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An Examination of Factors Deterring the Pursuit of Advanced Degrees Among Alumni of a Minority Research and Training Program

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Minority research and training (MRT) programs utilize interventions aimed at increasing student persistence toward the completion of undergraduate degrees and continuation into doctoral degrees. Numerous studies identify these support interventions as essential components for positive outcomes among underrepresented students, including research experiences, social integration, mentorship, and financial support. Many of these previous studies utilize quantitative design involving current program participants or program alumni who continued into graduate programs. This pilot study employed a multiple case study with a narrative approach involving participants of an MRT program who completed a BSc degree but did not subsequently matriculate into a doctoral program. The cross-case analysis identified perceived barriers deterring continuation into doctoral degree programs among former MRT participants. Results from this study add student voice to the current literature and provide recommendations to better serve underrepresented students in the STEM disciplines. *Ethn Dis*. 2020;30(2):313-320; doi:10.18865/ed.30.2.313

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Introduction

A lack of diversity in scientific talent hinders scientific advancement, thus hampering the vibrancy of the economy and health care in the United States. Hispanic/Latino/a, African American, American Indian, and Pacific Islander groups are consistently underrepresented at all education levels in science, technology, engineering and mathematics (STEM) related fields.[1] Minority research and training (MRT) programs at the bachelor and graduate levels are implemented across US colleges and universities to diminish the educational achievement gap and foster a skilled and diverse pool of talent that meets public demands for STEM careers.[2] Federal agencies, including the National Institutes of Health and National Science Foundation, provide funding for the implementation of MRT programs serving underrepresented minority (URM) students interested in pursuing STEM-related careers.

Federally funded MRT programs utilize various educational activities designed to increase student persistence and completion of science-related bachelor degrees (BSc) and continuation into doctoral programs. Basic program components include undergraduate research (UR), mentoring, participation in scientific meetings, and financial support. The literature identifies these program components as impactful interventions influencing positive outcomes among URM students in STEM. Participation in UR improves grades and completion rates in science courses and generates more significant interest in pursuing a STEM graduate program.[3-6] Mentoring relationships between science faculty and students improve student motivation and grades for URM groups.[7] Furthermore, entry and persistence of URM students in the STEM disciplines positively correlate to receiving financial support.[8]

Although the number of STEM degrees among URM students has increased over the past decade, inadequate representation in STEM research careers still exists. Several prior investigations have focused on evaluating the effectiveness of program components and utilize quantitative methods with surveys measuring self-reported gains[9-11] and interest in pursuing a graduate degree immediately following undergraduate training.[5,6] Further-

more, a few studies are biased toward only URM who matriculate into graduate programs.[12,13] Thus, factors that may have deterred matriculation into graduate programs among MRT program alumni are not thoroughly investigated, although they may lead to the identification of key program components that can address this challenge.

This pilot study expands the current literature and provides recommendations to improve programming strategies for URM students in the STEM disciplines. The questions addressed by the present study are: What are the experiences of students who participated in an undergraduate MRT program but did not continue into a doctoral degree? What factors deterred continuance in a STEM research career?

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Research Design

According to postmodern constructivism, people construct knowledge through interactions with their surroundings and the world.[14] Constructivism supports an inquiry design in which meaning making is co-constructed between the researcher and participants through narrative dialogue. In order to achieve a constructivist understanding of students who participated in an MRT program but did not enroll in doctoral studies, the present pilot study employed a multiple case study featuring narrative dialogue.

Program Description

The MRT program is in the southern region of the United States at a majority White, research-intensive institution with an estimated undergraduate student population of 30,000. Funded through a competitive federal grant designed to increase the number of URM students in biomedical research careers, participants conduct research under a faculty member, receive hourly wages and conference travel funds, attend bi-monthly seminars/workshops, and receive academic and career counseling. Student eligibility for program entry includes: US citizens or permanent resident, majoring in the natural, physical or behavioral sciences relevant to biomedical research, competitive GPA, sophomore or junior, and individuals from underrepresented groups, including African Americans, Hispanics/Latinos, American Indians, Pacific Islanders, individuals with disabilities, and students from economically disadvantaged backgrounds.

