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Exploring How STEM Graduate Students Conceptualize Levers of Change and Solutions to Enhance Departmental Racial Climate

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Abstract

The purpose of this qualitative study was to understand how STEM graduate students conceptualized problems that undergird a negative departmental racial climate and explore which policies and practices these students recognized as potential levers for change. Using a generic qualitative inquiry (GQI) approach, we conducted eight focus group meetings and one interview with graduate STEM students (n = 34) at two predominantly white institutions in the United States. Our findings suggest that STEM graduate students identified interpersonal interactions with faculty as a primary driver of negative departmental climate, highlighting a culture of discrimination and lack of accountability. Although students suggested institutionalizing DEI labor and making structural change, they often sought to first improve care for fellow graduate students, feeling ill-equipped to facilitate organizational change. Few research studies address the conceptualization of departmental racial climate from the student perspective and examine their proposed solutions. Using racialized organizations as a guiding theory, this study calls on scholars and practitioners to think more critically about efforts to improve departmental racial climate and address issues of entrenched whiteness. This study suggests that STEM practitioners examine their current departmental processes to enhance racial climate and involve STEM graduate students in valuable ways.

Keywords: STEM; graduate students; racial climate; change; racialized organizations; diversity; equity; higher education; qualitative

1. Introduction

The problematic experiences of graduate students enrolled in science, technology, engineering, and mathematics (STEM) programs, particularly those who are racially and ethnically minoritized[1], are well documented (e.g., Burt et al., 2018; Rodriguez et al., 2021; Slay et al., 2019). These challenges include having one's competence doubted, being excluded from peer groups, and lacking supportive mentors, and have been linked to deeply embedded norms regarding the selection and socialization of STEM graduate students (Amelink & Edwards, 2020; Burt et al., 2018; Rodriguez et al., 2022) and cannot be divorced from the recognition that STEM departments are situated in racialized organizations (Ray, 2019). Yet, STEM departments continue to lack identity-conscious practices and policies, and are often identity-evasive, particularly in graduate education (Robbins et al., 2023). Though progress has been insufficient, there is growing interest in activity intended to diversify and transform graduate education.

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As concerns about equity in STEM continue to grow, so do attempts to identify potential levers for change. Increasing interest in equity work highlights the overall importance of conceptualizing change and solutions to enhance departmental racial climate. Climate can refer to the historical, organizational, compositional, psychological, and behavioral aspects of inclusion and exclusion practices (Hurtado et al., 2012). Departmental racial climate specifically refers to the shared norms, dynamics, and inclusion and exclusion practices embedded within a department that are associated with racial beliefs (Perez et al., 2022; Shi et al., 2025). Departmental climate can be more salient for graduate students than climate in other contexts, given that it is often the academic department where socialization to the discipline and organization occurs (Greene et al., 2010; Margolis & Romero, 1998; Weidman & Stein, 2003). In particular, STEM graduate students often encounter departmental climates shaped by established hierarchies, unclear expectations, limited support, hyper-competitiveness, and other exclusionary practices (Posselt, 2020).

The role of STEM graduate students in departmental change and creating solutions cannot be overstated. Graduate students have the potential—and often lead efforts—to disrupt hegemonic norms around STEM graduate student education and racial climate (Perez et al., 2022; Rodriguez et al., 2022). From prior literature, we know graduate students, particularly those from racially and ethnically minoritized backgrounds, play a significant role in changing departmental climate (Perez et al., 2022). However, STEM graduate students may face challenges in conceptualizing change or in developing actionable solutions to enhance departmental racial climate. As we work to enhance departmental racial climate, we must ensure alignment between change and the levers of change (Perez et al., 2023). Furthermore, we must also recognize that meaningful equity change cannot rest fully on STEM graduate students and must acknowledge higher education institutions as racialized organizations in need of and accountable for creating change (Posselt, 2020; Ray, 2019). Thus, the purpose of this qualitative study was twofold. First, we aimed to understand how STEM graduate students conceptualized problems that undergird negative departmental racial climate. Second, we aimed to explore what policies and practices these students recognized as potential levers for change.

Research Questions

1. How do STEM graduate students conceptualize the problems that undergird negative departmental racial climate?
2. When STEM graduate students propose solutions for enhancing departmental racial climate, what policies and practices are recognized as potential levers for change?

2. Literature Review

To situate our study, we drew upon two bodies of literature. First, the literature on racial climate in STEM graduate education sets the context for participants' experiences with and understanding of departmental climate. Second, and in contrast, the literature on advancing diversity, equity, and inclusion (DEI) in STEM departments provides information on recent approaches and barriers to improving racial climate.

