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Affirmations From "Home": The Role of Relational Counterspaces in the Success of Underrepresented Minority Undergraduates in STEM

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Affirmations From "Home":

The Role of Relational Counterspaces in the Success of

Underrepresented Minority Undergraduates in STEM

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Class of 2022

Thesis presented in partial fulfillment of the requirements for the degree of Bachelor of Arts

Department of Educational Studies

Advisors: Professor Lisa Smulyan, Professor Amy Cheng Vollmer

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Dedication

I would firstly like to dedicate this writing to the Black women that have kept me afloat over the last four years. Their friendship and support have been a counterspace for me when the challenge of being a pre-med biology student and the difficulties that come with being the only Black woman not only in many STEM spaces but in many other spaces on campus felt overwhelming. Special shout-out to my girl Tolu for being amazing and helping me get through chemistry (particularly Orgo 2). Tolu was my unofficial tutor and though no one was paying her, she spent hours making sure that I understood concepts and is probably the biggest reason that I was able to persist in those courses. I want to acknowledge all the Black women in STEM for whom this level of care is a given and for whom collective success is their only measure of success. You are wonderful and deserve recognition and rest!

Secondly, I would like to dedicate this to all the students who face systemic oppression daily - the queer students, the DACAmented/Undocumented students, the FLI students, in addition to the racial minorities I discuss here who are struggling to persist in STEM. I won't tell you to just keep going because that is not what I want for you most. What I hope for you, is that you will choose yourself before you allow anything school-related to steal your joy. Stay committed to the belief that you matter because you exist and not because of the work that you can produce or the value you might have to a capitalist society.

Lastly, I would like to dedicate this thesis to my mother and sister, two very strong-willed women in STEM who have faced challenges in their journey to being where they are today that they have worked hard to overcome. I am grateful to have been able to see my mother, the single parent, immigrant, former high school biology teacher, and registered dietitian get closer

everyday to positively impacting the health of her community. Her commitment to holistic wellness has impacted my pursuit of a health career in many ways and always reminds me that the goal is always to serve with compassion. And I cannot forget my sister, the smarty-pants and chemical engineer who does things that I will never understand. Watching her persist in a challenging STEM field, oftentimes as the only Black student in the room and as a FLI student, has been fulfilling for me.

I realized that it would be cruel to leave my brother out of this just in case he ends up reading this at some point, so I am dedicating this to him as well for being so sure of himself and always voicing his opinions. Future STEM major or not, I hope he and all Black boys hold on to that confidence and let it propel them forward even when the academic spaces they find themselves in look for reasons to push them out.

Acknowledgements

Very big thanks to my thesis advisors Amy Cheng Vollmer and Lisa Smulyan for all their guidance while I was brainstorming and writing this thesis. I am very grateful to have had such caring advisors who always gave me encouragement and were very calm about the whole thing which definitely helped when I was stressing about not knowing where I was going with any of this. Special thanks to Lisa for always offering to get me what I needed to be able to write, whether it be a space, a snack, or a source.

Thank you to my mentor Professor Kathryn Riley for also helping me brainstorm and offering me many helpful suggestions about where to find data and what perspectives I could include during our meetings. Your support of my personal and academic goals over the years has been instrumental to my ability to face challenges with confidence.

Thanks also to Professor Roseann Liu who taught the introductory education course that convinced me that Educational Studies was the major for me and that showed me that the Education Studies department was home to passionate and caring professors. I would also like to thank her for allowing me to be her summer research assistant and giving my first foray into Ed research.

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Why Study Persistence and Attrition in Underrepresented Minorities in College Biology?

When I took my first steps on campus as a freshman, I had no intention of majoring in education at all. I had never seriously considered education as a field of study or as a career I could pursue, but as a product of an inner-city public school system, the aspect of education I had always been attuned to was the inequity in the experiences of students like myself compared to the students of the suburban public schools and the private schools, many of whom would be my classmates in college. When I got to my first STEM (science, technology, engineering, and math) course at Swarthmore, it was glaringly obvious that I would spend the next 4 years being "one of the only" in more ways than one. As a Black, non-male, low-income student of biology, I naturally found myself asking why there were so few people who shared my identities in the courses and the department as a whole. As I processed hearing many of my Black femme peers express that the intro biology courses had killed their joy for the subject and watching some drop the courses and change their academic trajectories, I also found myself balancing my own love for the subject and the reality that, honestly speaking, biology at Swarthmore was not treating me well. It felt like I was always struggling—struggling to understand, struggling to be seen, and ultimately failing to see the justification of my struggle. We could all agree, my friends and I, that things were harder than they should be and we weren't to blame. My decision to pursue biology and education was born of my desire to approach what was clearly a systemic issue from a critical pedagogical perspective. What was it about the structure, the content, the landscape of college biology, Swarthmore biology in particular, that made so many underrepresented students feel the same way?

Coming to the topic of attrition and persistence was born in part of a desire to reflect on my own persistence in biology and what it means to be graduating as a biologist despite feeling distant from that categorization most of the time. However, in a greater sense, the study of attrition and persistence for first-generation/low-income students and students of color is important because in an education system that not too long ago explicitly excluded them, these students continue to face many barriers to academic success. Increasing the representation of these students in STEM fields requires an understanding of the gaps in the resources available to them compared to their majority-group counterparts and taking steps to bridge those gaps. It is especially important to also consider how we as mentors, educators, and stakeholders in STEM fields may be acting in willful negligence when we guide students into traditionally exclusive spaces without ensuring that they will be met with the support needed to effectively navigate them.

