

Choosing Where to Pursue a PhD: Ideals Sought and Compromises Made by Traditionally Minoritized Students

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Abstract—In this Research Full Paper we explore the factors that traditionally minoritized students consider when selecting a graduate school to pursue a doctoral degree in an engineering discipline. To this end, we used case study methods to analyze the experiences of ten traditionally minoritized students through interviews conducted immediately after they had selected their graduate programs, but before they had commenced their studies. Our findings show that in choosing an institution, the most salient ideals these students hold are related to the offer of funding towards their degree and an alignment with their initial research interests. However, they described having made compromises on ideals related to their personal experience and racial identity, the most prominent being finding a faculty mentor with a similar racial background, finding a racially diverse institution, or being located in a geographical location they perceived to be more amenable to their individual identities. These findings suggest that continuing to increase the recruitment of traditionally minoritized faculty in engineering schools would have a direct impact on minoritized student recruitment, by thus helping to create spaces where more of their racial identity ideals are met and fewer compromises are made. Equally important to the recruitment of traditionally minoritized students is the transparency of funding opportunities during the recruitment and application processes, and the publication of current research opportunities within the institution.

Keywords—traditionally minoritized, graduate students, STEM, doctorate, Black, Latinx

I. INTRODUCTION

Despite demographic shifts in the US favoring the traditionally minoritized identities of Black, Latinx, Native American, Hawaiian, and Pacific Islander individuals to collectively become a majority in the next twenty years, improvements in the number of these individuals pursuing engineering graduate education are small. This current disparity

represents a loss of potential scientific and technological contributions, which pose an equity issue for future advancements [1]–[3]. In fact, although a majority of minoritized undergraduate students express having aspirations of obtaining a graduate degree, this does not always translate into actual enrollments [4]. And then, those who do enroll must face a system where their attrition rates remain disproportional in comparison to other groups, insomuch that only an 11.7% of all doctorate degrees in STEM disciplines in the US were awarded to minoritized students in 2019 [5]–[6]. To correct this discrepancy, some studies have shown promising practices for recruiting minoritized students, and to an extent, how these students approach the graduate school selection process in engineering. Yet not much detail has described their initial ideals for the graduate school they ultimately select, the compromises they make during their decision process, and how these influence their final choice. Examining what these decision processes look like, and how students navigate them, can help institutions develop specific strategies to successfully recruit and ultimately retain traditionally minoritized students in engineering.

The purpose of this study is to examine which factors minoritized students consider when selecting a graduate school to pursue an engineering doctoral degree. Using a case study approach, we address the research question: What ideals and compromises do traditionally minoritized students make when selecting a graduate engineering program? To explore this question, we study the experiences of a group of minoritized students to understand their considerations as they underwent this pursuit. Our findings could be used to inform and tailor the recruitment practices of institutions as they seek to increase the representation of minoritized students in the student ranks of engineering doctoral programs.

II. BACKGROUND

There have been numerous efforts to understand the many aspects of the graduate student experience, such as what influences them to pursue graduate studies, or what considerations they take when making decisions that are vital to their progress. Though these studies have not always looked specifically at traditionally minoritized students, they provide insight on how students approach their decision about a graduate school institution. Here we present a succinct summary of the factors minoritized students consider when choosing an institution to pursue their graduate degree.

When comparing institutions, potential graduate students have been shown to consider factors such as program ranking, family-related concerns, and research interests of potential advisors as being more important than the quantity of funding offered to them [7]. The significance of research interest-related considerations has been confirmed when working directly with minoritized students, where studies found that their decision is often linked to the availability of desired programs and their preferred research areas [8], [9]. Admittedly, the motivations for graduate students' selection of their research topic have been found to typically end up being extrinsic to their preferences, as their research work will depend on factors such as the funding mechanisms available to them [10].