Racial Climate in STEM Graduate Departments. In the United States, negative racial climate has been highlighted as a major contributor to the inequitable experiences and outcomes of racially minoritized students in STEM graduate programs at predominantly white institutions [PWIs] (Burt et al., 2018; Rodriguez et al., 2022; Slay et al., 2019). Across the literature, scholars have highlighted the subtle and overt ways in which the success of many racially minoritized students is hampered by hostile environments and varied access to the resources and opportunities needed to succeed. For example, researchers have asserted that faculty mentorship is vital to graduate students' degree progress and success

as they hone their capacity for independent inquiry (K. Griffin et al., 2018; Noy & Ray, 2012; Ramirez, 2017). Unfortunately, many racially minoritized graduate students at PWIs have reported lacking access to supportive mentors at their institutions (Amelink & Edwards, 2020; Burt et al., 2018; Noy & Ray, 2012; Ramirez, 2017) and having white faculty members doubt their competence and abilities to succeed in a graduate program (Burt et al., 2018; Gildersleeve et al., 2011; Joseph, 2012; Rodriguez et al., 2022). Rather than naming these disparities as a manifestation of racism and bias, institutions tend to avoid discussions of systemic racism and white supremacy in STEM by framing the problem as simply one of ill-trained mentors (McGee, 2021; Perez et al., 2023).

As such, it is not surprising that when some white faculty members tried to be race-neutral as they mentored racially minoritized students, with the idea that doing so would better support their success, their practices still reflected racist ideology. Specifically, McCoy et al. (2015) found their white faculty participants often held lowered expectations for racially minoritized STEM graduate students, viewing them from a deficit lens. Furthermore, Robbins et al. (2023) noted that faculty members' efforts to be race-neutral were experienced by racially minoritized students as race evasive. Rather than signaling inclusion, evading race sent students the message that they and their identities were not welcome in their department, discipline, or field. Thus, faculty members' attempts to be race-neutral have been anything but that and have been a factor in creating and sustaining negative racial climates in some STEM graduate programs. In effect, feigning notions of race neutrality and objectivity has been a means of upholding the centrality of whiteness in STEM (Le & Matias, 2019; McGee, 2021).

Doubts about racially minoritized students' capacities and presence in STEM graduate programs were not limited to faculty. Across the literature, racially minoritized students reported having white peers question their intelligence and their abilities as researchers (Burt et al., 2018; Gildersleeve et al., 2011; Joseph, 2012) and being excluded from groups or feeling tokenized by their peers (Amelink & Edwards, 2020; Burt et al., 2018; Gildersleeve et al., 2011; Joseph, 2012). In STEM, where collaboration is essential for advancing one's work, being excluded from groups has the potential to detract from racially minoritized students' research and, in turn, their degree progress and career opportunities (K. Griffin et al., 2018; Rodriguez et al., 2022). Scholars found that navigating exclusion and a hostile racial climate also had negative effects on racially minoritized graduate students' well-being and sense of belonging (Gildersleeve et al., 2011; Perez et al., 2022; Slay et al., 2019; Truong & Museus, 2012). In this regard, the cost of social and intellectual exclusion for racially minoritized students during their graduate training is high and has implications for their retention and success.

Across the literature, scholars who have examined racial climate in STEM graduate programs have tended to focus on identifying problems and uplifting the experiences of racially minoritized students, as these are often obscured in environments that centralize whiteness. Furthermore, the literature has primarily attended to how faculty members' thinking and behaviors contribute to negative racial climates in STEM. As such, there has been less attention to how graduate students conceptualize the root causes of negative racial climates and the implications of these understandings on their subsequent actions.

Approaches to Advancing DEI in STEM Departments. Given the challenging experiences and inequitable outcomes for racially minoritized graduate students, there have been calls to improve racial climate in STEM departments (McGee, 2021; Posselt, 2020). In response to these calls, interventions have targeted faculty members and institutional leaders with the understanding that these individuals strongly influence departmental climate and have more power to improve climate than graduate students (Perez et al., 2023; Posselt, 2020). Specifically, some STEM departments have engaged in holistic admissions practices,

enhanced faculty members' advising and mentoring skills, and provided opportunities for individuals to learn about how to promote more inclusive environments (K. A. Griffin et al., 2016; Hill et al., 2011; Posselt, 2020).

Despite substantial effort by some STEM departments to improve racial climate, change has been slow and difficult to sustain in many units. Dancy and Henderson (2008) asserted that change in STEM has been hampered by an overemphasis on fidelity to models and interventions that may not be applicable across contexts. In contrast, Kezar et al. (2015) argued that implicit theories of change constrain how individuals think about and engage in work to make change in STEM. They noted some individuals believed change started with interventions rather than deeply understanding the problem they were attempting to address. Although scholars have highlighted barriers to cultural change in STEM, they have not consistently attended to how racism and White supremacy have stifled this process (Le & Matias, 2019; McGee, 2021; Perez et al., 2023).

With this in mind, McGee (2021) noted STEM departments tend to create inventions (e.g., mentoring programs, affinity groups) intended to support racially minoritized students without addressing racism and white supremacy. While well-intended, these interventions have limited success because they do not substantively address racist cultures, policies, and practices that negatively affect racially minoritized graduate students. Similarly, Perez et al. (2023) found that STEM faculty members, administrators, and postdoctoral fellows did not discuss racism and white supremacy as root causes of hostile racial climate. In turn, their strategies for improving racial climate (e.g., recruitment, committees, workshops) left systemic racism untouched.

