

## Racialized and Gendered Labor in Students' Responses to Precalculus and Calculus Instruction

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Precalculus and calculus are considered gatekeeper courses because of their academic challenge and status as requirements for STEM (science, technology, engineering, and mathematics) and non-STEM majors alike. Despite college mathematics often being seen as a neutral space, the field has identified ways that expectations, interactions, and instruction are racialized and gendered. This article uses the concept of labor to examine responses from 20 students from historically marginalized groups to events identified as discouraging in precalculus and calculus instruction. Findings illustrate how Black students, Latina/o students, and white women engage in emotional and cognitive labor in response to discouraging events. Additionally, to manage this labor, students named coping strategies that involved moderating their participation to avoid or minimize the racialized and gendered impact of undergraduate mathematics instruction.

**Keywords:** Race; Gender; Labor; Calculus instruction; Undergraduate education

Students' first experiences with college mathematics often entail introductory precalculus and calculus courses. Precalculus and calculus courses are considered gatekeeper courses because of their academic challenge and status as requirements for entrance into STEM (science, technology, engineering, and mathematics) and non-STEM majors alike. Whereas for some students these experiences focus on learning content, for Black and Latin\*<sup>1</sup> students as well as white women, these courses often demand an additional focus: managing messages of belonging. Despite college mathematics classes often being seen as culturally neutral (Hottinger, 2016), many scholars have described how these learning spaces are shaped by racialized and gendered ideologies (Borum & Walker, 2012; Leyva, 2016, 2021; McGee & Martin, 2011; Rodd & Bartholomew, 2006). *Racialized and gendered ideologies* refers to a set of interrelated beliefs and values that place whiteness and masculinity in the center of what it means to belong in mathematics, thereby positioning Black and Latin\* students as well as white women at the margins (Leyva, 2017). This results in events that burden students from historically marginalized groups<sup>2</sup> as they navigate racialized–gendered spaces while trying to succeed mathematically (Borum & Walker, 2012; Oppland-Cordell, 2014).

This article uses the concept of labor (Acker, 1990; Moore, 2008; Pierce, 1996) to examine the responses of 20 students from historically marginalized groups to events identified as discouraging in undergraduate precalculus and calculus instruction. By *labor*, we refer to the ways that students from historically marginalized groups engage in processing and responding to discouraging classroom experiences in introductory mathematics courses. This study complements research about students from historically marginalized groups that often focuses on persistence in STEM in the form of long-term outcomes, such as passing or failing a course, dropping a course, or making decisions about pursuing a STEM major (e.g., Ellis et al., 2016; Jett, 2013; Leyva, 2016). As described in Ellis et al. (2016), these long-term outcomes are not the result of a single decision or event, “but a process based on a collection of curricular, instructional, and cultural issues” (p. 2). We extend prior research by focusing on more short-term responses. The cumulative impact of these responses implicates STEM persistence. Therefore, this research offers insight into everyday instructional practices that present barriers to students' long-term STEM persistence. We address the following research questions:

<sup>1</sup> *Latin\** is a term that encompasses fluidity of social identities. The asterisk considers variation in self-identification among people of the Latin American diaspora. Latin\* responds to (mis)use of Latinx, a term reserved for gender-nonconforming peoples of Latin American origin and descent (Salinas & Lozano, 2019). The Latin\* student participants in our study self-identified as either Latina women or Latino men.

<sup>2</sup> For the purposes of analysis, we use the descriptor *historically marginalized groups* to encompass Black and Latin\* students as well as white women with respect to access to mathematics.

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1. What types of labor do students from historically marginalized groups describe in responding to discouraging events in undergraduate precalculus and calculus courses?
2. What strategies do students adopt to cope with this labor?

### Invisible Labor

To frame our analysis, we draw on sociological literature to conceptualize labor (Acker, 1990; Evans & Moore, 2015; Moore, 2008; Pierce, 1996), which serves as a lens for detailing the responses of students from historically marginalized groups to institutional oppression through undergraduate mathematics instruction. This sociological literature has addressed the invisible labor in which historically marginalized communities engage when facing racialized and gendered forms of institutional oppression. Here, we unpack the constructs of emotional and cognitive labor before briefly exploring their role in mathematics education.