Researcher and Participant Selection

As suggested by Creswell[15] and Glesne,[16] building trust and rapport enables the researcher further access in the study and determines the success in qualitative inquiry. For this pilot study, the researcher served as the MRT program coordinator and counselor. Thus, interviewer-participant rapport was easily re-established. The Louisiana State University institutional review board approved this research study, and all procedures followed ethical standards of the IRB. The researcher sent personal email invitations to MRT program alumni who did not pursue a doctoral degree. Out of ten requests, five former program alumni agreed to participate in this pilot study, all of which participated for two academic years and completed their BSc degrees within six years. Of the five participants, two were African American females (BSc received in 2012 and 2015), one African American male (BSc 2014), and two Latinos(a), one male (BSc 2015), one female (BSc 2018). The researcher obtained informed consent through a verbal script from all participants at the start of each participant interview.

Data Analysis

Following a constructivist approach, the researcher conducted in-depth, individual interviews with participants with conversational style questions. Non-directive interviews gather rich, storied narratives without controlling the conversation and skewing toward

the interest of the interviewer.[17] The researcher began each interview with one open-ended prompt, "Tell me about your college experiences." Non-predetermined follow-up questions were asked to encourage continuous dialogue and investigate emerging themes. Examples of follow up prompts include: 1) Walk me through when and how you decided to attend college; 2) Describe the environment of your research lab; and 3) Tell me what influenced your decision not to attend graduate school.

Interviews were performed between December 2018 and January 2019 using WebEx videoconference software and lasted approximately 30 to 45 minutes. Conversations were recorded, transcribed verbatim and identifiable information, including schools, names, and cities, were omitted.

Analysis of the qualitative database included traditional coding to identify and interpret developing themes. Cross-case coding identified common themes and variations across the cases while preserving individual narratives.[18] The descriptive codes from each interview were divided and categorized according to repeated words and phrases and reduced into salient meta-categories relevant to this study. Supporting information from the meta-categories include select participant quotes formatted into conventional paragraphs.

Results

Narrative inquiry provides researchers with a framework for examining human experiences, allowing them to analyze participant experiences connected to social issues, explore the social context and culture in which the encounter took place, and the knowledge constructed.[19,20] The cross-case analysis suggested four shared themes among participants: confidence in science, peer support, limited faculty interactions, and family influence.

Confidence in Science

During the interviews, participants described their research experiences as supplemental instruction enhancing their scientific understanding and confidence as a scientist. Before participating in the MRT program, one participant felt hesitant about her belonging in science. She stated, "It appeared other students always knew another person in the crowd. I really didn't have my own group. I was like the odd person out." However, she shared how research bolstered her confidence and involvement in science. She stated, "When I joined the research group, there were students in the lab close to my age learning the same material. I had a lot of hands-on experiences with them. I learned the science better and made friends."

Another male participant shared how participation in the MRT program influenced his persistence in engineering. He shared, "College was fun but also very stressful when I started taking my core engineering classes. I had issues with taking tests and poor lifestyle choices." However, he discussed how participation in undergraduate research "was a very interesting experience." He further stated, "I didn't publish, but I did go to a conference. I think the research really helped me stick with engineering because I realized it was doable... and I actually placed at that conference."

Although another participant described her undergraduate research as "more of the manual labor rather than actual research" at the beginning, she soon felt her experiences "were truly rewarding" and "acquired many laboratory skills." A participant also explained how the research experiences allowed her to understand what the professor was teaching in the classroom at a deeper level because she could "see it in real life and apply that knowledge" to her project.

Peer Support

All the participants shared positive experiences with peers within the research laboratory. They often discussed the interactions they experienced with fellow undergraduate and graduate students. A participant shared, "I really, really loved the graduate student [name omitted]. She would be like 'hey we are both girls. I know what you are going through. She like took me under her wing and held me a lot". Another participant shared similar experiences with fellow students in his research laboratory. He stated, "We had six grad students and one postdoc in the lab. They were there for me if I needed them. If I was struggling in a class, they were there for me and what not."

Another participant described the initial laboratory environment as challenging, but in time, evolved

into an experience with positive peer interactions. She shared, "I had some minor disagreements with the staff about the research directions after failed bacterial transformations. Other than that, I've had good experiences in the lab environments". She further shared, "The lab environments became pleasant… I had great experiences with the lab staff."

Limited Faculty Interactions

Although participants expressed an appreciation for the peer support from fellow undergraduate and graduate students, four of the five participants responded with limited, positive feedback regarding faculty interactions. After asking the participants to describe the mentoring relationship they had with their faculty mentor, they communicated a mentor-mentee relationship with limited communication. For example, one participant shared, "During my REU programs, I had a very supportive relationship with the lab faculty. However, at [institution omitted] I had better relationships with the grad students and lab technicians than the faculty member." Similarly, another participant stated, "[name omitted] didn't really check on when you were coming and going. I didn't see or talk to him much. You were kind of on your own. I had to teach myself, but I know that's how it is in grad school."