Furthermore, departments' approaches were highly dependent on the labor of racially minoritized graduate students and faculty champions who received limited support for their work. In effect, the work of improving racial climate in STEM is often shifted to racially minoritized students who are simply trying to survive in environments not made for them (Perez et al., 2022). While graduate students may be motivated to create change, their ability to improve racial climate is constrained by their power and decision-making authority within their department. Yet, students' effectiveness may be further limited by their understanding of the underlying causes of negative racial climate since many departments avoid explicit discussion of how race, racism, and White supremacy inform culture and work in STEM (Le & Matias, 2019; Perez et al., 2023). Our study addresses this gap.

Theory. This study used Ray's (2019) theory of racialized organizations. This theory recognizes that organizations are racial structures rooted in whiteness, operating to the detriment of racially minoritized people through an unequal distribution of resources, labor, and opportunities. Rather than espousing race-neutrality and solely using race and ethnicity as demographic variables, the theory of racialized organizations explores racial structures that reproduce inequities and the relationships between agency (i.e., individual and collective) and those racial structures. In racialized organizations, individuals and groups have the agency to reproduce or challenge established racial hierarchies. However, racialized organizations, by nature, can restrain the agency of minoritized racial and ethnic groups while imbuing power to the organization's dominant groups. Given the pervasive race evasiveness, inequitable distribution of resources and labor, and constrained agency of those seeking to improve the racial climate in STEM departments described across the literature (e.g., McGee, 2021; Perez et al., 2022, 2023), this theory was well-suited to our study.

Ray's (2019) theory of racialized organizations illuminates four ways the centrality of whiteness is upheld in organizational hierarchies and processes, including how organizations: (1) give agency to white people while constraining the efforts of minoritized people;

(2) normalize the uneven distribution of resources, labor, and opportunities; (3) allow for whiteness to operate as a form of power and legitimacy; and (4) give the appearance of neutrality and maintain white supremacy by decoupling DEI efforts from key policies and practices. Ray described three levels of analysis to investigate these concepts: individual (micro), organizational (meso), and institutional (macro) levels. For the purposes of this study, the individual level (micro) helped us understand prejudice, racial attitudes, and implicit biases and stereotypes, group interactions, and unequal treatment. The organizational level (meso) of this theory allowed us to understand how graduate STEM students conceptualized the problems and solutions related to racial climate in departmental and university settings. The institutional (macro) level expanded our thinking to consider structures of institutionalized racism, including policies and practices that are either explicitly or implicitly racialized.

In the past, scholars have used this theory to study a variety of organizational contexts across interdisciplinary lines (e.g., medical schools, the administrative state), including how STEM faculty, administrators, and postdoctoral fellows understand their role in changing departmental climate (Nguemeni Tiako et al., 2021; Perez et al., 2023; Ray et al., 2023). The current study addresses a theoretical gap in our understanding of how STEM graduate students conceptualize their role (and the role of others) in addressing departmental climate in racialized organizations.

3. Methods

Using generic qualitative inquiry (GQI) research methods, we took an interpretive, holistic approach to understanding the situated, lived experiences of our participants (Denzin & Lincoln, 2011). A GQI approach allowed us the methodological and interpretive flexibility to capture the rich sense-making of STEM graduate student experiences without the constraints of any one qualitative methodology (Percy et al., 2015). We used focus groups as our main form of data collection, allowing us to capture a range of perspectives and allowing participants to engage in shared meaning-making (Glesne, 2011; Ritchie & Lewis, 2009). Institutional review board approval was secured prior to the beginning of the study. Informed consent for participation was obtained from all subjects involved in the study.

3.1. Research Site and Participants

This study, part of a larger National Science Foundation (NSF) project focused on enhancing racial climate through a networked improvement community (NIC), was conducted at two predominantly white institutions: Mid-Atlantic University and Northeast University (pseudonyms). NICs are structured learning communities that bring together a range of stakeholders with a common goal of solving a shared problem (Bryk et al., 2010, 2015). NICs often use their network of stakeholders to design structured interventions and engage in shared improvement cycles (LeMahieu et al., 2017; Noble et al., 2021). Sites were selected based on their unique institutional contexts and approaches to STEM racial climate interventions, as well as their participation within the NIC. We collaborated with partnering graduate schools of the NIC institutions to recruit students via email for this study. Specifically, our recruitment email was sent to STEM graduate students who were members of graduate student organizations or had participated in inclusion-oriented professional development programs provided by their graduate college. Participants included graduate students from a range of STEM disciplines.

3.2. Data Collection

Using a semi-structured protocol, we conducted nine focus groups and four interviews with graduate STEM students (n = 34) from majority and racially and ethnically minoritized backgrounds (see Table 1). Focus groups (~90 min in length, professionally transcribed) were conducted during 2018 and 2019. Because we collected data over multiple years, students could participate in one focus group per year. At Mid-Atlantic University, we conducted four groups and one interview, for a total of 11 participants. At Northeast University, we conducted four groups with a combined total of 23 participants. The single interview occurred when the student was the only person to show up to the focus group.

Table 1. Participant overview.

