EXPLORING THE CAPITAL LOW-INCOME STUDENTS USE TO NAVIGATE BARRIERS IN UNDERGRADUATE RESEARCH EXPERIENCES

Introduction

For science students, participation in undergraduate research experiences (UREs) has numerous tangible and affective benefits (National Academies of Sciences, 2017), and increases students' odds of entering scientific careers or pursuing graduate science degrees (Estrada et al., 2018; Lee et al., 2024). However, participation in activities like UREs often requires extra time and resources, either for the individual student or for the university. This leads to inequitable participation in certain activities, such that higher-income students or those attending higher-resourced institutions are more likely participate in activities like UREs (Lee et al., 2024). Entering an independent URE requires a great amount of specialized knowledge: a student must know what a research experience is, why it would be beneficial, and how to connect with potential research mentors (Cooper et al., 2021). It is likely that students with stronger scientific networks and higher-educated parents (factors often associated with higher-income backgrounds) possess more of this specialized knowledge to access a URE (Collier & Morgan, 2008). Even once in a URE, low-income students may not experience the same benefits as their higher-income peers: for example, low-income undergraduate researchers are less likely to be included as a co-author on peer-reviewed research publications (Grineski et al., 2018).

Though low-income students may face barriers to participation in UREs, students from low-income backgrounds are likely to have life experiences (e.g., increased unpredictability or hardships, or had added responsibilities) that have facilitated the growth of unique forms of social capital and background-specific strengths (Hernandez et al., 2021). To analyze students' social capital, we draw from the model of Community Cultural Wealth (CCW; Yosso, 2005)." CCW describes six forms of capital: "*aspirational capital*," or maintaining hopes and dreams for the future in face of barriers; "*linguistic capital*," the skills learned from communicating in more than one language or style; "*familial capital*," the cultural knowledge nurtured by one's community; "*social capital*," the network of people and resources; "*navigational capital*," the skills of maneuvering through social institutions; and "*resistant capital*," the knowledge and skills developed through behavior to challenge inequalities (Yosso, 2005). The CCW model highlights that though students from oppressed backgrounds have cultural capital, it is misaligned with the capital that is valued by dominant cultures and institutions. University environments, originally developed to serve students from educated and privileged backgrounds, reward students who enter their university studies with specialized knowledge and connections. In this work, we aim to explore this misalignment by describing the skills and knowledge low-income students may have that could enhance their capacity as undergraduate researchers, as well as the ways the challenges low-income students face in research environments. This IRB-approved study was conducted as a collaboration between two PhD-level biology education researchers and eight low-income undergraduate researchers in the context of a science education course-based undergraduate research experience (CURE). Through semi-structured interviews, we consider the research question: How do students perceive their experiences and positionality as low-income students impacts their undergraduate research experience?

Methods

Participant Recruitment

In Spring 2022, we conducted a nationwide survey of life sciences undergraduate students who had participated in a URE. From our 508 complete responses, we sent interview recruitment requests to a random subset of students who had participated in an independent URE and identified as having grown up in a low-income household and/or as having experienced

financial insecurity as an undergraduate student. In total, we contacted 65 students and completed 22 interviews from this pool: at this point, we determined we had met thematic saturation within our interviews and did not need to recruit additional students.

Interview Protocol Design

Because our research team included both experts in education research and novice researchers with lived experiences as low-income students, we began our project with intentional self-education and reflection. Over several weeks, we reviewed and discussed topics such as asset- vs deficit-based framing, how the historical origins of the university environment benefit the privileged classes, and theories of cultural capital. We participated in reflective activities and discussions about how our own backgrounds and identities are privileged or disadvantaged in a university environment. These discussions framed our development of the interview protocol.