One participant shared how interactions with her faculty mentor were limited and sometimes unsupportive. She stated, "I really did not have this strong connection with [name omitted]." She further shared when interactions did occur, they would leave her feeling insufficient as a researcher. She stated: "When we would go over my poster instead of saying 'hey this is good but let's work on this' he would say 'ok, I see what you did. Now just give it to me and I'll correct it all.' Then he would just take the poster and do all of the changes. This would make me think what I'm doing isn't sufficient. It was discouraging. I would think if I can't do it as an undergrad, how could I do it as a grad student."

Familial Influence

Three participants expressed the influence of family on their educational process, academic performance, and motivation to attend college. They voiced support from their parents to attend college but also how their commitment to the family may have influenced their decision not to pursue graduate school. One participant stated: "I really missed my family. Early freshman year, I had a little panic into why did I leave. By the time senior year came around, I was ready to go home and be around my baby brothers, especially with them being so young. I think that really influenced me to go back home." Another participant discussed the financial struggles his family experienced during his undergraduate studies. He shared, "My mom like lost her job, and financial decisions fell on me… I just needed to hurry up and get some money to help my family. So I put off going to grad school and joined the military." Although the military was not his initial career plan, he explained that his decision to enlist into the military "worked out anyways" because he can "make a good living, travel the world and serve my country."

Discussion

Participant narratives provided insight into when their interest in science began, undergraduate experiences, and into their current career choice. The conversation style interviews explored influential individuals and experiences, personal struggles and achievements, and future aspirations. The cross-case analysis of the qualitative data identified shared themes addressing the research questions: What are the experiences of students who participated in an MRT program but did not continue into graduate school? What factors deterred continuance in a doctoral program? Students expressed confidence in science and positive peer support during their participation in the MRT program. However, limited faculty interaction and family-related factors influenced their decision to not pursue graduate studies.

The emerged themes from this study support Lent's social cognitive career theory (SCCT).[21] Based on Hackett and Betz's career self-efficacy model[22] and Bandura's social cognitive theory,[23] SCCT contends that an individual's career goals and actions are shaped by self-efficacy, interests, and outcome expectations interacting with external factors. SCCT investigates how career interests mature and in what way career choices develop and turn into actions.[24] The participants shared

how their interest in STEM began in middle or high school after a positive experience facilitated by their science teachers. However, although STEM majors often develop their science interest during K-12 education, many lose interest during their college years.[2] SCCT highlights how self-efficacy, outcome expectancy, or environmental variables directly influence career choices more than by personal interests.

Establishing a sense of self-efficacy, a belief one can complete a required task, and experiencing positive outcomes, the ability of correctly applying the learned skills to new situations, influence student persistence in the STEM disciplines. According to Tate et al,[25] self-efficacy from UR is a significant predictor of graduate school intention among MRT program participants. Participants of this study described an increased sense of confidence in their science knowledge and research skills after participating in UR. For example, participants shared, "I learned the science better" and "I realized it was doable." Although the participants shared a sense of self-efficacy in science and research that led to successful completion of their BSc degrees, they did not pursue graduate studies.

While UR is a common MRT intervention for building self-efficacy, external factors may prevent students from implementing their choice options.[24] Students may alter their interests and make career decisions based on cultural values. Despite their interest and confidence in science, participants of this study expressed a change in career choice around their senior year of college. During this time, participants expressed environmental factors, including limited faculty mentoring and family influence, which altered their original career goals.

Students who develop a mentoring relationship with faculty through research experiences achieve improved academic performance and higher degree aspirations.[6,7] Studies also suggest advising in which faculty mentors meet with students several times during the academic year positively impact URM students' success.[26] In this study, participants shared positive relationships they developed with student peers rather than faculty. Participants shared how they had limited interactions with faculty advisors, and how this might have deterred them from pursuing graduate school. For example, participants stated, "I had better relationships with the grad students and lab technicians than the faculty member" and "I didn't see or talk to him much." Furthermore, a participant even shared how the limited interactions she did have with her research advisor were more "discouraging" than supportive, particularly due to the absent or negative feedback she received during poster preparation. This faculty-student interaction caused her to question further her level of self-efficacy in conducting and presenting research.