What we can conclude across several studies is that the students' selection of an advisor ultimately influences their choice of institution. Joy et al. [11] found that the selection of an advisor is often based on the availability of funding from the faculty member, their area of research, their personality, and other perceived qualities such as the ability to graduate students in a timely manner. In a separate study, Blake-Beard et al. [12] found that minoritized students are likely to seek mentorship relationships with professors who match their gender and racial identities. This finding aligns with Borrego et al., [13] who found that mentorship dyads between members of minoritized groups have indeed been proven to help students' perception of their self-efficacy through the vicarious experience of their mentor.

In addition to their research interests and the influence of potential advisors, the choice of institution for minoritized individuals is also circumscribed by the influence of the location of prospective institutions. Various researchers have converged on how factors related to the location of the institution, such as proximity to home or the perceived campus climate, are important consideration in minoritized individuals' decision-making process [9], [14], [15].

III. FRAMEWORK

Our study is anchored in the Graduate Student Socialization Theory [16]. This framework describes the progression of doctoral students through graduate education, dividing it into four stages: the anticipatory stage, the formal stage, the informal stage, and the final personal stage. We use the framework's characterization of the anticipatory stage as a lens to interpret students' decision-making process. The anticipatory stage is considered a preparatory period for the graduate student role and encompasses the period before the student has entered their

graduate program. Weidman et al., describe the anticipatory stage as follows:

"Prospective students at the anticipatory stage learn about the rules, department and university jargon, departmental norms, and what is deemed acceptable behavior for success in that particular program." [16]

Up to this point, what they know about graduate school is largely informed by stereotypes and generalizations. This knowledge contrasts with later stages, where the students are participating in the program and learning what their role entails through observation and their relationships with peers. We rely on this characterization of the anticipatory stage to develop interpretations of how minoritized students who were accepted and enrolled into engineering graduate programs navigate this process, and the factors that help them do it successfully.

The Graduate Student Socialization Theory has successfully been applied as a framework by past studies to explore the experience of minoritized individuals in engineering graduate school. One such study explored the investment of minoritized individuals as they progressed through their doctoral program [17], while another explored the impact that minoritized students' daily interactions and experiences in their doctoral program had on their career [18]. In addition to its application as a framework, aspects of the socialization theory have also been applied as an underlying concept with other theories while focusing on minoritized individuals, e.g., to study the challenges faced by Latinxs in their first-year of doctoral studies [19]. This case study differentiates itself from past research by focusing on the anticipatory stage of the socialization process as experienced by minoritized individuals who have not yet commenced their first semester of doctoral studies. Our exploration of how minoritized individuals choose a doctoral program in engineering will continue to grow our understanding of how minoritized individuals experience the doctoral socialization process.

IV. METHODS

We use case study methods to address the research question, conducting qualitative analysis to study the experiences of a group of students who went through the process of selecting a graduate program in an engineering discipline. We interviewed a total of ten minoritized individuals who had recently gone through the process of applying to graduate school and were about to begin their first semester of an engineering doctoral program in the Fall semester of 2021. The investigators had no control over the "site" or participants, and they recount experiences obtained in their real life independent of the research [20]. As such, our case is defined as the experiences of traditionally minoritized students who recently decided upon an engineering doctoral program to join.

A. Data Collection

Semi-structured individual interviews were conducted virtually, a week before a summer workshop directed towards helping minoritized students transition into their doctoral studies in an engineering discipline. Thus, interviews were conducted after students were accepted to graduate school but before they started. On average these interviews lasted approximately forty-five minutes. All ten interviews were conducted by the second

author. The interview included questions such as “How did you choose your PhD institution?”, and “Have you narrowed down on a research topic or research space?”. Other questions also explored the participants’ decision and motivation to apply to graduate school, which schools they considered attending, their experiences during the application process, and addressed aspects of the process that could have influenced their final institution decision. The interviews were recorded and transcribed for ease of analysis. The study was conducted in accordance with the approved human subject research protocol.

B. Participants

We interviewed ten students enrolled in eight different graduate institutions across the US; two of the participants accepted an early enrollment in their programs in the Summer of 2021, and eight were to begin their doctoral program in the Fall 2021 semester. Participants were recruited through the previously mentioned summer workshop, and their participation in the study was both optional to the workshop and voluntary. Five individuals self-identified as female and five as male. Three of the participants self-identified as Hispanic (Hispanic and white, Hispanic and Native, Hispanic and white/Native), and eight as Black (with one identifying as Black and Native). Finally, two of the participants held a master’s degree, and the rest held a bachelor’s degree prior to beginning their doctoral program. Our sample was intentionally limited to minoritized students, and therefore we make no comparisons or assertions relative to majority students.