Institution	Number of Groups & Participants	Discipline & Field Composition
Mid-Atlantic	4 Groups, 1 interview; 11 participants	0 Agricultural sciences 2 Biological sciences 2 Computer sciences 3 Engineering 2 Physical sciences 2 Social sciences
Northeast	4 Groups, 23 participants	2 Agricultural sciences 11 Biological sciences 1 Computer sciences 8 Engineering 1 Physical sciences 0 Social sciences

Sample focus group questions included, "How would you describe the racial climate in your department?" and "What recommendations would you make for enhancing racial climate in your department?" To ensure students felt comfortable discussing racial climate, we offered students the ability to self-select into focus groups that best aligned with their racial and ethnic identities. At Mid-Atlantic University, we organized focus groups into two categories: (a) racially minoritized students and (b) white students, while at Northeast University, participants could select between focus groups for: (a) Black, Latinx/e, and Indigenous, (b) Asian and Asian American, and (c) white students. To encourage students to discuss their own departmental experiences, we invited them to serve as experts on their own experience and discuss the unique attributes of their discipline or field. To address the possibility of deductive disclosure, we elected not to collect demographic data; however, when participants voluntarily disclosed relevant identities, we documented them and applied professional judgment when reporting.

3.3. Data Analysis

We used an iterative, hybrid approach (i.e., deductive and inductive) to code focus group transcripts and determine themes (Bogdan & Biklen, 2003). Using relevant literature on graduate STEM students, higher education change, and racial climate, we created an initial code list of codes (i.e., deductive coding) and then coded one focus group (e.g., sample codes: resistance/barriers to change, departmental climate, racialized taxation). We added and revised codes as necessary (i.e., inductive coding) to create our codebook, which was then used to code the remaining transcripts. After coding the data, we used specific examples from the focus groups to explore preliminary themes and their connection to our theoretical framework. To do so, we grouped inductive codes into categories, and then we utilized our theory as an analytic lens to interpret those categories. From there, we elevated interpreted categories into themes that reflected broad patterns across our data.

3.4. Trustworthiness

To enhance trustworthiness, we used consensus building and explored our author positionalities (S. R. Jones et al., 2014; Knafl & Breitmayer, 1989). Consensus-building guided our interpretations of focus group material and supported our construction of the study's findings. Our team established clear research goals at the outset, maintained open communication throughout the study, and engaged in systematic data analysis. Our findings are the result of an iterative process in which the team revisited the data multiple times and refined our findings to reach agreement on interpretations. Over the course of the study, we explored our own positionalities through self-reflection and a commitment to ongoing reflexivity. Each member of the research team identifies as a scholar from a racially or ethnically minoritized background and devotes a component of their scholarship to graduate education in STEM fields and approaches that work from an equity-minded lens. In addition to their expertise, Lee and Perez were trained in STEM fields and used their knowledge to contextualize findings. Although none of us worked at the institutions in this study, two of the authors (Rodriguez and Perez) served as co-PIs on the larger NSF-funded project. We used connections from the larger project to build trust and rapport with institutional partners and created a feedback loop in which we shared findings and engaged in discussions with them. Lee, who was not involved in data collection, brought a new perspective to the study and enhanced our team's ability to interpret our findings through the lens of Ray's (2019) racialized organizations.

4. Results

This study found that STEM graduate students recognized interpersonal interactions as drivers of negative departmental climate and identified negative racial departmental climate as resulting from a culture of discrimination and a lack of accountability. When STEM graduate students proposed solutions to enhance departmental racial climate, they tended to focus on interpersonal treatment and developing the capacity for holistic care for students. Furthermore, STEM graduate students often took on the burden of improving their departmental climate and worked to institutionalize change efforts, despite not always being aware of what institutionalization might entail.

4.1. RQ1: How Do STEM Graduate Students Conceptualize the Problems That Undergird Negative Departmental Racial Climate?

Our findings suggest that STEM graduate students recognized interpersonal interactions with faculty (individual level) as a primary driver of negative experiences or departmental climate. They attributed the quality of interpersonal interactions between faculty and racially/ethnically minoritized graduate students to the faculty members' awareness, understanding, and willingness to engage in DEI efforts, and to the extent to which graduate students depended on individual faculty for funding and graduate education processes. They also highlighted a culture of discrimination and a lack of accountability (organizational level) as underlying negative departmental climates.

STEM Graduate Students Emphasized Interpersonal Interactions as Drivers of Negative Experiences. Students recognized that negative interpersonal interactions/incidents perpetuate a negative experience or departmental climate for those with racialized and ethnically minoritized identities. Whereas some students remarked, "we've got some racism problems" (racially/ethnically minoritized STEM graduate student), it was far more common for these problems to be expressed as the result of problematic or uninformed faculty. The following statement captured this sentiment:

> I think it is more of a professor, a specific professor–advisee relationship, than a departmental thing. If the professor is a good professor, they'll treat the grad...