In my research for this project, I came across the concept of counterspaces and I was really intrigued by their diversity and their impact as described by underrepresented students themselves. Counterspaces have been described as both physical and ideological spaces that provide safe spaces for underrepresented students to receive academic help, encouragement, assurance, and connect with people of their racial and gender identity. (Ong et al. 209) Some counterspaces such as diversity conferences, and diversity pipeline programs whose goal is to actively recruit underrepresented students into white, male-dominated fields have been well-established and receive support financially. Relational counterspaces or informal counterspaces that function through student-faculty, student-student, and student-alum relationships, however, receive less institutional support. Yet these counterspaces are important to students having sustained support that temporary events and programs may not be able to provide.

For this project, I spoke with two alumni of Swarthmore STEM departments with experience in biology who identified these relational counterspaces as important to their persistence in their fields and thus, these are the counterspaces that I will be focusing on in my discussion of the ways in which we might be able to alleviate common barriers to STEM persistence for URM students. I speak about STEM generally in large part, but I present data and speak about biology specifically as well to highlight my personal experiences in the Swarthmore biology department.
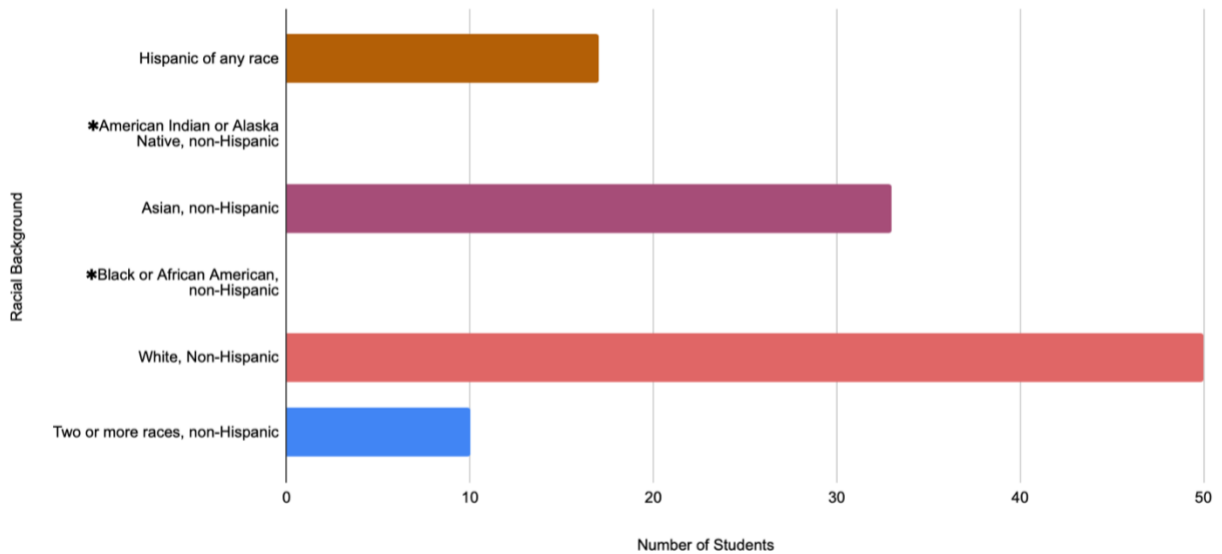
Swarthmore Biology by the Numbers

Fig 1. Number of Students Enrolled in Intro Bio Courses at Swarthmore (2020-2021, 2021-2022 combined)
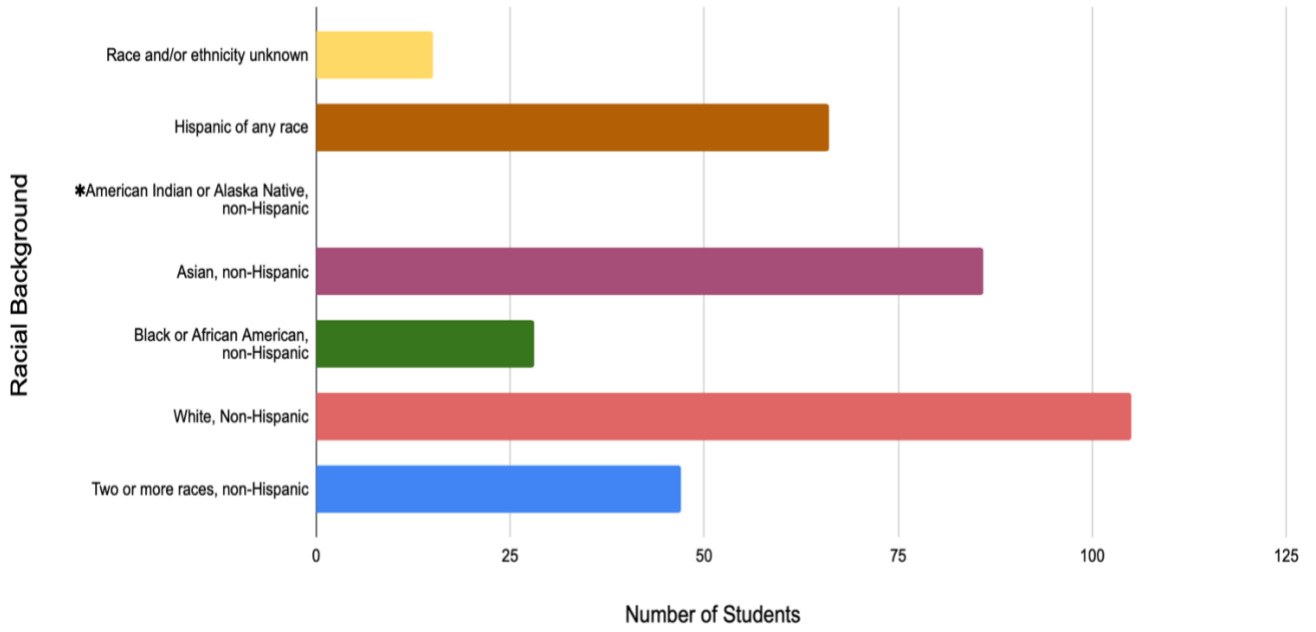
(Asterisk denotes categories for which there were less than 5 students counted.)