C. Data Analysis

We adopted a constructivist perspective to explore and describe the factors that ultimately influenced the minoritized students’ decision to go to a certain program. The transcripts were analyzed and the researchers examined how the students described their compromises and ideals in their decision-making process when choosing an institution to pursue their PhD [21]–[23]. Interview recordings and transcripts were reviewed twice to identify the general themes shared among the participants in relation to their graduate school choice. For the first round, we used the descriptive coding method to classify excerpts of the transcriptions into “Ideals” held by the students and “Compromises” that were part of their anticipatory socialization stage when choosing an institution. Afterwards, sub-codes were utilized to further analyze the descriptive codes, and a final round of focused coding yielded three main factors related to the ideals and compromises that the participants held.

D. Trustworthiness

To assure the quality of this work, the first author periodically debriefed his analysis with the second author as a quality measure, detailed definitions of the codes were created, and the data was constantly compared to these definitions [21]–[23]. Finally, the research team discussed the results at different stages of the process to ensure that the message and perspective presented by the results remained true to the experience of the participants.

E. Role of the Researcher

The first author is a doctoral student in engineering education at an HSI, who identifies as a man and Hispanic,

which helped interpret the experiences shared by the participants. The second author is an assistant professor of engineering at a HSI who identifies as a woman and Hispanic which helped build rapport in the interviews. Other authors are also identified as Hispanic, African American, and white with a variety of academic and consultant positions in engineering (assistant professor, Associate Dean, director and Dean) from varied universities.

V. FINDINGS

Our findings showed that the participants of this study came into the process of choosing a graduate institution with certain ideals to be met, but often had to decide to compromise some of them in lieu of what they considered to have more weight or importance in relation to their goals. We found that most of the ideals they held in common and the compromises they made could be classified into three areas (in order of importance): funding and research interests, faculty ideals, and institutional ideals.

A. Funding and Research Topic

The availability of funding from a program was a major influencing factor for the participants in choosing an institution in which to pursue their PhD. Without funding, many of the participants stated they would simply not have been able to pursue graduate studies, so that the availability of funding in a program would have more influence over their decision than other factors. A participant with a low-income background commented on their experience when comparing the funding offers, or lack thereof, of the programs they were accepted into:

“They gave me some money, but it wasn’t all (that was needed to cover the required expenses). Thinking logically, I was like, ‘I’m already in debt. So it doesn’t make sense to go to school (and incur further debt).’ That was off putting. So I was like, ‘Do I really care about going to those schools when they won’t find money for me, and I know that I deserve money?’ Because I think by that time, I had already gotten a fellowship package from [my future institution]. And I did get into another school, but they didn’t reach out to me (with a funding offer). So it felt like, ‘Okay, I’ve gotten into the school, but do they really care if I’m there?’” – Ali

This participant’s response illustrates how they had to manage personal factors such as undergraduate student debt, before being able to consider joining a graduate program. It also underlines how for this participant a funding offer was indicative of how much the institution cared for them as an individual when joining the program. Another student shared their aversion to the thought of going into debt to cover the costs of their degree, having seen the experience of peers who did:

“But the one thing that I was looking at was making sure that I wouldn’t be in debt, like loans and those kinds of things. I thought, ‘I don’t want any student loans, and I’m not planning on student loans.’ [...] ‘I don’t plan on trying to get 20, 40, 50, \$60,000, \$100,000 of debt.’ Because I got friends in that position right now, and they’re suffering. Yeah, so the funding, it’s got to be there, else I don’t know if I’ll be there.” – Adi

Being informed by their peers’ experience who had to grapple with student debt, this participant shared how much importance they put on the availability of funding in a program

being enough to cover all their expenses, to not have to carry the weight of student debt after graduation.