The entire research team collaboratively designed interview questions to probe students' experiences as a low-income undergraduate researcher. Example questions include: "*Given your experience as a low-income student, are there specific things that your research mentor did that [positively/negatively] contributed to your research experience?"* and *"Are there factors or responsibilities in your personal life that positively impact your participation in your research experience?"* Prior to conducting interviews, we conducted think-aloud cognitive interviews with several low-income undergraduate researchers to confirm that members of our study population were interpreting and responding to interview questions appropriately. A single researcher then conducted all interviews over Zoom.

Data Analysis

We read through randomly selected interview transcripts and discussed each transcript, noting different ideas and experiences that we observed in the transcripts. Through iterative discussions, the research team gained familiarity with the data and developed a preliminary codebook. The codebook consisted of codes (short phrases describing a particular student experience/perception) and code definitions (a longer explanation, with examples and clarifications as needed, to guide consistent code usage). The research team then coded all 22 interview transcripts to consensus: Each transcript was independently read by several members of the research team, and each researcher coded the transcript by tagging specific segments that related to a defined code. The team then met and discussed each code applied independently by any member of the research team, coming to a consensus to decide the final codes that were appropriate for each transcript segment. This collaborative process allowed for generation of provocative questions and leveraged our multiple perspectives to deepen our coding process.

Analyses and Findings

The 22 student interviewees represented 16 different institutions, including public and private research institutions (13 students), comprehensive institutions (7 students), and primarily undergraduate institutions (2 students). Many interviewees reported that they experienced financial insecurity (lacking money for food or rent) for some (10 participants) or most (8 participants) of their college experience. While most students described participating in traditional mentored UREs at their home institution, some described participating in UREs at outside institutions (for example, through the NSF REU program).

Through our coding, we identified five distinct experiential characteristics that were common among low-income undergraduate researchers in our study and impacted student's research experiences—both by contributing to student's cultural capital and by posing barriers to research participation. Each characteristic is described below.

Low-income students are more likely to have little discretionary income

Low-income students in our study were all short on discretionary income, or funds to cover non-essential costs beyond housing, food, and tuition. Moderate resource restraints and experience "using what is on hand" can develop individual skills in finding creative solutions to problems at hand (Scopelliti et al., 2014), which a few students expressed:

> *"[As a low-income student], I'm a bit more aware of if I'd like to do this experiment, what's the cheapest way to do it without sacrificing the data quality." -Alex*

Given the constraints on many scientific budgets, fostering creative solutions to lower-budget scientific experimentation and resourceful use of materials could be a form of *navigational capital* that could be immensely useful and valued by many research mentors.

Students in our study additionally described that their lack of discretionary funding could be a barrier when they encountered unexpected expenses related to their URE. For example, Daniel needed to pay for gas to drive regularly to his field research site:

> *"I drove my own car [to get to my field research site] ... Gas was basically the only research expense that was not covered by the research experience. A very significant part of my living expenses for the summer was from that commute to the research site, especially because gas got up to $5 a gallon."–Daniel*

Low-income students are more likely to face housing and food insecurities

While all our interviewees had limited discretionary funds, some students additionally did not have sufficient funds to meet their basic housing and food needs. Predictably, students in these predicaments had a much more difficult time participating in their research activities. For example, external stress and anxiety could significantly interfere with research participation:

> *"I spent a good week and a half, maybe two weeks without eating much because I just didn't have the finances for it... I was eating once a day or not eating at all. And that impacted my ability to even do research or even go to class. I still went to class, and I still did my research, but it was a lot harder." –Sofia*

By demonstrating their determination to persist in their UREs to advance their education despite challenges such as housing and food insecurity, students displayed a wealth of both *resistant capital* and *aspirational capital.*

Low-income students have increased expectations of "mutual aid" between family members

Low-income students are likely to have a higher sense of responsibility for family members, as low-income families tend to emphasize the moral code of "mutual aid" between family members, while middle- and high-income families tend to shield their children from family responsibilities throughout their undergraduate years (Pierce, 2023). Students in our interview study often lived with relatives to increase their housing security and affordability. However, these students likely spend more time contributing to their households and having more familial responsibilities as compared to students who can afford student housing on or near campus. Mia, a first-generation student whose family had immigrated to the US, explained:

> *"I just have to balance my time a little bit more, working, taking care of my family and trying to help around the household. In my family, I'm the only one who really is fluent in English so I help my mom with a lot of translating things or calling different companies to get things resolved. If we need a service in our house, I will be the one doing that." –Mia*

Connections with family and community also contributed to student's *familial* and *linguistic* capital, as some students were uniquely positioned to share knowledge from their

research experiences with connections who may not have otherwise been exposed to their scientific work. This included students sharing their work with non-English-speaking family, or with peers who did not go directly to college. Whether they lived with family or not, many described an immense amount of emotional support to persist in their education from their families, which supported student's *aspirational capital,* as described by Natalie:

> *"My mom has told me that she wishes she had gone into an environmental science program, but she didn't feel like she had that encouragement as a kid. So she's flipped that and tries to encourage me to take every opportunity that comes to me." –Natalie*

Low-income students are more likely to have longer commutes

Low-income students who live with family or live further from campus in more affordable housing also spend a lot of time, and sometimes money, commuting. Most interviewees described that their commute hindered their URE participation. Despite these constraints, many emphasized that their circumstances and limited time forced them to be highly productive and efficient in the time they could devote to research:

> *"I think because of my lack of resources, I've always been very resourceful, doing the most with what I have... When I go into lab, I really have to make sure I know exactly what I'm doing, because I don't have the most time… I feel like I annoy my group members because I will text, 'Hey, we should do this, this and this on these days.'"–Adriana*

This drive to be highly organized and productive with limited time is a form of *navigational capital*, promoting Adriana's success and development as a leader in her URE.

Low-income students are more likely to have increased employment responsibilities

To earn money to meet their basic needs, pay for tuition, support their families, and/or earn discretionary funding, many participants described having increased employment responsibilities in addition to their educational commitments. This could significantly consume available time for conducting research. Chloe explains:

> *"When you're offered extra hours at work, usually you take them, just so you can get more money to pay bills and stuff. But that cuts into time that you can dedicate to your research, that you can dedicate to your schoolwork and other things [like research]."–Chloe*

While outside employment could leave students with less time for research, many students described skills and knowledge developed from other professional opportunities that facilitated the growth of *navigational capital* useful for accessing and succeeding in a URE. This included a history of writing cover letters, professional emails, resumes, and interviewing:

> *"[My background as a low-income student has] made me pretty scrappy. I've been working some sort of job since I was 14, so I had the skills to write a resume and to perform well in an interview, to get [my research experiences]."–Liam*

Maya described that her outside employment had helped build communication skills that were valuable in her URE—forms of both *navigational* and *linguistic capital*:

> *"I'm a home health aid… I feel like that gives me people skills... And that helped me gain community with my [research] group. When it comes to presenting my work, I'm able to connect with people more." –Maya*

Conclusion

Though low-income students have many forms of capital bolstered by their experiences that support their potential for success in a URE, the challenges they face to participating in

UREs are not easily fixed: Research mentors cannot gift students with more time, reduce student commutes, or eliminate familial financial inequality. However, research mentors can engage in practices that alleviate these challenges and support research participation for low-income students. This can include facilitating compensation and sticking to a mutually agreeable research schedule that accommodates commutes and outside responsibilities. Research mentors can also provide psychosocial support for their students and facilitate an inclusive research environment. At the administrative level, universities should continue to invest in and expand the many ongoing efforts to broaden access to undergraduate research, including CUREs and other scaled-up URE models. Universities should also prioritize efforts designed to ensure that all students, regardless of social class, can access research. These can include targeted science intervention programs or university-led efforts to help students prepare for UREs, assist students with placement in research labs, and uncover "hidden curriculum" so that all students learn what is needed to enter UREs. If higher education is meant to be accessible to all and a path to socioeconomic upward mobility, universities need to continually assess how UREs and other promoted practices might exacerbate existing systemic inequities.

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