Fig 2. Number of Biology Majors at Swarthmore (2020-2021, 2021-2022 combined)

(Asterisks denote categories for which there were less than 5 students counted.)

Fig 3. Biology Degrees Awarded in USA in 2019 by Race/Ethnicity (Data sourced from National Center for Education Statistics, Graphic by DataUSA)
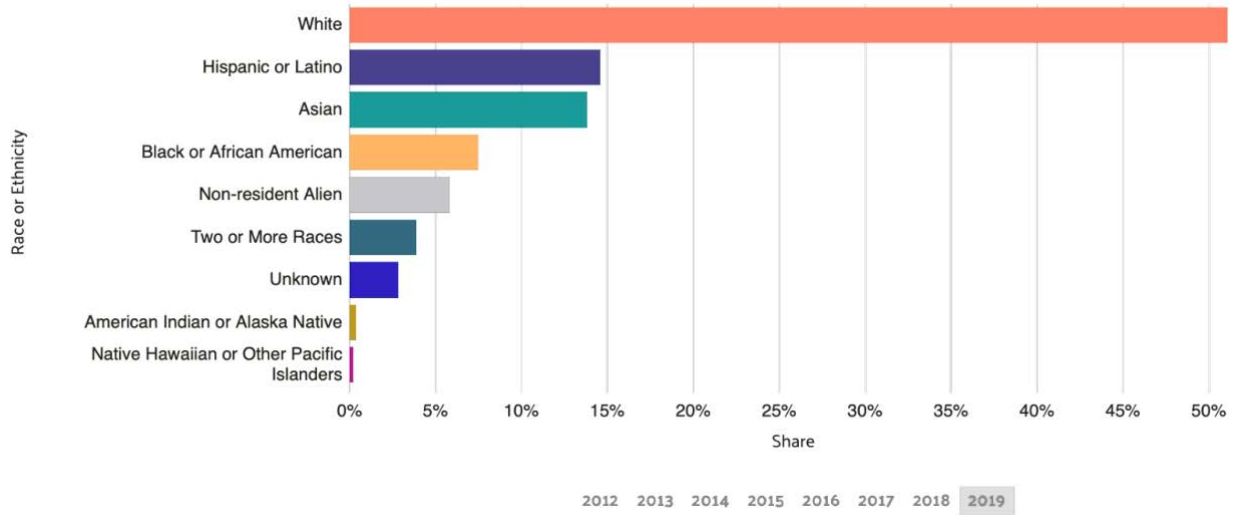
Fig 4. Table of 2021 Swarthmore Graduates by Race (sourced from Office of Institutional Research)

	2021 F	M	Total
American Indian or Alaska Native	1		1
Asian	29	21	50
Black or African American	22	7	29
Hispanics of any race	15	19	34
Nonresident aliens	21	28	49
Race and/or ethnicity unknown	10	11	21
Two or more races	14	13	27
White	67	64	131
Total	179	163	342

Calculations and comparisons

I calculated a range for the values in some of these categories as some racial categories had < 5 students, but the exact number was unknown. I calculated the total number of biology graduates nationally, total number of URM graduates at Swarthmore, etc. twice - the first for the possibility there were 0 students in that category and the second for if there were 4 students. I used those two different totals to give me the range of percentages below.

I am taking majors as a substitute for biology graduates here and assuming both that all students that majored graduated with a biology degree and that the number of biology majors has stayed consistent over the last couple of years.

% of URM bio graduates nationally:

AI - 0.37

Black - 7.5

Hispanic - 15

Asian - 14

% of URM student graduates at Swarthmore:

AI - 0.3

Black - 8.4

Hispanic - 10

Asian - 14.6

% of URM bio majors at Swarthmore:

AI- 0 - 3.2

BLK- 0 - 3.2

Hispanic- 13.6 - 15.4

Asian - 26.4 - 30

White: 40 - 44.2

% of URM bio students in intro classes:

AI: 0 - 1.1

BLK: 8-8.06

Hispanic: 18.8-19

Asian: 24.5-24.8

White: 30 - 30.3

Difference b/w URM intro classes and URM bio majors (URM bio majors-URM intro students):

AI: 0 - +2.1

BLK: -8 - -4.86

Hispanic: -5.2 - -3.6

Asian: -5.2 - +1.9

White: +10 - +13.9

Difference b/w Swat and national bio graduates (Swat - national):

AI: -0.37 - +2.83

BLK: +0.5 - +0.56

Hispanic: -1.4 - 0.4

Asian: +12.4 - +15.4

Difference b/w Swat bio majors and Swat general URM (Swat bio - Swat general)