> He or she will treat the graduate students really well and if you're not a good adviser then they'll take advantage of them.—(racially/ethnically minoritized STEM graduate student)

As illustrated in the example above, negative experiences were not necessarily viewed as a "departmental thing" and were easily located at the micro level by some participants. Whereas some students (mostly white students) attributed negative interactions to faculty not being "good," others noted faculty needed to "learn about the experiences of the students that they're bringing in that are underrepresented" (racially/ethnically minoritized STEM graduate student).

STEM Graduate Students Recognize a Culture of Discrimination and a Lack of Accountability. Whereas interpersonal interactions were primarily emphasized, some graduate students identified the organization's role in perpetuating these issues or failing to take adequate action. As one student suggested, "I feel like until universities find ways to institutionally address discrimination from faculty members to graduate students, like systematic discrimination, I don't think that's going to change. That's pretty ingrained in the culture" (white STEM graduate student). Related to these issues being ingrained in the culture, students also discussed the racist behavior of faculty being openly recognized, as well as it also being "hard to know what to do with one faculty member that is just so. . .blatantly disrespectful" (racially/ethnically minoritized STEM graduate student). This recognition manifested itself as faculty being aware of student issues and students actively steering prospective students away from certain labs, yet no action was taken at the organizational level.

Students expressed minimal confidence in organizations (e.g., departments, graduate schools) being able to "enforce its own policies about [the] discrimination of students" (white STEM graduate student). This lack of confidence was communicated through comments about tenure providing "too much power and protection" and "no protection against retaliation" if a student was to call someone out.

4.2. RQ2: When STEM Graduate Students Propose Solutions for Enhancing Departmental Racial Climate, What Policies and Practices Are Recognized as Potential Levers for Change?

Our findings suggest STEM graduate students sought first to improve the interpersonal treatment and holistic care for graduate students (individual level) before focusing on departmental racial climate (organizational level). When asked specifically about racial departmental climate, graduate STEM students suggested institutionalizing DEI labor and making structural change (organizational level). However, students recognized the burden placed on them to lead such efforts and did not always know exactly what those changes might look like.

STEM Graduate Students Focus on Interpersonal Treatment and Developing Capacity for Holistic Care for Students. Graduate students focused their suggestions for potential levers of change on addressing the negative experiences of individual students, particularly through improving the mentoring provided by faculty members who advise/supervise them. One student remarked:

> There should be a greater push for faculty, at least, to take courses around just being a better person. It's not going to change [the] core of who they are, but I guess I feel like there are a lot of people who are either neutral with regards to these issues, and there are people who just aren't willing to listen.—(racially/ethnically minoritized student)

Another student highlighted how training might help faculty members enter difficult conversations on the topic:

> I don't know if that comes in the form of trainings or just self-improvement or self-education or just caring enough to join the conversation to talk about things that affect their students and affect other faculty that don't belong to the majority group.—(racially/ethnically minoritized student)

Other common suggestions were mandatory training for faculty, staff, and students and greater interconnectedness between individuals across disciplines or fields. One student offered the following suggestion:

> I feel like it's when you're the only Black person in a department or the only minority in a department, or one of the very, very, very few, there should be, somewhere in the university, some sort of supporting faculty member who is outside of that department, and doesn't have skin in the game, who can sort of check in on you, and keep an eye on whether the decisions that are being made on your behalf are decisions that make sense, or decisions that seem like they're steeped in bias.—(racially/ethnically minoritized STEM graduate student)

In addition, it is important to note that students often located the power to enact these changes in the agency of individual faculty members, often faculty of color. The suggestions made were seldom aimed at addressing departmental racial climate.

STEM Graduate Students Recognize and (Often Accept) The Burden of Improving Departmental Racial Climate, Sometimes Noting Being Ill-Equipped or Uncredited for the Task. Students recognized that (often white) departmental leaders do not support DEI work, leaving graduate students (often racially/ethnically minoritized students) with an expectation to improve diversity (via recruitment events) and departmental racial climate (via committees and other professional service) but little agency to make real substantive change to departmental policies and practices. Students articulated the general lack of support for racially/ethnically minoritized students doing the work:

> We don't have any support for underrepresented graduate students in our department. It's more just like underrepresented students doing the labor to bring other underrepresented students from surrounding areas.

Students regularly discussed contributing to such labor, sometimes expressing a desire to do so, but other times expressing an urgent need to address the poor racial climate. For example, a racially/ethnically minoritized student stated:

> [A] common pattern that every single one of us shares is that we are willing to facilitate an environment so that people who come after us. . . they won't have to go through the same struggles that we went through.

Racially/ethnically minoritized students often used their own negative experiences with racial climate to inform their often unrecognized labor to the department.

However, this labor does not manifest the same across racial groups. Similar to racially/ethnically minoritized students, white graduate students articulated a lack of support for addressing racial climate. As one white student noted:

> there's not [any] resources for how white students can help with that if there is discrimination, or how you even report that, right? If there's something that happened in the lab or just at an event on campus, I don't know how I would actually report that. . .

Ill-equipped to report negative instances of discrimination, this student hesitated to engage in such departmental labor. White graduate students also discussed a culture of faculty taking credit for DEI work at the department level. One student highlighted how DEI work was often uncredited and co-opted by self-congratulatory departmental faculty:

> I've heard that that's pretty common across other departments or fields is that the students are the ones creating the change and then faculty will pat people on the back and sometimes even take credit for it, after the fact, and brag about how great their students are, how great their programs are about being aware of things.