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Peer mentoring increases mentoring accessibility for URM students when faculty are often absent from the laboratory. However, peer mentoring does not adequately substitute faculty-student relationships. MRT programs should implement mechanisms to evaluate and monitor mentoring experiences for student participants and provide mentor training. Impactful research experiences include regular and meaningful interactions between faculty and students on research projects.

The participants of this study also indicated family factors influenced their decision to forgo matriculation into graduate school. Participants did not suggest an absence of support and involvement from family but rather the value of family on their career choice. They expressed a desire to "go back home" and "help family." Many URM students connect to cultures valuing interdependent relationships and collective contribution. Thus, they do not attend college just for themselves, but also for their community and family.[27] The cultural role of obligation to community and family affect continuation into graduate programs among URM college students.[28]

In addition, family financial rea-

sons may have deterred the students from pursuing graduate school. One student shared, "My mom like lost her job, and financial decisions fell on me… I just needed to hurry up and get some money to help my family." URM undergraduate students are more likely than White students to come from low-income households and experience financial hardships during college.[29] Bersola et al[30] found that prospective URM graduate students in STEM disciplines place more emphasis on financial support than non-URMs when applying and selecting a graduate program. The cost of graduate school applications and attendance has risen over the years and this might deter some students from further pursuing graduate school upon graduating with a BS degree, particularly in the STEM disciplines.

It is worthy to note that four of the five participants in this study entered science-related careers including a K-12 science teacher, laboratory technician, and an industrial engineer. The fifth participant is currently enlisted with the US military but still plans to utilize his engineering degree in the future. Although they did not matriculate into graduate programs, participants believe the MRT program did play a crucial role in their confidence in science, attaining a STEM degree, and pursuing a science-related career.

Institutions and MRT programs must encompass a cultural lens for program design and support to improve URM matriculation into graduate programs. Awareness and understanding of cultural differences and career opportunities in STEM disciplines may help counselors and program administrators ensure URM student continuation in research careers.[28] Furthermore, academic interventions, such as community-focused UR paired with parental involvement, facilitates positive graduate school transition and degree completion for URM populations.[4] Family involvement opportunities, including laboratory tours, career fairs, invitations to research presentations, and community-focused research projects may foster a motivational network for URM students and convey the advantages of research careers. Furthermore, MRT programs should provide adequate graduate school and fellowship application support, so the costs associated with graduate school application and attendance become manageable.

Limitations

As with all methods of inquiry, this study has limitations. However, pilot study results suggest further questions and future implications for continuing this research topic.[31] First, this pilot study has limitations in terms of a small sample size. Also, majority of the student comments made regarding faculty mentor interactions involved a male faculty mentor. Out of the five participants, only one student had a female faculty mentor. Inclusion of a greater number of trainees may produce variations in findings and provide information of mentors from both sexes.

Furthermore, since the interviewer served as the MRT program coordinator, participants may have provided favorable narratives of program activities and opportunities. Thus, social desirability bias may have altered the validity of participant narratives.[32] For future studies, involvement of an external researcher may help diminish social desirability bias through increased anonymity.

Conclusion

Participant narratives provided insight into when their interest in science began, undergraduate experiences, and into their career choice of not pursuing a doctoral degree. The conversation style interviews explored influential individuals and experiences, personal achievements, and future aspirations. However, students expressed limited mentoring and communication with faculty mentors. The participants also shared the importance of family on their persistence into college and current career path. The study supports SCCT in which self-efficacy, outcome expectations, or environmental variables may influence career choices more directly than by personal interests. In particular, the influential role of obligation to family and community among URM college students is an influential factor in their career choice to pursue graduate studies.

Results from this study add student voice to the current literature supporting MRT programs as an impactful intervention on undergraduate degree attainment among URM students. The study suggests influential factors for the academic

development of URM students in STEM disciplines and recommendations for MRT program activities that promote student continuation into graduate programs, including development and monitoring of faculty mentoring and fostering family and community involvement with campus activities. With this information, institutions and programs may better serve URM students and improve minority representation in STEM research careers.

Conflict of Interest

No conflicts of interest to report.

Author Contributions

Research concept and design: Burton, Vicente; Acquisition of data: Burton; Data analysis and interpretation: Burton, Vicente; Manuscript draft: Burton; Statistical expertise: Burton; Acquisition of funding: Vicente; Administrative: Burton; Supervision: Vicente

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