only Black or Latinx student in the class to discuss their experience with race). What Ruben's experience helps us bring to light are the ways in which WIP can impact students so subtly that it looks like something other than what it is. Like slowly chipping away at a stone, the small disruptions, personal expense, and extra labor that Ruben experienced on his journey began to wear him down. Though he could mark the ways in which he was growing as a scientist and as a scientific writer, his momentum was slowing and, with it, his commitment to and engagement with the discipline. By the middle of his second year in undergraduate research, Ruben was already discussing how, after he graduated, he would take time away from school and work in construction to earn "some decent pay." When asked if he would consider a degree beyond the master's, he replied with an emphatic, "No! I'm already too old for a PhD. I can't any more." He simply wanted to finish, work in "a clean setting," and earn a decent wage. Compounding this situation was the reality that Ruben's immigration status was in flux. A DREAMer[9], he came to the US at the age of ten and, *18 years later*, he was still trying to finalize his citizenship status. "That's one of the things that is holding me down, you know?" he explained. "It's part of it, you know, because at the same time this thing has motivated me to get an education and be useful to society. But I'm not a US citizen and this puts a halt on my movement."

About this time, Ruben's mentor had also noticed a significant "attitude shift" that was concerning her. He had seemingly disengaged from the laboratory, missing meetings, not showing up during the week, and being mentally absent. His discursive work was also showing a lack of commitment—by her account, he seemed not to be reading as much and not retaining as much of what he read. This is not to say that his awareness of the skills needed to conduct research had faded away, only that he seemed to be taking the path of least resistance toward completion. After some probing about why he was seemingly less engaged, Ruben disclosed to me that he found out he needed to take one class more than he thought he needed to meet graduation requirements, which meant an additional semester that he had to pay for out of pocket. He also had started to look at job opportunities and was feeling disheartened. His goal was to work in a toxicology laboratory, but after reviewing job announcements and talking with hiring managers, he learned that, in New York State, an additional "medical laboratory license" was required, a license that a BS in forensic science did not qualify him for. By his description, this license required an entirely separate degree that entailed at least 15 months of full-time academic work and research. Though he did have an academic advisor, that person seemed to have missed the fact that Ruben's

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9.   The Development, Relief, and Education for Alien Minors Act, known as the DREAM Act, provides temporary residency for minors who are illegal immigrants in the United States. If the individuals meet certain qualifications later, they can apply for permanent residency.

schedule and the degree requirements were not aligned as well as the fact that the degree would not help him achieve the goals he set out for himself. Combined with the questioning of allegiances he received from work colleagues and family, Ruben felt defeated.

The White meritocratic storyline that Ruben had entered his academic career with—that if you work hard enough, you can achieve anything and that race and economic background did not matter if you cared enough—ran headlong into a different storyline. Working hard can only get you so far. Without guidance along the way to help you chart your course and navigate obstacles, you can quickly find yourself in lands you had not planned on visiting. Without financial and academic support, the exhaustion of tightened budgets and extra labor can induce a level of exhaustion that is hard to overcome on your own and can sap energy away from learning new things. And these hurdles—this exhaustion and frustration, this extra labor that disproportionately effects underrepresented minorities in STEM education—can cause you to withdraw, to pull away from the very thing you intended to do.

Conversely, when students have a reprieve from these outside burdens, there are opportunities to thrive. Amrita's second proposal was simply a resubmission of her first without edits or addendum. This allowed her to continue her research into the summer. A more significant third proposal came in the fall of 2016, after she spent the first part of the summer completing her data collection on her first project and then participating in a study abroad experience with a nongovernmental 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 was not sure what her fall project would actually be, only that Dr. Bianchi had offered her a place as part of a team on a more substantial endeavor that 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 had 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).

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

> 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 and public health nongovernmental organizations—as well as 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 to cell and molecular biology so that she could avoid taking the extra courses required of forensic science 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 her first project, taking classes, and simultaneously doing an internship with a local hospital while trying to work with her 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 used in insect reproduction), 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 her first proposal than the earlier; Amrita was successfully engaging with the genre of the proposal on this second major attempt, and the amount of editing by her mentor was noticeably low. Most of the mentor comments and edits focused on areas where Amrita could add some content and additional citations (e.g., "Put in a statement about the importance of visual cues"; "There are some studies on [cues] to cite in your

intro"). 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 [our field] 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 both to build her understanding of 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 without changes, and 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 a 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 looking over their shoulders. Though not explicitly stated, this freedom positioned Amrita as a scientist at a level higher than is typically thought of 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. She continued,

