

Article

Considering Student Voices: Examining the Experiences of Underrepresented Students in Intervention Programs

Gina Sanchez Gibau

Department of Anthropology, Indiana University–Purdue University Indianapolis, Indianapolis, IN 46202

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Qualitative studies that examine the experiences of underrepresented minority students in science, technology, engineering, and mathematics fields are comparatively few. This study explores the self-reported experiences of underrepresented graduate students in the biomedical sciences of a large, midwestern, urban university. Document analysis of interview transcripts from program evaluations capture firsthand accounts of student experiences and reveal the need for a critical examination of current intervention programs designed to reverse the trend of underrepresentation in the biomedical sciences. Findings point to themes aligned around the benefits and challenges of program components, issues of social adjustment, the utility of supportive relationships, and environmental impacts.

INTRODUCTION

For the past three decades, the scientific community has expressed great concern about the apparent disparity in participation among historically underrepresented groups in science education and in the sciences in general. This underrepresentation continues to persist, despite the creation and implementation of interventions designed to reverse this trend and ensure the development of a strong future workforce. Some of the more successful strategies that have emerged have enabled underrepresented minority (URM) students to gain greater access to institutions in the fields of science, technology, engineering, and math (STEM) by virtue of increased funding opportunities. Other strategies have focused on the concomitant challenge of retaining and graduating URM students in the sciences to meet the growing

demand for such professionals. To this end, research has revealed the benefits of mentoring, professional development, socializing experiences, and the cultivation of inclusive campus environments for these students. Yet underrepresentation continues to exist, often leaving the academic and scientific communities at a loss for a solution to this dilemma.

This study contributes to existing literature on effective approaches, models, and interventions to address the chronic condition of underrepresentation in the biomedical sciences. Most of the research on the participation of URM students in the sciences has been quantitative or mixed method in nature, which is perhaps understandable, given the background in scientific inquiry of researchers within STEM fields. Such studies often deploy surveys and other assessment instruments to deduce the relative success of URM students in STEM disciplines, focusing on such aspects as motivation, persistence, self-efficacy, and the impact of climate and mentoring, to name only a few (Hung *et al.*, 2007; Chang *et al.*, 2008; Griffith, 2010; Estrada *et al.*, 2011; Coronado *et al.*, 2012; Hernandez *et al.*, 2013; Kendrick *et al.*, 2013; Thompson and Campbell, 2013; Salto *et al.*, 2014). While such analyses are critically important to understanding the dearth of participation, they may not explain the totality of URM student experiences. Qualitative studies that offer the richness and depth of the voices and perspectives of URM students themselves are comparatively few (Lewis and Collins, 2001; Gardner, 2008; Hurtado *et al.*, 2009; Johnson *et al.*, 2011; Palmer *et al.*, 2011; Dickins *et al.*, 2013; Prunuske *et al.*, 2013). This study uses a phenomenological approach to examine the experiences and perceptions of URM graduate

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Address correspondence to: Gina Sanchez Gibau (gsanchez@iupui.edu).

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students in the biomedical sciences of a large, midwestern, urban university. The perspectives offered by URM students, as captured in transcripts from 24 individual interviews and one focus-group interview centering on the evaluation and revision of existing intervention programs in which the students participate, provide a critical contribution to ongoing conversations regarding underrepresentation in the sciences.

Considering the voices of underrepresented students themselves in the design and implementation of these programs is an intervention in and of itself. Taking a phenomenological approach to understanding the experiences of underrepresented students in the sciences is a necessary means for close examination of what types of interventions may or may not work at a given institution. Qualitative studies are particularly valuable, since they offer a more nuanced viewpoint on assessing the efficacy of such interventions and serve to complement existing quantitative research. Likewise, they can serve to enhance and enrich program conceptualization, design, implementation, and revision.

The purpose of the current study was to examine the perspectives and experiences of URM graduate students engaged in National Institutes of Health (NIH)-funded intervention programs and to assess program effectiveness from the students' accounts. Questions that served as a guide to this study include the following: What were the experiences of the URM students? Which experiences were most critical to their persistence in their programs? And how can these experiences potentially inform and enhance intervention strategies?

Broadening Participation

Much of the literature on historical underrepresentation in the sciences focuses on both the source of the underrepresentation and possible solutions. Aside from the now more recognized barriers to broadening participation, such as lack of funding, mentors, support, preparation, and professional development opportunities (Castle, 1993; Davidson and Foster-Johnson, 2001; Summers and Hrabowski, 2006; Powell, 2007; Butts *et al.*, 2012), some researchers cite increases in retirement that occur over time as contributing to underrepresentation, given the lack of a robust and diverse pipeline of individuals who are not yet ready to enter the workforce (Olson, 1988; National Science Board, 2004). Others express the concomitant concern of increased competition in the U.S. job market due to the steady influx of internationally trained scientists who dominate the current workforce (Campbell, 2000; Hurtado *et al.*, 2009; National Academy of Sciences, 2011). Still others identify a need for URM students to pursue careers as research faculty members, so they can eventually serve as role models for an increasing URM college population (Nelson, 2007). Indeed, URM attrition at the undergraduate level also contributes to the lack of depth of a pool of applicants for the PhD (Russell and Atwater, 2005). Finally, lack of social integration in the culture of science and nonacademic commitments (e.g., economic, familial) are often cited as contributing factors (Davis *et al.*, 2004).