Despite being catalysts for change in STEM graduate education, students were often uncredited for work towards a more inclusive racial climate.

STEM Graduate Students Suggest Institutionalizing DEI Labor, but Don't Always Know What that Means. STEM graduate students, particularly those from racially/ethnically minoritized backgrounds, insisted departments should institutionalize the labor that graduate students have been doing. Students articulated the need for buy-in from departmental leadership and asked for a commitment to normalizing the racial climate, so everyone has to be involved. Students recognized the need for labor to be redistributed, to balance the power, as well as to put legitimacy and resources towards enhancing departmental racial climate change. Students wanted DEI efforts to be aligned with policy and practice, and could recognize when it was performative and reactive. However, they often stopped short of specifying what that would look like. One student captured a potential reason as follows:

> I don't think I have a wider view of how the [university] government functions here, how that administration functions. That level is higher than my chair, unfortunately. I wish I did, but I know that there's just signs. I see signs of where the university's values are.—(racially/ethnically minoritized STEM graduate student)

Several students mentioned not understanding how the university functions or knowing the current policies when discussing potential solutions. They perceived a lack of knowledge regarding "what's possible and what's not…" (racially/ethnically minoritized student) and how to approach departmental racial climate change: "I don't know if it's because of bureaucracy or how the system is established…" (racially/ethnically minoritized student).

5. Discussion

This study sought to understand how STEM graduate students conceptualized the problems that undergirded a negative departmental racial climate and what solutions were recognized as potential levers for change. Together, these findings suggest that STEM graduate students saw interpersonal interactions, particularly with faculty, as drivers of a negative departmental climate in which discrimination and a lack of accountability were consistent patterns. Through the lens of Ray's (2019) theory of racialized organizations, our findings suggest that organizational patterns give agency to certain individuals (faculty, organizations) while constraining others (STEM graduate students). Persistent discrimination and a lack of accountability further align with Ray's position that organizations espouse neutrality by separating DEI efforts and systematic approaches to changing departmental racial climate. These findings also suggest that STEM graduate students' emphasis on interpersonal, holistic approaches to addressing departmental racial climate, rather than larger reform, reflects Ray's argument that within racialized organizations, minoritized populations are often constrained and carry disproportionate levels of labor while those in authority gain power and freedom to set departmental norms and expectations as well as gain organizational capital for change carried out by minoritized populations.

Past scholarship has highlighted the negative racial climate as a major contributor to inequitable experiences and outcomes for racially minoritized students at PWIs (Burt et al., 2018; Rodriguez et al., 2022; Slay et al., 2019). This study demonstrated that STEM graduate

students conceptualized issues of departmental racial climate as both interpersonal in nature and organizational. It also reveals that STEM graduate students proposed a range of practices for addressing departmental racial climate; however, those solutions were often limited by students' own admitted lack of knowledge of the university system, as well as limited agency in the organization as a whole. The following sections discuss these findings in light of Ray's three levels of analysis: the individual (micro), organizational (meso), and institutional (macro) levels.

5.1. Micro-Level Interactions Form the Foundation to Departmental Racial Climate

This study found STEM graduate students primarily recognize interpersonal interactions (e.g., poor mentoring) as drivers of negative departmental climate, echoing prior scholarship that highlights the often troubled nature of faculty–student interactions (Amelink & Edwards, 2020; Burt et al., 2018; Noy & Ray, 2012; Ramirez, 2017). However, this study also demonstrated how STEM graduate students often stop short of connecting negative departmental racial climate to structural issues, and conceptualize problems as solvable through increased awareness, community-building, or addressing individual, race-neutral problems involving structural issues, and conceptualized problems as solvable by increased awareness, community-building, or addressing individual, race-neutral problems with "disrespectful" bad actors. As such, STEM graduate students might believe they are addressing the issues at hand, but in reality, their agency remains constrained despite their best efforts to improve departmental racial climate.

Seen through a lens of racialized organizations, this study points to the importance of how interpersonal interactions mediate power and agency, giving greater agency to more powerful stakeholders (e.g., faculty) and dominant identities (e.g., white faculty and STEM graduate students) while constraining minoritized individuals (e.g., STEM graduate students of color). As such, micro-level interactions have the ability to create opportunities to enhance departmental racial climate or perpetuate inequities. A lack of accountability enables negative micro-level interactions to persist and a negative departmental racial climate to become entrenched.

To counter this, there should be more emphasis on the responsibility that institutions, departments, and faculty have in transforming departmental racial climate. And, while scholars (Posselt, 2020) have called for increased responsibility for those institutional actors serving STEM graduate students, accountability remains elusive, particularly as norms and expectations around DEI efforts continue to shift at the micro-level as a result of shifts within the larger meso-, and macro-levels.