In addition to funding offers, the participants' ideal research interest was one of the direct factors to their decision when choosing an institution. Participants stated seeking alignment between their interests and those of their potential advisors. Some participants shared that their desire for research interest alignment came from insight received from peers, mentors, and their own past experiences about the factors they should consider in a program. One participant shared their view on aligning research interests and values, not only with an advisor, but with the institution as well:

"I realized the importance of finding an advisor that is just as committed to the things that you're committed to and has research projects that you would like to work on. And so, I think finding a program that aligns with your values and causes, finding research projects that you would like to work on during your time there and finding an advisor who is just as committed to the things that you're committed to them." – Angel

This participant's insight came from their own previous experience at an engineering graduate program, where they expressed having experienced a lack of alignment between their personal values and those represented by the previous institution. Another participant, with no previous graduate school experience, shared how finding a potential advisor whose research aligned with their interest was the deciding factor when choosing an institution:

"When I saw that [my future advisor] was doing HBCU engineering education, research focus, I loved that. And I also loved that [their] focus was on Black women, and I saw a publication that [my future advisor] did few years prior about Black women and I really fell in love with that article and just the work that came out of that." – Albany

Though quite different, the experiences of these two students highlight the importance of the role played by faculty members as potential advisors in the students' process of choosing an institution.

B. Faculty Ideals

The second most common factor were the ideals participants held of the faculty in a program, which included the ideal relationship they sought with a potential advisor, and finding an advisor who shared their race or ethnicity. The latter was often compromised when their desired field of study was not racially or ethnically diverse enough to find an advisor that shared their identities. It was also compromised when they found a professor that shared their racial or ethnic identity, but their research interests were not in alignment. This ideal often stemmed from a shared notion stated across some of our participants, i.e., that working with a faculty member who shared their racial or ethnic background would foster a better mentoring relationship. A student shared how they, as well as others' they talked to, felt that having a mentor who was a minority would benefit their research within their community:

"I don't want to generalize this, but most of the minority students that I talked to are doing research around their own community [...] When you're trying to have those conversations with white professors, sometimes they don't understand, or it's not their experience so they

don't necessarily understand the need beyond statistics and things. I think it's more than statistics for minority students." – Aiden

Here they explain having had difficulties trying to convey the relevance of their research interests to faculty who did not have a personal connection to it. Because their research interest was intrinsically tied to the racial or ethnic identity of this student, their faculty race ideal was a strong factor to their choice of institution. On the contrary, one participant of Hispanic descent shared how not compromising on this ideal would have severely diminished their options to work on their desired research area:

"It would have been nice (finding an advisor who was a minority), but that would have eliminated 99% of [my options]. I would say that [out of] every school that I applied to, there was only one researcher who [was doing work I'm interested in] who was a minority. So no, I couldn't really look for that or else I wouldn't really be working [in my area of research interest]... but I do want my advisor to make the effort and try to empathize and at least recognize that it is a real thing and for as much as we all want to forget about it and just put our nose down to the ground and then grind it out for grad school, some things are a little different. I think my faculty appreciates that, and so maybe it's the next best thing." – Alex

Here we see how for this participant research interests took precedence over having an advisor of their same race or ethnicity, which was possible as their research interest was not intrinsically related to their racial identity. This excerpt also shows how in the absence of a PhD advisor with a similar racial background, students search for other proxy qualities in their potential advisors such as empathy. The personality, work ethic, and approach to race of potential advisors could play an essential role in how the students felt towards the program and their ultimate decision to join or continue their search.