To address the persistence of underrepresentation in the sciences, researchers have been compelled to examine interventions designed to increase a variety of positive outcomes pertaining to the successful achievement of the PhD (Fagen and Labov, 2007). Several factors have been identified that

pertain to realms of support, including social, familial, academic, financial, and institutional. Drilling down to the critical components, these would include the following:

- Mentorship, with the quality of the mentoring relationship identified as a key factor
- Institutional climate, in which the institution embodies the value of diversity as stated in its mission
- Funding, with targeted grant programs being the most successful
- Research opportunities, especially those opportunities occurring during the summer months, which then inevitably enhance students' studies and lab work conducted during regular semesters
- Social integration, which is of particular concern for URM students at predominantly white institutions (PWIs) and critical to the development of a sense of belonging to a larger community of scientists and to students' acquisition of an identity as a scientist
- Critical mass of URM students and faculty members, which must also be buttressed by a high value for diversity
- Supplemental/flexible instruction or curricula, with which URM students have excelled and which speaks to a more individualized manner for mentoring a student

While the literature pertaining to the experiences of URM doctoral students is growing, this review will focus on the literature that is most germane to this study, pertaining to mentorship, science identity, and science enculturation in general.

The Mentor–Protégé Relationship

The mentor–protégé relationship is critical to the academic success and career advancement of any student pursuing a degree in the sciences (National Science Foundation, 1991; Prunuske *et al.*, 2013). In identifying key indicators for Hispanic doctoral student success, Millett and Nettles (2006) highlight the importance of research assistantships, indicating that “research assistantships may influence other doctoral student experiences such as student interactions with peers, their academic interactions with faculty, their interactions with their faculty advisor, whether students stop out of their doctoral programs, and their rate of progress” (p. 271). A successful doctoral student is one who will have a substantial amount of publications written and who will have had the opportunity to engage in other professional development activities, such as disseminating research at national conferences (Millett and Nettles, 2006). If the mentor–protégé relationship is strained, there are tremendous ramifications for the student (Prunuske *et al.*, 2013). One bad experience in the lab, for example, a protégé being asked to leave or fired, can reverberate throughout the department and create a negative impression on all other preceptors with whom the student could have worked.

Turner and Thompson (1993) examine the mentor–protégé relationship as it pertains to doctoral students who are minority and female. Their research raises the question of whether or not minority women receive adequate opportunities for graduate school socialization in their programs compared with their majority colleagues, bearing in mind that the culture into which students are socialized has been

historically and predominantly white and male (Turner and Thompson, 1993, p. 357; Johnson *et al.*, 2011). This question is gauged on a number of factors, including university recruitment, opportunities for mentorship, perception of departmental environment (cooperative or competitive), and individual experiences with racial and gender discrimination. The study found that most minority female doctoral students experienced less recruitment and fewer apprenticeship opportunities than their majority colleagues. The apprenticeship opportunities were measured by coauthorship, copresentations, referrals to job searches, teaching assistantships, and mentorship from one's graduate advisor. These students also experienced their departmental environment as competitive, in contrast to majority students, who described their environment as cooperative (Turner and Thompson, 1993, p. 362).

Overall, the minority female doctoral students encountered fewer socializing experiences, which is troubling, given the importance of the apprenticeship experience to the successful completion of the graduate degree and the eventual securing of a career in academe. Enculturation or socialization into the community of science is critical to URM students' successful acquisition of their identity as scientists, which is a necessary prerequisite to navigating the culture of science, both during their training and afterward when pursuing their career trajectory (Gardner, 2008).

Scientist Identity Development

In their study of the impact that race and gender have on science identities, Carlone and Johnson (2007) utilize a science identity model, which includes indicators of competence, performance, and recognition, upon which students must rate themselves and be rated by others as a "science person" in order to demonstrate a strong science identity. According to Carlone and Johnson (2007, p. 1192), a science identity is "accessible when, as a result of an individual's competence and performance, she is recognized by meaningful others, people whose acceptance of her matters to her, as a science person." They further define the science identity by the following criteria:

She is competent; she demonstrates meaningful knowledge and understanding of science content and is motivated to understand the world scientifically. She also has the requisite skills to perform for others her competence with scientific practices (e.g., uses of scientific tools, fluency with all forms of scientific talk and ways of acting, and interacting in various formal and informal scientific settings). Further, she recognizes herself, and gets recognized by others, as a "science person." (p. 1190)

Studies have shown how URM students who have acquired an identity as a scientist fared better than those who did not (Johnson *et al.*, 2011). Conversely, those who experienced instances in which their identity as a scientist was doubted by the institutional support system found it more difficult to navigate the culture of science based on their gender, race, and class status. This navigation process was necessary, since the experience of being doubted effectively "interrupted" their goals of becoming a scientist (Carlone and Johnson, 2007). These "disrupted" students "expressed

dissatisfaction about how they were positioned in science and felt their goals to become scientists and doctors were disrupted" (Carlone and Johnson, 2007, p. 1197). The disruption also occurred when students acquired information regarding their professors' perceptions of them as students. These perceptions included whether or not the professor believed the students to have the requisite skills and ability to succeed on the one hand, versus the perception of them as "exceptional" students if they performed particularly well on the other hand. Students who encountered a disruption in the development of their science identities often "felt overlooked, neglected, or discriminated against by meaningful others within science," namely their mentors (Carlone and Johnson, 2007, p. 1202).

Carlone and Johnson (2007, p. 1207) concluded that women of color pursuing science as a career path experience one of three phenomena: 1) they are disrupted briefly in their recognition as science people; 2) they seek recognition from relationships outside the traditional mentor–protégé model; or 3) they redefine the parameters of recognition for themselves, in order to persist in their programs and to understand their presence as women of color within a university science community. Those who did persist in the sciences despite the disruption often found ways to negotiate their educational experiences and eventually came to see themselves as scientists (Carlone and Johnson, 2007; Johnson *et al.*, 2011). This negotiation process is a pivotal skill for URM students to acquire if they are to effectively navigate the cultural environments in which science education takes place. It also relates back to mentorship, as one must have a mentor who not only effectively guides the student through the program but also aids in the socialization process to ensure the student acquires the identity of a scientist.