5.2. Burdened, Uncredited in Efforts for Meso-Level Improvement to Departmental Racial Climate

This study's focus on departmental racial climate is most closely intertwined with concepts regarding Ray's meso-level, as this is a space in which micro-level interactions transform into accepted organizational practices. Although there have been calls to improve racial climate in STEM departments (McGee, 2021; Posselt, 2020), this study shows that universities cannot merely engage with DEI interventions, but they must address the racialized organization. Taken together, our findings take DEI work and questions at a fundamental level regarding how university communities—and STEM graduate students specifically—conceptualize racial climate and the proposed levers of change. We are left to ask what it truly means to change departmental racial climate, including who is involved, what levers of change must be engaged, and who retains the power to make those changes.

Prior scholarship has noted how STEM departments and institutional actors often create interventions (e.g., mentoring programs, affinity groups) intended to support racially/ethnically minoritized students without addressing racism and white supremacy

(Kezar et al., 2015; McGee, 2021). However, this study demonstrates how racialized organizations constrain the agency of STEM graduate students, burden them with improving racial climate, and create an environment where they feel ill-equipped to facilitate real change. When STEM graduate students did recognize negative racial departmental climate, they were generally at a loss for how to address the culture of discrimination and lack of accountability at the organizational level, or shifted focus to addressing holistic care, without addressing racial climate. Though we know navigating exclusion and hostile racial climate can have negative effects on racially minoritized graduate students' well-being and sense of belonging (Gildersleeve et al., 2011; Slay et al., 2019; Truong & Museus, 2012) and that these students are often the ones doing the majority of DEI labor (Perez et al., 2022), this study highlights the limitations of STEM graduate students' knowledge and training regarding graduate education policy and practice and general workings in a university setting. Even with a high degree of agency to effect change, STEM graduate students remain constrained within racialized organizations due to the need to navigate highly complex higher education systems and graduate education norms and expectations.

Although this study echoes prior research on the exploitation of DEI work and elements of racial capitalism (Leong, 2021; Rodgers & Liera, 2023), it also questions whose labor is uncredited or expected (racially/ethnically minoritized graduate STEM students or faculty) and whose labor is recognized (STEM faculty—most of whom are men) or absent without training or credit (white STEM graduate students). Departments normalize and justify allowing STEM graduate students to carry the burden of DEI work by allowing students to take on the burden of DEI work, with little to no recognition or compensation, and by taking credit for that work. Whiteness operated as a form of power and legitimacy (e.g., K. Jones & Okun, 2001) within this study in several forms, including: (1) faculty members inherently having a right to comfort, but STEM graduate students had to endure faculty members who were blatantly disrespectful and harmful, (2) faculty members and administrators who hoarded power and decision-making from students, and (3) faculty members who sought individual recognition and credit for STEM graduate student DEI work.

When students are taking up individual and organizational work to ensure others do not suffer, they are up against a formidable foe and can only operate in the bounds/levers that they are allowed to by the organizational (meso) and institutional (macro) level structures and its actors. Even when the university is not outright constraining graduate STEM students, power remains with the white majority (e.g., faculty, leadership; Perez et al., 2023; Posselt, 2020) as they assume credit and continue to allow whiteness to operate as a form of power and legitimacy, treating DEI work as a commodity. As such, DEI becomes a commodity in the racialized organization and something departmental citizens can opt in or out of, depending on its worth relevant to the field, discipline, or society. If departments wanted STEM graduate students and faculty members to engage in DEI work, they might support a rebalancing of power and agency and train up-and-coming scholars in such work, seeing it as a value and priority, rather than efforts which are decoupled from policies and practices.

Although efforts aimed at improving departmental racial climate at the meso-level may seem the most promising, the reliance on STEM graduate student labor, agency, and power fails to hold institutions, departments, and faculty members accountable. Now, with the turning away from DEI efforts once aimed at improving departmental climate, STEM graduate students may come to experience even greater levels of constrained agency and a complete lack of accountability hidden under the chilling effect of anti-DEI legislation and policy changes in recent years.

5.3. Absence of Macro-Level Connections to Departmental Racial Climate

Using Ray's (2019) theory of racialized organizations reveals how whiteness is upheld through departmental hierarchies in which the organization cannot change because of an entire class of people (primarily white male faculty members and leaders) who perpetuate, ignore, or tolerate a negative racial climate. These findings reflect an uneven distribution of power, legitimacy, and opportunities for change, and demonstrate that STEM graduate students lack significant agency within the current U.S. graduate education system and demonstrate how STEM graduate students lack any form of significant agency in the current U.S. graduate education structure. This may also relate to a student's awareness and locus of control, in which STEM graduate students can most clearly see and potentially address issues at the individual (micro) and organizational levels (meso) but not the institutional (macro) level. Relatedly, while prior studies have highlighted the race-neutrality perpetuated by faculty members, administrators, and postdoctoral fellows (Perez et al., 2023; Robbins et al., 2023), this study further suggests that the appearance of neutrality and centrality of whiteness may extend to how STEM graduate students conceptualize and offer solutions to address racial climate. Markedly, participants of the current study did not refer to institutionalized racism (macro level), perhaps because these data were collected prior to several significant U.S. socio-historical events taking place in 2020 (Rodriguez et al., 2022).