AI: -0.3 - +2.9

BLK: -8.4 - -5.2

Hispanic: +3.6 - +5.4

Asian: +11.8 - +15.4

Conclusions

This data shows that the Swarthmore biology department graduates about the same percentage of American Indian, Black, and Hispanic students as seen on a national level. Swarthmore biology appears to graduate a significantly larger proportion of Asian students than seen on the national level. Asian students are not typically included in URM statistics, however I decided to include data on Asian students to see if they were underrepresented in a Swat bio specific context. Using the definition of underrepresented that signifies a smaller percentage of a racial group in a place than is found in the general population in the US, it appears that Asian students are not underrepresented at Swarthmore nor the Swarthmore biology department. Asian people are 7% of the general pop. of the US and make up 14.6% of Swarthmore graduates. Additionally, the percentage of Asian students represented in the biology majors is almost 2x that of graduates (26.4 - 30%). Based on the analysis of these percentages, the category of URM as I use it here will not include Asian students. However, I want to acknowledge that Asian students, particularly those that are first-generation and low-income, continue to face systemic and social barriers to entering and feeling included in STEM spaces and the discussion of the role of counterspaces in mediating these struggles very much still apply to these students.

Attrition: The data shows a decrease from the percentages of URM students in Bio 001 and Bio 002 to the percentages of URM students that are bio majors. This trend likely has many contributing factors including the fact that these courses are a requirement for many other majors. However, considering the significant increase in the proportion of white-student majors compared to their proportion in intro classes (~30% to ~40%), there appears to be evidence of URM-specific attrition.

The comparison of the proportions of URM students at Swarthmore and the proportions of URM students in the biology department reveals that Black students are most underrepresented in biology in a Swarthmore-specific context.

I was unable to obtain data for the proportion of URM bio students that are also first-generation and low-income (FLI) due to privacy restrictions. However, from personal observation and knowledge of the background of many of my peers in the department, I know that many of the Black and Hispanic students in the department are also FLI and face a unique set of obstacles at the intersection of those identities.

Barriers to STEM for URM Students

Unbelonging

Important to supporting the persistence of URM students in STEM departments is an understanding of the factors contributing to their decision to leave their fields. For many students, the principal barrier to investment in their fields is a lack of a sense of belonging. This is brought about in part by students' experiences with microaggressions, muted instances of discrimination, and generally negative experiences that make students' feel like social and

intellectual outsiders in their fields. Examples of microaggressive experiences include being excluded from or chosen last for group assignments by peers, being told by peers that their presence in their field is solely due to affirmative action or other diversity initiatives, and being dissuaded or actively discouraged from choosing STEM majors or taking challenging courses within them.(Ong et al. 224, 230) Both the potential for such occurrences and lived experiences can negatively impact how students perceive their belonging in STEM spaces. (Jantzer et al. 6) Naturally, the feeling of danger elicited by an environment in which microaggressions are a possibility hinders a URM student's ability and willingness to receive support from those that are representative of that space, instructors, and administrators and leads to patterns of self-isolation that further contribute to students' perceptions of themselves as outsiders. Furthermore, the impact of these experiences extends to the way that students perceive the value of their intellectual and social contributions to their departments. Students internalize that because their presence as people is questionable, their work and ideas will not be received well or duly acknowledged. Feeling invested in the classroom and social spaces of their STEM departments thereby becomes more difficult as the contributions that should co-constitute the learning space are missing their perspectives.

Processing these experiences and these doubts often requires that students devote more of their mental and emotional energy to the work of redressing harm than their white counterparts, resulting in URM students with less energy to devote to their academic work. Importantly, negative experiences are often processed collectively and stories of similarly identifying URM students often inform how both current and potential URM STEM students perceive their fields and impact their decisions to continue in them or to pursue other fields. For example, as a

freshman I had many stories relayed to me from friends in Bio 001 about their struggles in the course. I learned of how they felt ignored in help sessions, how a professor had declared that they "be more like white men" in a poor attempt to emphasize taking advantage of resources, and how they had received little guidance about expectations throughout the course. These stories made me weary of the course and deterred others.

Previous research has also shown that URM students' perception of themselves as incompetent not only contributes to feelings of unbelonging but also correlates with the fact that these students also receive lower grades in introductory biology courses, a strong indicator of attrition.(Rainey et al. 9) While incompetence would generally be described as the inability to understand relevant concepts and perform tasks that rely on that understanding, what marks incompetence often differs between individuals and students of different identities. For example, for some URM students, what constitutes a grade that demonstrates their incompetence is anything below an A. (Rainey et al. 9) This presents an interesting insight into the way that URM students gauge their success and perhaps also their adherence to the belief that they must be exceptional to be accepted into the STEM world. It is worth noting that even when indicators of preparedness such as ACT math scores are accounted for, URM, first-generation students fare worse compared to non-URM students in introductory biology specifically. This reality is certainly a contributor to their perceived incompetence and supports the conclusion that the differential experiences of URM students within introductory courses and STEM spaces corresponds to lower outcomes in their academic success. The connection between perceived incompetence and feelings of unbelonging become clear when one considers that performing poorly according to traditional and personal standards can make a student question their ability to succeed in a major.

In writing about perceived incompetence and how URM students define it, I am reminded of the immigrant experience - my own and, undoubtedly, the experience of many other immigrants and children of immigrants, many of whom happen to be FLI students as well. URM and URM FLI students tend to hold themselves to a higher standard because of their desire to honor the sacrifices of their parents and to meet the expectations of those parents who themselves have faced barriers to achieving their educational goals. It becomes extremely important to these students that they do well in the majors and fields of work in which they find themselves. As a result, persisting after less than satisfactory grades (however mountainous that may be defined), regardless of interest, interferes with their dedication to the futures of their families and communities. To try and fail could mean taking longer to graduate and subsequently losing earning potential. This topic most definitely belongs to a larger conversation about the harm of ideas such as "Black excellence," model minority status, and general exceptionality discourse about URM students in higher education. Though not the focus of this writing, this is certainly worth discussing within the larger context of how to support URM and FLI students through college generally.