The Culture of Science

Female and URM students in the biomedical sciences face the challenge of confronting the tradition of the culture of science, one often associated with masculinity and a historical Eurocentric base (Brickhouse, 2001; Johnson *et al.*, 2011). Carlone and Johnson (2007, p. 1207) caution, "Recognition can thus be viewed as a mechanism for reproducing the status quo in science. It is much easier to get recognized as a scientist if your ways of talking, looking, acting, and interacting align with historical and prototypical notions of scientist [traditionally, white and male]." The current presence of female and URM students and students with disabilities in institutions challenges this long-standing culture, which must undergo change and adaptation to accommodate an agenda of broadening participation of diverse individuals engaged in science education.

Research focusing on the agency of women of color, in particular in negotiating their identities as scientists, illustrates the challenges faced in the educational process (Johnson *et al.*, 2011). Some of these students have encountered incongruence with the science curriculum. The challenge for these students lies in the enculturation process; URM students, particularly those who may come from historically black colleges and universities (HBCUs) or other minority-serving institutions (MSIs), are asked to immerse themselves in a culture of science and acquire identities as scientists, but in order to do so, they are asked to perform in ways to which

they are not accustomed or to adjust to different pedagogical approaches with relative ease (Stassun *et al.*, 2008; Hurtado *et al.*, 2009). Students in the Carlone and Johnson (2007) study had to make a shift in their course performance, from simply doing well on exams to applying their knowledge and thinking like a scientist.

The ability to think like a scientist and to acquire an identity as a scientist is paramount to URM students' successful socialization into and completion of graduate degree programs. Ultimately, any intervention created to address underrepresentation in the sciences must consider these factors.

METHODS

The methodological approach to this study was phenomenological by design (Patton, 1990; Creswell, 2009). Narrative data were extracted by document analysis, which entailed reviewing, open coding, and analyzing interview data from program participants over a 6-yr period, as transcribed by the program external reviewer. With a qualitative methodology, document analysis enables the researcher to make meaning out of student experiences based on what was reported (Patton, 1990). A phenomenological approach, in particular, allows the researcher to uncover core meanings by investigating commonalities in experiences among study participants, in this case among URM students in a particular intervention program. Student narratives bring to light the lived experiences of minority students as they progress through their degree program. The idea is that students, speaking for themselves, are far more expert in their own cultural ways of being and thus are equally suited to comment on a particular program and offer suggestions for change.

Program Context

The interviews from which data were extracted were conducted as part of an annual evaluation of two NIH-funded intervention programs at a large, "high research activity," midwestern, urban university: Bridges to the Doctorate; and the Initiative for Maximizing Student Diversity (IMSD). The intended goal of the Bridges program was to increase the number of URM students who matriculate into and graduate from PhD programs in the biomedical sciences at the medical school or any other doctorate-granting institutions upon completion of their master's degrees at a partnering MSI. In this study, the "bridge" spanned the master's program at an HBCU in the South and the doctoral program in the medical school at the midwestern urban university. Partnering with an HBCU was critical, since these institutions produce a disproportionate number of URM students who earn bachelor's degrees in the sciences (Leggon and Pearson, 1997) and who go on to pursue doctorates (Solorzano, 1995; Syverson and Bagley, 1999).

The Bridges program, initially funded in 2003, consisted of the HBCU master's students spending one to two summers at the midwestern urban institution conducting research with a mentor, with the hope that the students would then leverage this experience toward the successful completion of their degrees at their home institution. The program provided students with a 12-mo stipend and fee remission for those who had the opportunity to engage in regular semester research as well.

In addition to financial support, the program offered students multitiered mentoring through interaction with research faculty members, postdoctoral students, other graduate students, lab personnel, an academic advisor, and advisory board members (Gibau *et al.*, 2010). Through the Bridges program, URM students had the opportunity during the summer to acquire a mentor at their host institution who could thereafter be engaged along with faculty members from the HBCU in monitoring their progress toward the master's degree. The hope, thereafter, would be that the students would pursue their doctorates at the host institution or a similar institution (Gibau *et al.*, 2010).

In contrast, the IMSD program, initially funded in 2007, provided 2 yr of graduate school funding for URM students in the 10 biomedical sciences PhD programs at the midwestern medical school. In addition, it provided funding for some laboratory supplies and the opportunity for students to present their research at a national meeting. Ostensibly, the IMSD program was created to meet the needs of Bridges alumni who would transition into the PhD programs in the medical school. This grant provided support for the first 2 yr of a student's doctoral work, with the student garnering sufficient mentoring to apply for and secure external funding for his or her remaining years in the doctoral program.

The Bridges program began with a small cohort of three students in 2003 and grew to 27 individuals as of Fall 2013. In 2010, program coordinators expanded the program and initiated a second partnership with a Hispanic-serving institution located on the West Coast and a third with another southern HBCU in 2013. Of the total 18 Bridges students tracked over time during the course of this study, only three dropped out of the program entirely, while 12 eventually matriculated into doctoral programs.¹ Six of these 12 individuals became IMSD-funded students at the midwestern urban institution.