C. Institutional Ideals

The third emergent theme covered factors that were intrinsically related to each of the institutions they considered. The participants expressed having ideals about the racial diversity found in the institutions, the geographical location of the institution, and the graduate student community. The perceived racial or ethnic diversity of the institutions was a key factor for various participants when making their final choice; the ideals for the institution's racial or ethnic diversity included the student body, general faculty, and administrative personnel. However, when finding that the institutions were not as racially diverse as they would have preferred, students often compromised this ideal to pursue their goals. A participant shared how their process included looking for minoritized individuals among the faculty:

"For me, when I'm looking at a faculty or at the list of faculty in the department, it jumps out to me that there's no Black person or there's no Latino person. So that's something that gives me pause when I'm looking at a school. I don't know how many other people think that, but I think, if you're a minority, that kind of stuff jumps out at you. When you look around at your lab and you're like... There is no other Latino person in any of the labs that I wanted to go to." – Alex

Their final decision was to compromise this ideal to give way to their research interests, to open more options of research groups to work in. Another participant shared how they managed this ideal during their decision process:

"I was looking for it (racial diversity), but I also know that no institution is great on diversity [...] And what I saw at [my future institution] was that demographic-wise, the university is not very diverse at all. There are very low numbers of people of color, and I noticed that, but I also saw how much work they were putting into those steps that they were trying to make real change with, and I appreciated that, so that's definitely something that I was looking for."
– Ariel

For this participant, seeing how a particular institution was taking positive steps towards diversity and inclusion became an encouraging middle ground, where they believed they were not completely compromising on their institutional diversity ideal.

On the other hand, when comparing institutions in terms of location, participants contemplated broad factors about the area, city, or state it was located in. This included whether they saw themselves living in certain regions of the US, the availability of recreational activities, familiarity with the area, or proximity to home. Though not every participant assessed the location under a racial or ethnic lens, i.e., whether they felt that it was a safe place for them to live as minoritized individuals, when they did this ideal was often not compromised. The following excerpt echoes a participants' concern over having to live in a location with a historically low number of minoritized individuals to pursue their PhD:

"There were a couple of schools that one of my summer mentors told me to apply to, and they were in the Midwest, and I just wouldn't really feel comfortable being in an area that didn't have so many minority people. So I think that shied me away from really good programs and schools, just because it was like, I just don't feel like I would be able to fit in." – Ali

In recounting their decision process, we find that though they had been advised by past research mentors to apply to certain programs that would have been beneficial to their goals, they did not do so on account of their racial or ethnic identity.

Similarly, participants had a very clear ideal of what they desired in a student community for their institution of choice. Their ideal student community included factors such as racial diversity, sense of community, and collaboration. When finding that their considered programs may not have a racially diverse student body, they went for the programs where they could follow their research interests, as illustrated by the following example:

"I originally thought the students would play a role in that, [I tried] finding programs that had more Black students in them, but there aren't that many, especially at the schools that I applied to. So that wasn't necessarily a factor either. Yeah, I think there was only, when I start, there will be four out of sixty in my program. So it's not really a factor anymore." – Aiden

This participant forwent finding a program with more Black students when faced with the reality of the programs they applied to, opting instead to find an institution where they could pursue their research interests. As with the faculty racial ideal, when the participants had to compromise their racial diversity ideals of the student community, they then looked for proxy factors such as unity among the current graduate students and their desire to include and help new students as they acclimated to the program. One participant recounted how helpful and pivotal the graduate student community was in their process:

"It's just been really great. And then there's a lot of support from the students that are already there. The older students who have been there, who are like, 'hey, what types of seminars do you all want to see? Send us some information on that.' Or, 'if you need any help on this, let us know.'" [...] So, I mean, it's just simple things like that, that have really helped really get me connected." – Andy

The active role that the current graduate students took in helping and including this participant during their application and decision process helped them feel connected to the community even before attending the institution. Having taken the initiative to contact current students, their experience showed them that the institution had a proactive student community in their doctoral program, which was an ideal for them.

VI. DISCUSSION

This case study examined the ideals and compromises considered by minoritized individuals when choosing an institution to pursue their doctoral studies in an engineering discipline after being accepted into various programs. Our study showed three salient themes in their decision-process: funding and research interests, faculty ideals, and institutional ideals.