Navigating Science Identity

A western cultural understanding about how science is done that haunts all STEM students and contributes to feelings of unbelonging and incompetence is the "lone genius" conceptualization of the scientist. (Ong et al. 217) Students are taught throughout their education that the scientist is an independent, mad genius with innate intelligence who by happenstance makes world-changing discoveries. Of course, these stories center on the likes of Benjamin Franklin and Isaac Newton, people URM students would struggle to see themselves in. URM students who find

themselves unable to succeed on their own not only perceive themselves as lacking a science identity but also as failures who could not hold up to the core of what it means to be a scientist. It is really an impossible standard many URM STEM students find themselves committed to, as most URM students would agree that they are in deep need of community. For many of them, their being present at colleges like Swarthmore and in historically exclusive fields of study like biology required the effort of a village and a propensity for collaboration is their cultural capital. Addressing this issue requires that we continuously re-emphasize that science is not a one-man band and that it is the person who relies on others and accepts help who makes a good scientist.

Related to my previous discussion of self-perceived incompetence, struggles in building science identity among URM students also stem from students' false belief that their incompetence is being perceived widely by their peers and instructors. Imposter syndrome, or students' belief that they are always at risk of being found out as under-qualified to be in the academic spaces that they are in, often hinders their ability to feel fully included in their STEM departments. Asking for help at office hours or joining a study group feels risky, like others may learn just how much they don't know. This belief is linked to another phenomenon known as stereotype threat, students' fear of reifying negative stereotypes about the inferiority of people of identity categories they belong to by their actions and more specifically by their academic failures. For URM students struggling through imposter syndrome and stereotype threat, the difficulty of academic challenge is exacerbated, and belonging is always out of reach. It is important that students' beliefs in this area are acknowledged as based on lived experience and the historical context of the active exclusion of minorities from STEM and not as the irrational thinking of individuals with low self-esteem. The fact that most URM STEM students have felt like

imposters at one point or another in their academic careers points us away from understanding this issue according to the latter interpretation.

These issues of belonging, science identity, and the beliefs students hold about how they factor into STEM spaces that are yet still lacking adequate representation of people like them are the principal indicators of student's decisions to enter STEM fields of study. (Chelberg and Bosman 40) With the knowledge that the ghosts of the systemic exclusion of STEM students haunt these issues, it then becomes clear that we can also use systemic solutions to address them. At the core of these solutions would be the goal of providing spaces where students are presented with counternarratives that communicate how welcome and well-equipped they are, and successful they can be. At the core of the solutions, I would argue, is counterspaces.

And having said this, the last barrier I wish to discuss as it relates to belonging and cultivating alternative belief frameworks for URM students in STEM is the lack of a critical mass of URM students within STEM departments. URM students often attribute their persistence to a critical or visible mass of students who share their identity in their fields and the supportive interactions that result from it. To be able to see other people of the same background can help to "make the center the margin." (Ong et al. 233)

From the data presented on biology in the previous section, it is quite clear that Black, Hispanic, and American Indian students are not likely to find community and safety through their numbers alone. This necessitates the cultivation of meaningful interpersonal relationships in which students can feel rooted and connected and truly cared for. These barriers illustrate the need for greater emphasis on strong interpersonal relationships that provide students with meaningful

connections within STEM spaces and for greater support for the recruitment and retention of a critical mass of URM students.

An Aside - My Swarthmore Experience with Barriers in STEM

I would argue that URM students are more poised to perceive less than satisfactory academic achievement as gaps in their value rather than gaps in their knowledge. It doesn't help that many of the STEM courses at Swarthmore—the pre-medical pre-requisites in particular— are colloquially understood as, and from my own observation, are effectively weed-out class for students of disadvantaged backgrounds. I think that a large barrier in many of these courses is their structure. Bio 001 and Bio 002 as team-taught courses present a challenge to all students but, I think, to URM and FLI students especially as they often already struggle to navigate asking for help and attending office hours when there is a single professor for the duration of the semester that they can spend time getting to know according to their own comfort. In these large courses in which professors alternate in their lecturing, it is more difficult for students to have the connections that decrease the fear-factor associated with asking for help.

Additionally, a significant barrier is a lack of general awareness amongst students about what resources are available to them. For example, many students never learn that there are free tutoring services through the Office of Academic Success and that to request one does not require that they be failing a course or that they have a certain grade. It is necessary that STEM departments are intentional about making these resources known. Many URM students are also first-generation students who are navigating the college system on their own and this means that they do not take the existence of such resources for granted. To learn about them requires direction from others and that is too often missing at Swarthmore.