Participants

The participants whose narrative responses are captured in the data set were accepted into the Bridges program and were currently enrolled as graduate students, either as master's students at the MSI or as PhD students at the partnering institution, between 2003 and 2008. Eighteen graduate students engaged in annual interviews with an external reviewer during this time period. Of the 18 participants interviewed, 16 were women and two were men.² All of the participants were African American.

Data Collection and Analysis

The data collected and used in this study were part of an ongoing exempt study conducted as part of regular program review (IRB EX0610-29). A purposeful sample of transcripts from 24 individual, standardized, open-ended interviews

¹Of the remaining three individuals, two pursued careers outside medicine, and a third obtained a terminal master's degree from the medical school.

²The apparent gender inequity may speak to the contemporary distribution of women to men in all areas of higher education.

Table 1. Sample interview protocol

1. Tell me a little bit about your background: Where did you get your undergraduate degree, and what did you major in?
2. How did you first hear about the Bridges program? [Did you know Dr. Y (MSI program coordinator) before enrolling?]
3. At that point, how certain were you about wanting to get a Ph.D?
 - a. How clear was your sense of what you wanted to study?
4. Did you have concerns ahead of time about enrolling in Bridges? What were they?
5. What did you know about [midwestern institution] and [midwestern city] when you first enrolled in the program?
6. This summer when you came to [midwestern state], where were you at in your graduate work at [MSI]? Had you started any of the research or the writing for your thesis?
7. How was it decided who your mentor at [midwestern institution] would be?
 - a. Did you have any interaction with Dr. X [midwestern mentor] before you came up for the summer?
8. Was there anything you did ahead of time to prepare for your summer in [state]?
9. How was it decided what you would work on during your time in the lab?
 - a. How well prepared did you feel once you realized what you would be working on?
10. Who else was working in Dr. X's lab?
 - a. Who supervised your work? How much contact did you have with him/her?
 - b. How comfortable did you feel with the other people in Dr. X's lab?
 - c. How often did you meet with Dr. X? What sorts of things did you talk about?
11. How did the lab work go?
 - a. If you had trouble understanding something or getting something to work properly, how comfortable did you feel asking for help?
 - b. How good were they at providing the help you needed?
 - c. What was your lab schedule like?
 - d. How did your lab experience that summer compare to what you thought it would be like?
 - e. Is there anything you wish you had known or been told about beforehand?
12. Tell me about your poster presentation and how that went.
 - a. How easily were you able to take what you'd worked on during the summer and turn it into a presentation?
 - b. Had you ever done anything like that before?
 - c. How did you feel about your poster presentation and how it went?
13. How comfortable did you feel living in [city] during the summer?
 - a. Where did you live?
 - b. Was it difficult being away from family and friends back home?
14. Who was in charge of coordinating the program in [state] this summer?
 - a. How often did the Bridges students meet with Dr. X?
 - b. How often did you meet with [academic advisor]?
15. What would you describe as the highlight of your summer experience?
16. What were the most difficult or challenging things about this summer in [state]?
17. Was there anything Dr. X or her lab group could have done to make it a better or more productive experience?
18. How much contact do you have with other students in the Bridges program during the school year?
19. Is interacting with other students in the program helpful to you? In what way?
20. How much interaction do you have with Dr. Y?
 - a. What do you see his role in the program as being?
 - b. What sort of assistance or advice have you gotten from him?
 - c. Is there anything you think Dr. Y could be doing to be more effective in his role?
21. Has your experience in [state] changed the way you approached your classes, your studying, or your research at [MSI]? In what way?
22. What has been the most valuable or rewarding aspect of participating in this program?
23. If there were things about the Bridges program that you could change, what would they be?
24. What advice would you give to another [MSI] student who is thinking about enrolling in Bridges?
25. If you knew they would listen, what advice would you give to a faculty mentor at [midwestern institution] who is thinking about taking an [MSI] student into his or her lab for the first time?

and one focus-group interview conducted by the external reviewer over a 6-yr period was selected and independently analyzed (see Table 1). The transcripts were divided into cohorts determined by the participants' year of entry into the Bridges program. A total of six cohorts were delineated (see Figure 1).

Because the purpose of the study was to determine the meaning that students attributed to their experiences as participants of the grant programs, responses on the interview transcripts were first open coded and then reread, focus coded, and interpreted. Units of meaning were determined inductively and then grouped into patterns of themes, which were interpreted. Thematic analysis allowed the data to be further divided into structures based on cohorts of students as a means of delineating patterned evidence.

RESULTS

Analysis and interpretation of the interview transcripts revealed several themes that characterized the experiences of the URM graduate students participating in the programs, clustered around students' perceptions of program benefits and challenges. The benefits included the summer research experiences, mentorship, social and professional support, and career definition. The students also encountered specific challenges, including environmental and curricular adjustment as well as status differentiation.

Summer Research Experience

A key theme that emerged from the interview data were the benefits received through summer research experiences. Not

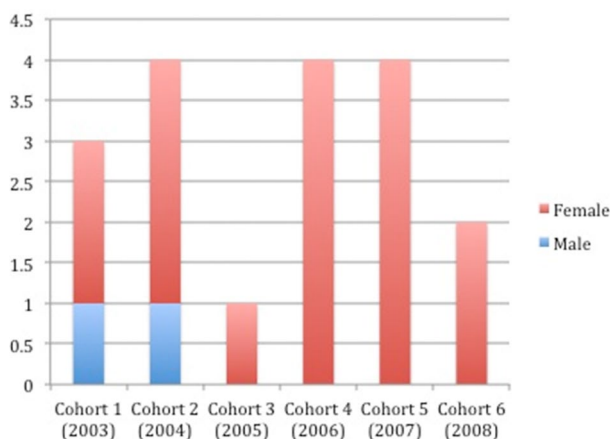


Figure 1. Bridges to the Doctorate cohorts, 2003–2008.

only did the students have the opportunity to work in a lab, but they also gained new lab techniques under the guidance of nationally recognized mentors and equally competent lab personnel, in the form of PhD students, postdocs, and lab technicians:

“I got a lot of lab work done, a lot of lab experience, which was great, but we didn’t take any classes during the summer.”