When considering doctoral programs, most participants would not compromise the availability of funding, and their research interests. That being said, our participants did not express having considered the dollar amount of a funding offer as a main factor when comparing programs, which was found to be in accordance with a recent study by Wall Bortz et al [7]. However, the salience of funding availability as a key factor in our findings could be related to the fact that, historically, minoritized individuals have incurred in bigger student loan debts from their undergraduate degree than their majority counterparts [24]. In addition to the availability of funding, one of their most important considerations when narrowing down their program options was the participants' ideal of finding a position aligned with their research interest. These students often coupled their search for research interests with the values and beliefs of their potential advisors. We found that, contrary to the findings of Mosykowski et al. [10], at this point of their process most participants held intrinsic motivations for their ideal research interest. We believe this difference to be due to our focus on minoritized individuals possibly holding different assessment values, which has been confirmed by prior studies [8], [9].

Many participants stated ideally working with an advisor of their same racial or ethnic background was important, but this ideal was often discarded due to lack of representation among the programs' faculty [12]. In the absence of their racial or ethnic ideal, the faculty's personality and perceived approach to race were highly regarded by the students when balancing their ideals and compromises. Funding and research interests also influenced their choice of faculty, and ultimately their choice of institution. The assessment of potential advisors on their personality, perceived qualifications, availability of funding and research projects aligns with the findings presented by Joy et al. (2015).

The students' ideals related to the institution comprised the institutions' racial diversity, the general racial climate of the

locations where these institutions resided, and the culture of support from the student community. Here the most compromised ideal was the institutions' racial diversity, as the programs that met their ideals of funding and research interests were not as racially diverse as they envisioned. Their ideals of campus climate and location confirm those found in the literature regarding minoritized individuals in graduate school [14], [15]. Yet, contrary to previous findings, the participants did not consider the institutions' proximity to home a decisive factor to their graduate school choice, and instead contemplated how the locations agreed with their personal preferences and how safe they perceived the locations to be for minoritized individuals. This difference notes a departure point with much of the literature discussing proximity to home as a key factor, which is primarily anchored in undergraduate students [19]. Finally, in looking at the community student ideal expressed by the participants, we find that an early connection with the student community in campus was as important to the prospective students' decision process as was the early connection with potential advisors. Their expressions as to how important both types of interaction were to them echo past findings about the importance of a community of support for minoritized individuals in graduate programs [18].

The findings presented may only be transferable to specific circumstances with similar characteristics, i.e., to the experience of traditionally minoritized students who recently chose a doctorate program in an engineering discipline. Additionally, our pool of participants included traditionally minoritized individuals belonging to the Black and Latino communities. While we lack representation from other minoritized identities (Indigenous students, Hawaiian/Pacific islanders, etc.), we believe these findings may translate similarly to their experience given prior aligned studies. Future work should strive to achieve the representation of more minoritized communities to continue to explore how they approach choosing an institution.

VII. CONCLUSION

In conclusion, this study sought to uncover and understand the ideals and compromises that traditionally minoritized individuals sought and made when choosing an institution in which to pursue their PhD. Through a qualitative analysis we found that the most salient factors were their funding and research interests, faculty ideals, and institutional ideals. Faculty ideals included both racial and non-racial factors considered by the students, while institutional ideals involved concerns about diversity, location, and ideals about the student community. It is evident from the findings presented that continuing to increase the recruitment of traditionally minoritized engineering faculty will have a direct impact on the recruitment of minoritized individuals.

Our findings showcase key implications for institutions as they seek to enroll minoritized students. First, our findings lead us to believe that transparency in research opportunities and available funding would increase consideration of enrollment for this student population. Thus, we recommend doctoral engineering programs to maintain accurate and current information along with explanations about their specific admissions process and funding possibilities in their program

websites, to create transparency and accessibility throughout the recruitment and application processes. Second, our findings also suggest that continuing to increase the recruitment of minoritized individuals as faculty in engineering departments would have a direct and positive impact on recruiting minoritized students. Thus, we urge institutions to continue efforts towards growing the faculty's ethnic and racial diversity and consequently creating spaces where more potential students' racial or ethnic identity ideals are met, and fewer compromises are made. In this vein, and in lieu of a diverse faculty, having non-minoritized faculty that can empathize with student identities and struggles could influence their choice of institution. We recommend that faculty do not take a "colorblind" approach to their relationships with their students [25], but be open about their relationships with students in an effort to achieve mutual understanding.

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