Counterspaces - How URM Students Create Networks of Support

<u>What Are Counterspaces?</u>

Counterspaces in STEM are defined as spaces that "lie in the margins, outside of mainstream educational spaces and are occupied by members of non-traditional groups" (Solorzano et al. cited by Ong et al 2018). In essence, they are both ideological and physical spaces that provide students of non-traditional or underrepresented groups with the opportunity to receive support from other URM individuals and engage in community that is safe from the stresses of white-dominated mainstream STEM community, some of which include microaggressions and stereotype threat as discussed previously. The goal of many counterspaces is to give students, especially those at predominately white institutions, the opportunity to experience that critical mass of URM students that is lacking at their institutions but is often so important to the process of building science identity. Such counterspaces include diversity conferences such as the annual convention hosted by the National Society of Black Engineers (NSBE). Students describe these kinds of spaces to be both physical and ideological counterspaces in which their racial identity and science identity are not put at odds and in which they can meet and network with people of their racial background who have reached levels of success in their STEM careers that they aspire to. Additionally, they can immerse themselves in the science and in the scientific language and intellectual challenge of their fields by attending lectures in a space where various academic levels, undergraduate to postgraduate, are represented. These aspects make spaces like these places where students can engage in their fields without the extra weight of being "one of the only" as they are within the contexts of their departments and institutions. Likewise, counterspaces such as non-STEM campus affinity groups, and STEM-related student clubs

function similarly to provide an inclusive social space that may not be found in the standard academic spaces like classrooms.

Dedicated research programs for URM, FLI students interested in STEM similarly allow students to be immersed in the study of science within racially diverse learning environments and often have an explicit goal of giving students both the academic preparation and material resources to apply for and attend graduate and professional schools. Largely hosted by research universities, many programs provide students with graduate and professional school entrance exam instruction and application assistance and with academic experiences such as conducting and presenting independent research, helping to make them better applicants for these post-graduate opportunities. The focus of these programs includes a range of different STEM disciplines including public health, computer science, and translational medicine. These mostly summer experiences are instrumental to students' being exposed to research and graduate school as post-graduate options early-on and they act as spaces for students to find mentors in the professors with whom they work on their independent projects. They also gain confidence and skill in their ability to communicate scientific ideas. These opportunities are few and far between for many students however, and there is yet still a need for more support for these programs so that more first-gen and low-income students can have formative experiences that help maintain and explore their interests in STEM. The latter is particularly important as for many FLI students, academic exploration is made difficult by the reality of having little parental guidance about choosing a major but also simultaneously facing familial pressure to pick a major or career that is financially sustainable.

Interestingly, in addition to the social and academic spaces that center URM students directly, students also identify STEM departments themselves as having the potential to be counterspaces. Students identify some ways that STEM departments can work toward making "the margin the center" as hiring more URM faculty and actively recruiting more URM students, implementing anti-discrimination policies, and minimizing the culture of competition. (Ong et al. 233-234) For students who find their departments to be counterspaces, it is intentionally inclusive practices that acknowledge that their identity often produces experiences different from those of traditional students, that help to make them welcoming environments.

While spaces like these that exist within the context of institutional initiatives or well-established associations are well-appreciated for the work they do as counterspaces, relational or interpersonal counterspaces receive less attention for their importance in supporting URM persistence in STEM. However, URM students make use of and largely attribute their success to relational counterspaces such as faculty mentorships, upper-classmen mentorships, and peer-to-peer relationships. (Ong et al. 234) Unlike the collective nature of department and conference counterspaces, personal relationships as counterspaces give students the opportunity to be more open about their struggles and to receive personalized help. Additionally, as these relationships see to the personal growth of students, they can continue beyond the undergraduate level to provide support as students enter their careers. URM students therefore build a lifelong network of support that accompanies them as they achieve greater levels of success in their fields which undoubtedly entails working within increasingly less diverse and potentially more exclusionary spaces.

URM Counterspaces in Swat STEM

As part of this project, I spoke with two alumni of Swarthmore STEM departments. These two students have graduated in recent years and were chosen primarily because they were recommended to me by my thesis advisor Amy Vollmer in response to my interest in including the perspectives of students who had participated in the S3P program (to be discussed further). My first interviewee, Sasha (pseudonyms used for privacy), is a Black, female neuroscience and pre-health graduate. Admittedly, I, seeing myself as having a very similar background, expected our sentiments about the biology department to be the same. However, that was not the case. As a sort of refreshing surprise for me, Sasha shared that the biology department was a home for her. She also shared some of the relational counterspaces and experiences that made that possible.

Likewise, Brian, a Black, male graduate of chemistry at Swarthmore and former pre-health student characterized his experience in chemistry as largely positive, citing many of the same counterspaces as Sasha. I will highlight these counterspaces and what my interviewees had to say about them below.

Peer Support

Sasha discussed how the other Black students in the department became a source of kinship for her.

> " ..second semester, senior year, I remember just looking around and seeing that I was only one of like a handful of black faces in the classroom. And you know, like I had grown up in a place that, where I was one of the only black kids, but sort of just being reminded of that, like again and again, and knowing that like in my future career and like, I don't know, hopefully not, but like, just sort of in this like academic path I've taken that I unfortunately might, you know, like walk into a room and only see like one or two other people that look like me, or like potentially no one that looked like me. And that's always sort of like disheartening, I would say, but I think the other black kids in the class and I, we all got like really close. We all knew each other and we all like help each other and support each other. So that was nice" (Stone)

Here, in response to my question about how she would describe her sense of belonging in science, Sasha credits the support of other Black students for making the isolating experience of being "one of the only" in a STEM space, then an organic chemistry course, a space where she was able to experience close bonds. Oftentimes, the lack of representation of people of the same racial background pushes URM students to lean on each other for moral and academic support. I too have found myself being one of the only Black students and Black women in many of my biology and other STEM courses at Swarthmore, and I too credit the care and kinship of my URM peers for helping to create circles of support.