“I guess actually working in a lab as big as Dr. X’s. She had a really nice lab with a lot of nice equipment.”

“I like the fact that you get the hands on research experience. I think that’s great. I think that it’s good that you get to have that experience outside of [the HBCU] because [the HBCU] is a familiar environment.”

“Honestly, they were more readily available [lab equipment] at [the Research I institution], they have bigger grants and more money, so they can supply their labs with all the instruments and equipment that they need, as opposed to [the HBCU]. We have core labs, and this could be a problem if you want to get something done and you don’t have time because other people are using it. It’s more convenient and readily available, and it’s easier to plan in [the Research I institution].”

The positive outcome of summer research experience is aligned with what has been documented in the literature on effective interventions, with the contrasts in access and scale of resources most evident.

Mentoring Relationships

Another benefit for students were the mentors who expressed a vested interest in ensuring their success from the outset. Students were matched with mentors based on their general interest in a particular research area or based on the availability of space in a particular lab. Some mentors chose to contact their assigned students before their arrival at the partnering institution; these mentors would often send articles for the students to read, to prepare them for what they would encounter in terms of the mentors’ research agendas. This type of outreach relates back to the literature on socialization, with the mentor taking an early and proactive means through which to guide students through their transition.

Others experienced mentors who would meet with them weekly or twice a month. Many times, the mentors would meet with the entire team of students and researchers; the students later pointed out that there was some desire to have alternative methods, like one-on-one meetings. But none of the students indicated any difficulties with gaining access to their mentors or any relationship problems with their mentors. This is key to the development of what was mentioned in the literature as the need for strong and high-quality mentor–protégé relationships to ensure student success. For the most part, they mentioned how their mentors were always willing to help and would encourage the students to seek them out if they were encountering any difficulty:

“So the mentor, she was just great and very helpful. Even before I started the rotation, she would send me articles and different things, like if she had a speaker coming in or a conference that they had on campus.... I thought that was great that she took an interest early on, even before I rotated through her lab. That was cool.”

The relatively positive comments provided by the students about their mentors speak not only to their assessments of the quality of their mentoring experiences but also to the type of mentorship that is most desirable:

“I want a person who wants to see me graduate or who wants to see me succeed. I want to have somebody on my team or on my side who is willing to work with me and whatever type of training. He has remarkable people in the lab, and those are the people who I operate with every day, and we all get along fine.”

“I have a person, and kind of advocate. I have a person, Dr. X, I can go to her if I have any questions about anything that comes up in the department, and I can go to her and talk to her. Or if I have a problem, and if she says that I’m not sure who to go to, she can give me advice.”

“Awesome, I think she is great. She’s very supportive and understanding, nurturing, not just to me but it seemed like it was to everybody in the lab.”

Despite these comments, there were others that indicated the mentor was not the first person sought out when encountering difficulties in the lab or the classroom. Interestingly, many of the students interviewed talked more about the help they received in the lab from the staff than from the mentor. Many times, the student, if in the lab, would obviously go to the personnel in their immediate vicinity, the postdocs and PhD students. In these instances, the student would receive immediate attention. Thus, many students credited the PhD students and the postdocs with their successes in the lab:

“They [the postdocs] were great. I don’t think I could have done it without them, because ... like the techniques and the different procedures and equipment. They helped me out a lot. They helped me make my own protocols and things to follow, and they let me use their protocols, and explained ... they didn’t just like tell me how ... this is what you do. They explained why you do it, and the whole process. It really helped me understand exactly why I was doing what I was doing.”

Access to minority role models through programmed lectures and luncheons was another evident benefit. Yet some students also questioned this strategy based on who was invited to visit:

“As far as other things, the department has done a lot, as well, to help us adjust by bringing in these different minority speakers, that’s always nice to see that there are minority faculty members out there. So it helped a little.”

“Well I guess coming in through the Bridges program and having the opportunity to meet other professors that went to Ivy League schools or came from a different system. It’s good to meet other African American scientists that have made it. So it’s kind of like inspiration. So those are highlights. And then to see students that I met as a summer student matriculate and get their PhDs, those are good things too, because it kind of gives you the inspiration to know that I can finish too.”

“The seminars go well and actually seeing prominent African American scientists, I think that is a great thing. However, I have one issue. One issue is that it is generally ... When they bring these speakers, they bring them from places that we, being from historically black colleges and universities, cannot relate to, you understand? So they bring them from Harvard, from Yale, which is great, but none of us went to Harvard or Yale. And I think it would be more beneficial for us to see someone that has come from Grambling or Elkhorn or Jackson State that is doing good science and doing well in their field.”

This speaks to the need for authentic role models, who not only can provide the type of quality mentorship needed to motivate students to persist, but can also enable them to envision potential and/or alternative career pathways by their example.

Professional and Social Support

Another resource for the students were their peers; even though they might not be in the same lab or classroom, students would often relay problems to their peers, who would then attempt to talk through the problem or offer some advice or guidance.

The Bridges students relied upon each other for support:

“Students at the Bridges program, we pretty much look out for each other. You know, we stay together and all that kind of stuff. So we really have a good friendship outside of just schoolwork.”