5.4. Limitations and Implications

With any research endeavor, the current study was limited in several key ways. First, the study represents the experiences of STEM graduate students at two U.S. institutions and cannot begin to address the nuances of departmental racial climates in each department and discipline throughout the nation, let alone internationally. Future research studies might seek to include a broader spectrum of universities, across various institutional types (e.g., small private, Hispanic-serving Institutions) or beyond U.S. contexts to tease out similarities or differences in addressing departmental racial climate.

Second, because we elected not to collect demographic data, the current study does not include an empirical analysis of demographic data. Future researchers may take a different approach that more in systematically explores how graduate students' views on racial department climate are impacted by their positionality.

Third, as the current study looked across STEM fields, future research might seek to disaggregate by field or specific discipline (e.g., computer engineering) to capture a greater level of understanding regarding the conceptualization of racial climate problems and solutions for those areas. Future research might discuss how differing fields and departments approach racial climate work and delve deeper into how some fields may more readily allow for whiteness to operate as a form of power and legitimacy. Third, this study represents a snapshot of departmental racial climate seen by STEM graduate students, which may shift as students undergo their own racialization processes and sense-making and departments shift their stances on these issues. For a more comprehensive understanding, future researchers might consider longitudinal studies of these issues, particularly around the racialization processes and sense-making of racially/ethnically minoritized STEM graduate students.

Lastly, we would like to explicitly acknowledge the temporal context of the data as a limitation of the study. Because the data were collected 2018–2019 and there have been significant developments in discussions and institutional responses to racial climate in STEM fields in recent years, our findings may have some limited generalizability to the present context. For example, significant racial climate discussions occurring as a result of the sociohistorical events associated with the COVID-19 pandemic, Black Lives Matter Movement, and growing anti-DEI legislation across the United States may represent

important shifts in the approaches to departmental racial climate since the time of data collection. Therefore, future research might seek to understand longitudinal shifts in departmental climate to understand changes over time or more contemporary examinations in order to capture a more robust understanding of this issue in the ever-changing landscape of STEM higher education.

As DEI efforts across the United States and beyond are under attack, this study also points to a continued need for addressing racial climate with meaningful, structural approaches. If we are going to continue turning to graduate students to identify ways to improve the university, we must also work to ensure they understand how it works. Similar to other forms of academic competence, STEM graduates might also learn about university processes (e.g., organizational, administrative, grievances, leadership) and anti-oppressive relationship building and practices (e.g., advising, student–faculty or colleague interactions).

However, this study suggests a reliance on STEM graduate students and a failure to institute structural changes for enhancing racial climate may result in continued marginal improvements. Rather than solely relying on the labor of STEM graduate students, institutions must partner with graduate students to address the underlying structural racism and other oppressions that undergird graduate education. To address problems and solutions beyond the individual level, departments might seek to decenter whiteness by encouraging and incentivizing STEM faculty and leadership to cede some of their power to graduate students, particularly racially/ethnically minoritized groups. This might look like adopting greater transparency regarding departmental policies and practices and bringing STEM graduate students into the decision-making processes of the department, equipping them with the knowledge to successfully take part in these processes, and incentivizing their participation (e.g., through monetary support, a required component of departmental socialization).

Relatedly, departments might also seek to redistribute resources, labor, and opportunities to make them more equal, particularly for racially/ethnically minoritized students. This might look like increased spending on DEI work or redistribution of limited resources to give greater importance to key policies and practices, such as examining admissions or grievances policies and practices. Finally, departmental leadership working towards acknowledging whiteness operates as a form of power and legitimacy by clearly recognizing DEI as an established value and tangible incentive in organizational policies and practices. For example, this might mean examining departmental policies and practices related to the areas of research, teaching, and service for opportunities to express values and incentives to faculty members and leadership for their DEI work. Given the anti-DEI rhetoric and established DEI bans throughout the United States and beyond, departments may have to exercise care and creativity to preserve these efforts during a time in which inclusion and diversity are under attack.

6. Conclusions

The purpose of this qualitative study was to understand how STEM graduate students conceptualized problems that undergird negative departmental racial climate and explore what policies and practices these students recognized as potential levers for change. STEM graduate students conceptualized the problems as both individual and organizational in nature. Although STEM graduate students suggested institutionalizing DEI labor and making structural change, they often sought to first improve the interpersonal treatment and holistic care for their fellow graduate students or felt ill-equipped to facilitate organizational-level change. Future research should continue to investigate these issues in a more nuanced and longitudinal manner to gain a better understanding of how to improve departmental racial

climate. This study suggests STEM practitioners might examine their current departmental processes to find ways to enhance racial climate and involve STEM graduate students in meaningful, valuable ways.

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Note

[1] We use the term racially and ethnically minoritized in order to be power-conscious in our analyses and highlight the process of oppressing students into their status as a minority through structural racism. For the purposes of this paper, minoritized racial and ethnic identities in the U.S. context include American Indian or Alaska Native, Black or African American, Asian American, Native Hawaiian or Other Pacific Islander, and Hispanic or Latina/o/x/e.

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