One experience, I recall that speaks to the importance of peer support as a counterspace for URM students is a study group that my friends and I, all women of color, created during our time in the infamously challenging Organic Chemistry 2 course. As a collective we scheduled time to go to office hours at the start of the course for the sole purpose of introducing ourselves to our professor, attended TA sessions and office hours, and held study sessions during which we made a list of concepts we each didn't understand and reviewed them together. It was truly a counterspace for all of us, given that we all had had negative experiences at the often white-dominated study spaces available through the department. We could both participate in mainstream spaces as a collective, creating a supportive environment for ourselves within them, and maintain a space that centered our needs. Especially in a time where the feeling of isolation was exacerbated by remote instruction, our group was essential to my feeling like I still knew how to seek out help. These counterspaces are student-cultivated, however, structural support for them is possible through the creation of departmental programs and processes that connect URM students to one another, for example.

Mentorship

Both graduates had much to say about the role of mentorship in their success, here defined as their persistence in STEM (Brian is currently a science teacher and Sasha is currently a medical student), and in their strong science identity. Both graduates discussed how they had mentors in the context of their lab research. Brian had this to say about how meaningful it was to have the support of his research professor inside and outside of the lab:

> "So research changed the game. As much as research itself, I think Professor [name omitted] her guidance really shaped me into not only the researcher I am, but like the person I am. So having that mentor was so important for me, early. Yeah. Having that mentor was like game changer, game changer. The mentorship definitely shaped my major, my decision, like what I was doing. Professor [name omitted] has a very large influence - had a very large influence, and still does today...And she highly recommended me to continue to do chemistry and continue to take high level courses on it. Um, so I just kinda, I followed, I followed her lead. I trusted her guidance, so I was like bio, you know, I'll see you later, let me lock in on chem, you know?" (Lawrence)

As illustrated by his words above, the combination of his early research experience (he began working in his professor's lab in the summer after his freshman year) and the mentorship relationship Brian developed with her increased his confidence in himself as a researcher and afforded him a well of support to draw from. The support was so strong that it convinced him that he had what it took to be a chemist even if he didn't fully know this for himself at the time he decided to start down that path. Brian also spoke about her high expectations for him in the context of research. Spending his days in the lab "pedal to medal" (Lawrence) as he described it, running experiments and presenting at conferences not only grew his skill but made him comfortable in the laboratory setting. As a mentor and as a professor, Professor [name omitted] effectively showed Brian that he was capable of being successful by putting him in the position to show himself that through the production of his own high-quality work. I think this is an important aspect of mentorship as a counterspace, as URM students throughout the entirety of

their schooling are often met with low expectations and internalize them as representative of the limits of what they can achieve.

Similarly, Sasha found support in her research professor and recalled how invaluable it was to her:

> "I remember when, um, professor like [name omitted] came to Swat and I started working in her lab and just like the way that she structured her lab and like how, like just great she was like, as a professor and as a person made me feel like I could do it. And I remember like senior year I was applying for research jobs and she was like my reference for a lot of them. Also, I remember like when I had like job offers, I would talk to her about them and like, you know, she would always want to say like, okay, I want to make sure that you go to a place like that you have good mentorship wherever you end up." (Stone)

This mentorship not only gave Sasha support for her undergraduate journey, but it also ensured that she transitioned to an environment in which she would have continued access to support. As previously mentioned, this emerges as one of the greatest strengths of relational counterspaces. They set URM students up for successful futures in white-dominated fields by building caring relationships in which support is given to help them make successful transitions to higher levels of STEM.

What both Sasha's and Brian's experiences demonstrate is that mentorship is effective as a relational counterspace because their personal growth is supported. They are challenged and enabled to consider their needs as they make career choices. For first-generation URM students, having post-graduate support counters the idea that family with experience in higher education is essential to success. Additionally, their experiences illustrate that mentorship need not come from a URM individual for it to be impactful. While neither of the professors the graduates

mentioned were of minority racial groups, the graduates cherished their perspectives because they knew that they were based in the belief that they could succeed which was most important.

Reflecting on my mentorship experience, it was one of the greatest contributors to my persistence in STEM. Like Brian, I met my mentor in an introductory course and it was the way she worked to ensure my success there that convinced me that she would make a great mentor. She became my mentor as part of the Richard Rubin Program and to have a mentor who is a Black, female professor in STEM is not something I expected coming into Swarthmore. Over my time here, I have grown both as a student as a person because of her guidance. We have worked on everything from time-management to negotiating salaries. When I knew a course would be challenging, she would email the professor of the course to ensure that I would have a tutor right at the start. We would plan my finals study schedule and discuss what I might need to make studying easier. During the pandemic, I struggled to remain invested in the courses I was taking and when the return to campus was approaching, I was feeling nervous about readjusting to in-person campus life. As a student with anxiety around testing and speaking publicly, I found that virtual classes allowed me to implement my own pre-test relaxation rituals and decrease the pressure of public speaking by turning off my camera. My mentor and I had many conversations about this transition and in them she reassured me that I had not only done it before but that I had grown so much in that time. Our meetings after that transition continued to be a source of relief for me. Of course, as a Black woman myself, I also appreciated being able to have conversations about what it's like to be Black in STEM and at Swarthmore.

The most notable of the moments in which her support helped shape my trajectory was at the end of my junior year when I was really considering leaving the biology major and my mentor aided me in figuring out which courses I would need to take to catch up in the other major and emailed

the chair of that department about my request. What sticks with me most is that, knowing my frustration and how conflicted I was, she didn't try to convince me to persist but instead ensured that I would be able to be successful no matter what my decision was. While I made the decision to keep the biology major, her guidance in that process let me know that whatever happened, I'd be fine.

In the same way that the relationships she built there made the biology department home for Sasha, this mentorship was home for me. It was a space where I received tools to tackle the academic challenges I faced and where I could be honest about how I was doing. I was also able to receive support from my URM peers who were also her mentees and that network of support is one that will last beyond Swarthmore.