“Yeah, the fact that [Bridges alumna] went through it even though she’s not in it really helped us, I don’t think we would have made it without her.”

“I think that now that X and I are up here, I think it’ll be a lot easier for anyone else to come, to come along and to come through because we kind of know the ropes now and I will throw a life raft at anybody ... I don’t think that either of us, either X or I, would’ve been able to survive without the other one. So I think that was a good thing that we came up together. And you know, it wasn’t just one student from [HBCU] coming up by herself.”

These narratives relate back to the idea of students needing the recognition of “meaningful others” as a “science person.”

In these instances, the students’ peers became those meaningful others; they held each other accountable for their mutual success in the program and thus fostered a sense of collective responsibility in their acquisition of their science identities.

Indeed, what stands out most strongly in these narratives are the ways in which the students relied upon one another to “make it” in the program. The program was designed to offer the students opportunities for cohort building and socialization experiences. During their summer experience at the midwestern medical school, they were often housed together in a dorm or apartment. The Bridges and the IMSD students were also expected to attend grant-sponsored luncheons with committee members or with the medical school speaker brought to town, as mentioned earlier. In addition, the students often got together at local restaurants or one another’s apartments, most likely on the weekends. So the students had the ability to see one another on multiple occasions outside the confines of the medical school and share their daily experiences. Whether these experiences had to do with receiving a particular grade on an exam or working through a particularly challenging lab experiment, the students found in one another a sympathetic ear, one that served as a means to validate their presence and thus motivate them to persist in the program.

Career Definition

Finally, the summer research experience also aided student with career definition. The program exposed students to the possibilities of pursuing a career in academe, an alternative to the lure of industry. Much of this exposure came from their interactions with their mentors, their lab work, and the professional development opportunities afforded to them:

“The strengths are it gives you an opportunity to, expose you to areas of research, and, that you never would have been able to do at [the HBCU]. It also exposes you to mentors who are excellent teachers and who can give you really good advice. It allows you to attend scientific conferences. I never would have gotten a chance to present at national meetings.”

“It’s basically done everything for my career. Before this, I had no, ... before Bridges I really didn’t know what I was going to do once I finished my undergraduate. I was kind of ... I had applied to the graduate school at [the HBCU], but not really knowing what I was going to do. But with Bridges, I was able to find direction.”

“At first I was just wanted to, after my master’s or maybe even after my undergrad, I kind of wanted to teach high school or something. Bridges helped to motivate me to go further with my degree, just wanting to do more as far as research goes.”

As mentioned earlier, the literature supports the idea that professional development opportunities, those connected to one’s research and inclusive of the ability to interact with scholars at national meetings, are a critical indicator of the likelihood of students pursuing science careers. Effective mentorship is critical to this process of career definition for the students.

Environmental Adjustment

Students in this study also identified significant challenges to their success and persistence in the program based

on their experiences. One concerns the mere adjustment to social and cultural climate, as experienced at two different types of institutions:

“There is an adjustment to two vastly different environments. You’re coming from [the HBCU], coming up here. It is somewhat of an adjustment, so maybe you might need to brace for kind of that shock a little bit.”

“It’s different. Because I came from two HBCUs and so it is a totally different environment as far as that’s concerned. We use to go around [laughs] at my old school and be in awe when we saw white people in the hall.”

“Yeah, just walking past they say, ‘How are you doing?’ When we first got here, especially me, but I know all us, we were walking past and we were like ‘Oh, hi!’ If I make eye contact with you I think we are supposed to speak, and people are like ‘I don’t know you, why are you talking to me?’”

The latter statement speaks to the difference between regional norms of greeting. The impact of the shift in environment from an HBCU to a PWI for URM students is one that should not be overlooked. Indeed, a holistic approach to student success requires a consideration of their learning environments. In other words, acknowledging and attending to the realities of cultural adjustment experienced by students coming from the supportive culture of an HBCU into an overtly competitive one at a Research I institution, inclusive of an understanding of the time actually needed to make such an adjustment, should be considered in the design and implementation of an intervention strategy (Stassun *et al.*, 2008).

Curricular Adjustment

Related to this shift from HBCU to PWI, students also experienced difficulties adjusting to the pedagogical style and expectations of the faculty members at the Research I institution in the delivery of graduate instruction:

“Here, it’s a group of instructors, professors that teach the class. So it takes a couple of days to get used to different people training you now. Instead of getting used to one person, you have to get used to a number of people, and they all kind of teach differently. So that took a little bit of time.”

“It took awhile to adjust to teaching styles, different learning styles because at previous institutions we basically had one instructor for the course, and they taught every aspect of that course. Here you have multiple instructors.”

“I guess the teaching style is a little different here. I have never been through a course, undergrad or even at the master’s level, where I had three teachers teaching one subject, and that can be a little tricky, because they all have different teaching styles.”

Providing students with clear expectations of the level of work desired and a thorough review of the curriculum should serve as foundational preparation for students, far in advance of their entry into the program. Similar to what was encountered in Carlone and Johnson’s (2007) study, if students encounter challenges in adjusting academically,

this could serve as a negative indicator for the instructor, who could unduly disrupt a student’s self-perception as a scientist by expressing some doubts to their ability to successfully complete the program. Students would benefit greatly from adequate time to adjust, which is difficult given the current culture of science driven by a competitive atmosphere.