> 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 conducted 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. When Amrita and I spoke, Dr. Bianchi was 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 did not 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* her knowledge in a way that the other team members 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, and they were influenced not only by the laboratory but also by her writing-intensive biochemistry course (taught by another faculty mentor who embraced explicit instruction). This course required full-length laboratory reports each week, and though there was no variability in the genre requirements, the reports 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

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 Amrita 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 presentation of her results. In her 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 the conventions of IMRaD; however, she implemented that format for a much broader audience than she usually wrote for—forensic scientists in general. In the first draft of the presentation, Amrita opened with an orientation to her sub-discipline, situating its place in forensic science as a whole and explaining the use of the specific organism used in estimating post-mortem interval. This was an important rhetorical move because the sub-discipline is relatively new (approximately 40 years old) and is greeted with suspect by the multiple disciplinary communities it straddles. Amrita also included in her introduction information about variables that affect organism behavior, which is a critical factor in the research she was conducting. She followed this introduction with a discussion of the materials and methodology used, which incorporated appropriate specifics, such as species and trademark names, as well as the research protocol. Finally, she focused the bulk of the presentation 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 images—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 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 also on the points Amrita should be sure to talk about—the organization of 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.

Considerations and Applications

Systems of oppression—patriarchy, White supremacy, classism—become invisible and evasive in their institutionalization, which allows them to persist. Because of this invisibility and evasiveness, it becomes easy for minoritized individuals to internalize barriers to success as the result of deficits within themselves: If the system tells me that I do not belong, if I cannot successfully navigate the labyrinth, then I must not belong here. Yet, it is the systems themselves that are problematic and require closer critique.

In this chapter, I have examined the ways in which the URE participants embodied speech acts through performativity. I have shown how small acts of indifference and "the way we do things in science" can manifest as microaggressions that make minoritized individuals feel unwelcome. Anne's experience illustrates the importance of meeting students where they are and of recognizing the value their diverse experiences bring to our educational spaces, even when gaps persist. Ruben's case highlights how an individual is likely to not engage with or learn a new discourse if they do not see it as being part of themselves or as something that aligns with their future. Amrita's story shows us how students can flourish when they adopt the disciplinary community as their own and have the resources and support to pursue their research without added burdens.

As faculty members working with women and BIPOC students in STEM disciplines, it is critical that we unpack what it means to successfully perform as a member of the discipline in both behavior and discourse. Quite often, as faculty members we uphold structures and policies that have been handed down to us without actively asking why they exist, who they serve, and whether they are truly necessary for the advancement of our disciplinary work. One direct, actionable way of enacting such questioning is to adapt the antiracist writing assessment framework that Inoue and Poe (2020) offer so that we ask similar questions of our disciplines and educational spaces:

- What do we think constitutes a "good scientist"? What does a good scientist look like? Why does a good scientist look like that? Is there space for difference?
- What are your goals for the students participating in your classroom or laboratory? Are they reasonable? Do they account for the extra labor and additional responsibilities students may have to juggle?
- How do the ways in which you interact with and assess those students reflect your goals? Are those practices equitable? Are they causing microaggressions?
- How do the backgrounds and experiences of students in your classroom or laboratory differ from your own? Are you making unfair assumptions about them?

- How are you positioning students within your classroom or laboratory space? What messaging are you providing about whether or not they belong?
- What are the power dynamics of the space? How are you including students as knowledge-makers and individuals with power?
- Who is represented in your learning space? Who is visible in texts, theory, and physical representations?
- What products do you expect your students to be able to produce? At what level?

To counteract the daily microaggressions students may experience, it is critical that faculty members offer *microinclusions*: moments that tell students that they *do* belong, that their perspectives and cultures and discourses have an important place within disciplinary spaces. But that work cannot be successfully done without active reflection and conscious, authentic moves to recognize difference as a value-added component to educational spaces. To be inclusive and accountable, faculty members need to confront the frictions that cause resistance to change—whether the frictions be psychological, physical, or ontological.

At the beginning of Chapter 3, I introduced the idea that undergraduate research experiences serve as a "third space" where students' home discourses and sociocultural orientations and those of the mentors' come in contact with one another in important ways. In the next chapter, I examine the ways in which inclusive program structure and pedagogy was enacted within some PRISM spaces to move toward counterspaces. While the program and mentors consistently enacted some disciplinary ways of being and knowing that reinforced systemic bias, they also made moves to disrupt inequity in other ways, creating spaces where mentors and students could safely critique problematic aspects of STEM education.