S3P

As previously discussed in my description of counterspaces, programs dedicated to URM undergraduate students in STEM are instrumental for preparing students academically and giving them early exposure to careers and further education in various fields. The Swarthmore Summer Scholars Program (S3P) is a summer program for matriculating first-year students at Swarthmore that features courses taught by current professors. A science, writing, and math course are taught every year and students spend the summer living with their cohort. Throughout the program, students take tours of labs on campus, meet with student deans and support staff from various offices, and work on independent projects. While the opportunity to become accustomed to college-level courses is important, what the graduates I spoke to valued most was the relationships they developed with their peers and professors. Sasha commented:

> "I think for me, S3P, I didn't view it as much about, working on like, I don't know, math skills or like English skills or writing skills. For me, it was really more just like having that summer before school started on campus, like getting to know the campus, getting to

know professors from different departments, getting to like, you know, make friends like ahead of time and sort of just like all of the benefits that, that had in terms of like building up my confidence, I think, um, for entering stem at Swarthmore and like, knowing that I already had like people like on my side, people I could talk to. So, I think that was really helpful. And also I remember, from my year we did some stuff, like talking about imposter syndrome and stuff. So I think like really tackling those issues head on and just speaking about them. I think that was like really the first time I'd heard the term imposter syndrome. Um, even though it was something I felt before. So, yeah, I think it was really helpful sort of, and just, you know, having support and like knowing that I can do it." (Stone)

For Sasha, the value of the program was less the academics and more the relationships. In our interview, Sasha elaborated on this, explaining that S3P contributed to her feeling like biology was a home and like there were safe spaces for her in the other STEM departments in which she took courses because she got to know many different professors through the program. When she was feeling hesitant about approaching the professor of a course she was taking for help, she would reach out to another professor in the department with whom she had already built rapport. This made her more likely to ask for help than she otherwise would have been. Sasha's reflection reinforces the idea that relational counterspaces create networks of support that can be called upon when students are feeling estranged from a STEM space and that familiarity and ensured positive reception decreases the threat of reinforcing stereotypes and facing microaggressions that typically prevent URM students from seeking help.

Sasha's comment about the discussion of imposter syndrome also touches on an important aspect of not only relational counterspaces but institutional counterspaces like the S3P program itself. The most effective counterspaces do not work to address the barriers to URM persistence in STEM by denying or hiding from the fact of the issue. They are not race-blind. They are spaces in which conversations are freely had about how students are currently or may struggle as a direct result of their race and provide them with the tools to work through those situations.

Overall, what I find from my conversations with these graduates and my reflection on my own experience is that within the context of many different institutional STEM spaces including bridge programs, research labs, and departments, it is the relationships that exist for a student in those spaces that allow them to firstly take value from the academic undertaking and secondly to have positive, affirming experiences that establish them as places they would like to continue to participate in.

Home is other people for URM students in STEM, and at home, they are affirmed in their belonging, their scientific identity, and given the skills and tools needed to seek out support in the future.

Recommendations - How Counterspaces Can Inform Diversity and Inclusion in Swarthmore Biology

Firstly, I would like to say that I am no expert in Diversity and Inclusion, in curriculum and policy, or in teaching. I am simply making the following recommendations to the Biology Department from which I am graduating based on the experiences I have had as an underrepresented student myself and from the conversations I have had with peers and alumni.

Dedicated Spaces for URM Students

It is important that URM Students, especially first-years, have spaces they can retreat to discuss how they are navigating the courses in the department and their identities within them. An effective space of this kind should be student lead but also could involve a URM faculty member of the department as an advisor to this group. Students create groups like these informally,

however, departmental support for a group like this not only lifts some of the burden to make space for themselves off the shoulders of students but ensures that this space could receive the material support needed to keep it going.

Relatedly, in my conversation with Sasha, she brought up the lack of an open forum for URM students to express feedback or concerns. A transparent physical space or system through which all URM students can make their opinions known are an important supplement to the closed diversity committees that exist across many departments, including Biology.

To my knowledge, neither of these spaces currently exist in the department.

Critical Mass – Representation Matters

In my conversations with both Sasha and Brian, they recalled how impactful it was for them when a Black professor arrived to the chemistry department. Brian remarked, "I remember a big difference it made seeing, uh, I don't know if you know, [name omitted], when she came, it was like a breath of fresh air for the department. I did have her as a teacher, my junior year for analytical chem, but man, it was so nice to see." (Lawrence) Sasha explained that the professor's arrival was remarkable because she had not had the opportunity to have a Black professor in the biology department and that there was a "click" despite never having taken a course with her.

While most conversations around representation and attaining a critical mass of URM individuals center students, it cannot be overstated how critical it is for students to see themselves represented in the people who instruct them and inspire them to continue learning.

Student-Professor Connections

The interpersonal relationships described as key counterspaces previously should be fostered continuously among professors and students. My recommendation is to increase the opportunities for students and faculty to engage with one another informally which will allow for personal connections to be made and decrease the fear students may feel about approaching professors for help. In the same way that my friends and I practiced introducing ourselves to our professors and breaking the ice, it would be beneficial to create programs that foster these types of connections as well.

These are my recommendations. In sum, "…the department interested in increasing persistence rates among students from all demographic backgrounds, taking inventory of the extent to which members of the department—faculty and students—form positive connections and providing structures that encourage strong interpersonal relation- ships are likely to be productive strategies." (Rainey et al. 12)

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