Status Differentiation

Perhaps the most urgent challenge faced by these students involves the practice of status differentiation. Administrators of intervention programs are often faced with the dilemma of positively promoting such programs and highlighting the successes of their students, while not unduly singling out a particular cohort of students for what can be perceived as special treatment to the rest of the student body. Unfortunately, students in this study experienced a sense of hyper-visibility due to the branding of the program in the school. Students expressed a myriad of perceptions based on their daily interactions with others:

“Sometimes when things happen with the minority students, it seems that everyone knows about it. Where with other students, it may not ... everyone may not know about it, but with minority students, it seems that everyone knows about something that’s happened ... I mean, yeah, for me it is a little bit embarrassing, a little bit embarrassing. You kind of are looking around wondering, ‘Okay who knows?’”

“I just think each individual, each person has to learn how to adjust individually. And I guess everybody is different, some people can and some people can’t. I don’t think that because of my color or because of where I am from I deserve any special privileges. I don’t feel that way. But at the same time, I don’t think I need to be looked at under a microscope either just because I don’t make an A or just because I’m not in class or just because I’m not doing work the way my committee feels like I should be or whatever.”

“All right, well I think there are some things that are being done now on the front end to try and be more supportive of not only students of color but of all graduate students. Because we do all have similar issues. Ours I feel like are exacerbated a little bit more, they are all out in the forefront, and we are put on crazy person watch. ... Whereas some other students are, ‘Well we’ll handle this,’ and they are a little more discreet about it. But I think our business is completely out there. ... And there is [*sic*] still people after four years that call us by other people’s names, because they don’t ... I guess maybe they can’t tell the difference.”

This perception, of feeling as though one or all URM students are under a microscope, led students to believe that there existed a lack of discretion on the part of their preceptors in relationship to their degree progress and to experience a lack of anonymity not experienced by their white peers. Clearly, receiving this additional attention, though well-intended, did not aid in their socialization into the culture of science in the medical school and may have served as a disruption for some in their development of a science identity, if they did not feel as though they were being accepted as a “science person” on the merits of their work.

DISCUSSION

Given its design, a study such as this is not without its limitations. A phenomenological approach was used to interpret the data within the context of the existing literature and in light of some broad, guiding questions. As such, the findings are not intended to be generalizable but rather to shed light on the experiences of a particular set of student experiences during a particular time period. In addition, as is typical in anthropological research, the open coding of data conducted by the author as the sole researcher places limits on the degree to which analytical validity and reliability can be assessed. However, qualitative studies such as this one are usually conducted to provide insight into what is possible in a particular social context (Chase, 2008, p. 79) and perhaps inspire others who may seek to expand the scope of inquiry and quantitatively test the emergent themes found therein. Finally, this study relies upon document analysis, and thus it captures student experiences as they were relayed to another person (the external reviewer) and not directly to the author. This method was chosen based on convenience, given that several of the study participants were either at their home institutions or had completed their doctorates and were subsequently engaged in postdoctoral work elsewhere. Nevertheless, a more explicitly ethnographic approach would have garnered additional insights through participant observation of students as they were engaged in various activities.³

While the interview transcripts contained responses to questions intended for program assessment, the extracted data nevertheless provide an in-depth and valuable account of student experiences in this particular intervention program, in their own words. The student narratives provide an intimate and representative account of their perceptions of themselves, the program, and their experiences therein as participants.

Overall, the findings from this study reveal that students had both positive and negative experiences in the program and that their peers, mentors, and professional development opportunities were critical to their persistence and success in the program. The participants benefited greatly from the opportunity to engage in summer research. They also relied particularly on a strong network of peers, which developed over time with the persistence of the grant programs. However, another key finding was the unique experiences of hypervisibility that the participants encountered as URM students at a PWI.

With respect to the cohort experience over time, Cohorts 1–3 emphasized challenges with transitioning into graduate school, inclusive of the adjustment to a change in environment (social and physical). Cohorts 4–6 experienced a climate wherein a critical mass had developed, and thus their experiences highlighted their reliance upon previous cohorts when navigating challenges. Finally, cohort 6 in particular demonstrated increased knowledge of more competitive interventions at other institutions (e.g., availability of more funding). Indeed, one can speculate as to this being the impetus for the two individuals in that cohort eventually matriculating into other institutions for their doctoral work.

³Having served in the role of “social scientist” on the grants, the author was privy to such observations, but they did not enter into the data analysis for this particular study.

Funding from NIH grants remains the most direct pathway to greater access of URM students to the biomedical pipeline. While some of the students in the more recent cohorts have indicated the need for increased funding, the earlier cohorts often cited funding as the principal reason they chose to participate in the program.

The African American female participants in this study experienced struggles in maintaining their academic standing at times and endured financial challenges. Many of these students also had the added responsibility of children, partners, and other dependents, each competing for their attention, compounding their concentrated efforts to succeed at the institution. Yet these same women tapped into resources, most notably themselves as a network, that assisted them in their progression through the program. In the end, three women, out of the total of six students who chose to pursue the PhD at the midwestern urban institution, have obtained their degrees; two have entered into the professorial ranks, and a third is currently a research biologist at a government agency.

In Carlone and Johnson’s (2007, p. 1201) study, students who were women of color looked to their family and community as a source of support and for a sense of recognition as scientists. Many of these students spoke of pressure received from home to “do well.” This desired recognition from individuals outside academia and the realm of science calls into question the traditional forms of recognition, recasting the practice in terms of “whose recognition matters most.” The present study revealed similar comments from students about having the added support of family at home and knowing that their success in their programs was directly tied to the hopes and the dreams of family, thus serving as a motivational factor when times were difficult.

Yet students also reported feeling out of place, similar to what Gardner (2008) has identified as a feeling of “not fitting the mold.” Attention to the institutional environment into which the students enter, therefore, is an important factor to consider. An optimal institutional environment includes organizational and institutional support for URM students (Oliver *et al.*, 1989). Organizational support ensures a student’s integration into social networks on campus, for example, through student and professional organizations. Institutional support ensures student interaction with university personnel and entities, particularly when a student is struggling academically.

The institutional environment must also be one that is not only welcoming and nurturing to URM students but also one that is characterized by a strong diversity-valuing climate in which the traditional culture of science is problematized and transformed. An intervention program that seeks to increase the representativeness of its student population must also be attentive to the representativeness of its faculty and staff members (Powell, 2007). If not, it will be accused of not “walking the talk” that it presents. Furthermore, it calls into question the need that URM students often voice about wanting a learning environment in which they see authentic role models who have the potential to motivate them in their pursuit of degrees (Nelson, 2007). It follows that, if there is little to no URM faculty representation, it is easy for URM students to question their identity as scientists and their very presence in a program with the ultimate goal of a PhD, which would gain them entry into the professoriate.

Hypervisibility, as revealed in this study, is a challenge that is difficult to resolve. On the one hand, there is a need to showcase the successes of URM doctoral students, as a means of dispelling myths about the difficulty in mentoring such individuals in relationship to additional time that may be needed and as a means solving the dilemma of underrepresentation in general, so that the culture of science is one that is moving toward more representativeness. On the other hand, there is the problem of singling out a group of individuals for attention that would not otherwise be elicited were it not for their minority status (Beagan, 2003). Majority students in medical schools, defined in terms of the overrepresentation of whites and Asians, do not witness a parallel experience of having the spotlight shown upon them in every department meeting, public lecture, or classroom. Ironically, an added dimension in this dilemma was that of the Bridges students relying upon one another for support; they socialized with each other outside class and attended events collectively. Therefore, their physical presence as distinct group circulating within a predominantly white environment also amplified their hypervisibility.

IMPLICATIONS

The findings of this study, particularly the challenges experienced by the students, suggest a number of improvements that could be initiated for similar programs designed to increase the matriculation, retention, and graduation of URM students in the biomedical sciences. In terms of the opportunity to engage in summer research, the students highlighted the positive contrast between the HBCU and the Research I labs, and that is an important factor to maintain. However, they also seemed to have longed for an added component of summer classes. A program that includes summer research and class work may ease the transition that students may encounter should they choose to matriculate into the partnering institution. In terms of course work, it could also expose them to the difference in pedagogical modes of instruction earlier, which would ease their adjustment. Combining research and course work or having the opportunity to engage in summer research over multiple years supports some findings that suggest a single summer research experience does not create a meaningful experience for students (Fechheimer *et al.*, 2011). The findings of the present study clearly suggest that there needs to be earlier and sustained outreach to students in preparation for the transition from HBCU to PWI.

In terms of mentorship, the type of mentor-protégé contact varied, from group sessions to one-on-one meetings. The student narratives reveal a preference for the latter. Student responses also indicate a greater receptivity toward mentors who demonstrated care in their success, who exercised a degree of nurturing, and/or who could act as an advocate as they progressed through the program. This type of mentorship is also best facilitated through one-on-one contact. Of course, it is also a time-intensive strategy. Programs attentive to these needs may yield greater successes for their URM students.

The students in this study also expressed a desire for authentic role models. These are individuals who are not only URM scholars but who are knowledgeable of their particular experiences (e.g., coming from an MSI). An authentic

role model can also be a scholar who can effectively support students through a period of adjustment while inspiring and motivating them to complete a program. Finally, the ability to interact with authentic role models through professional development opportunities (e.g., conference presentations) helps students to envision career pathways they may not have previously considered, particularly in areas of research.

The student responses clearly elucidate the structure that best facilitates their persistence: peer interaction. Programs that build in intentional peer interaction may yield greater results. Intentional peer mentoring could be facilitated through a programmatic matching of previous and current cohorts to ease transition and adjustment. The type of mutual accountability fostered through peer mentorship may go far in solidifying the coconstruction of science identities among students who frankly grow to feel like kin to one another.

Finally, the findings suggest that the highest degree of discretion must be exercised when managing any challenges faced by URM students and that these challenges must be addressed immediately and one-on-one. A step toward developing strong trusting mentoring relationships includes understanding how a student wants to be mentored; specifically, what type of approach is most motivating. The findings suggest that labeling a cohort of students by the grant that supports them may not be an effective means to foster this type of relationship and, indeed, may impede the socialization process.

CONCLUSION

It is important for students to evaluate programs designed to benefit them (Oliver *et al.*, 1989). Through an examination of URM students' individual and collective experiences as members of a particular program, their voices are effectively heard and contribute to the assessment and evaluation of program effectiveness. With this feedback, program administrators can measure student experiences in relation to the intended goals of the program. Ideally, if the students' experiences are in line with the intended goals of the program, administrators and coordinators can observe the track of students' success toward the achievement of the ultimate goal of graduation. On the surface, one can observe this particular Bridges program and gauge its relative success, having obtained the goal of "bridging" 13 out of 18 students into doctoral programs. However, there is much more to be learned, perhaps by listening to the voices that were not included in this study.

The challenges to solving the problem of underrepresentation are multiple and long-standing. While a few students cannot speak for an entire cohort of students, much less capture the entire experience of all URM graduate students enrolled at a particular institution, institutions cannot afford to minimize the importance of their voices either. The experiences revealed in this study relate to the overall experiences documented in previous studies related to URM experiences at PWIs, pertaining to both undergraduate and graduate students. Only by revealing what students experience in their own words can we begin to understand their experiences (Davis *et al.*, 2004). When we understand their experiences, we can affect changes in programs designed to serve them.

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