Acker (1990) discussed how gendered interactions place more of an emotional burden on women, which they must then bear in the workplace. Organizations shape these interactions through *organizational logics*, which Acker defined (in a gender-specific way) as a shared set of underlying assumptions about gender as well as institutional practices rooted in these assumptions. Specifically, Acker noted that gendered organizational logics frame emotions as disrupting the optimal functioning of work. Pierce (1996) operationalized how logics play out by examining how paralegals manage the emotions of lawyers. Particularly, she noted that the nurturing of men is a feminine type of work that organizations devalue, leaving it invisible and uncompensated. This places emotional work outside the valued space of the organization and forces women to internally manage their emotions—in other words, to perform emotional labor.

Moore's (2008) work extended these ideas to look at emotional and cognitive labor with respect to race. As she noted, emotional labor is born from regulating dissatisfaction, frustration, and anger that stem from encountering deficit views and racial microaggressions. Moore showed how students of color in law schools negotiated and challenged racialized perceptions from administrators, faculty, and peers. Merit, for instance, is a contested concept for students of color because they must battle stereotypes about whether they belong and whether they have the ability to remain in the program. This produces cognitive labor for students of color as they employ strategies that counter stereotypes at play in institutions. As students experience discriminatory acts, they must manage whether and how to respond to such events, while also worrying about the ways their emotions will be interpreted (Evans & Moore, 2015).

Emotional and cognitive forms of labor are more than just managing strong feelings or grappling with complex thoughts; they are additional work required of students of color and white women to navigate spaces infused with gendered and racialized logics about ability and belonging. Thus, students of color and white women are taxed with regulating expressions of anger, frustration, and embarrassment that would otherwise align with gendered and racial stereotypes.

Labor plays out in both racialized and gendered ways in mathematics education (Battey & Leyva, 2016; Leyva, 2016, 2021). Battey and Leyva (2016) laid out the cognitive, emotional, and behavioral labor in which students of color potentially engage to manage stereotypes, emotions, and interpersonal relations while learning mathematics. Behavioral labor can result from teachers enacting classroom control over Black and Brown bodies through harsh discipline and physical exclusion from instruction (Battey, 2013; Ferguson, 2000; Skiba et al., 2006). For example, Black and Latin\* students engage in behavioral labor when they regulate how they interact and participate in mathematics classrooms, which reflects the management of racialized expectations of ability (Larnell, 2016; McGee & Martin, 2011). Building on this race-specific work, Leyva (2016, 2021) addressed the intersectional complexities of Black and Latina women's experiences, illustrating the cognitive, emotional, and behavioral labor of managing racialized–gendered underestimation, isolation, and within-group tensions. However, the racialized and gendered construct of labor has largely been explored tangentially in mathematics education. The present article adopts it centrally in an empirical analysis. With this in mind, we briefly review existing literature that touches on invisible labor to illustrate ways that it functions in undergraduate mathematics education.

### Racialized and Gendered Labor in Undergraduate Mathematics

Although the specific concept of labor has not been used as a lens in literature about the mathematics experiences of individuals from historically marginalized groups, historical accounts of mathematics have addressed pervasive experiences of managing social isolation, undermined ability, and instances of being singled out as the only woman or Black student in a classroom (Donaldson, 1989; Mayes, 2005; Walker, 2014). These historical accounts showed how, for decades, minoritized students and faculty have persevered in spite of the extra labor that requires additional time and energy to succeed in mathematics (Walker, 2017). In adopting a lens of emotional and cognitive labor for our study, we recognize how contemporary forms of labor that students from historically marginalized groups experience in calculus classrooms are situated in a history of structural racism within mathematics as captured in this historical literature (Joseph et al., 2021).

More recent work on the experiences of students from historically marginalized groups in undergraduate mathematics education has noted both racialized and gendered influences on persistence (Borum & Walker, 2012; Ellington & Frederick, 2010; Jett, 2013; Joseph, 2017; Larnell, 2016; Leyva, 2016; McGee & Martin, 2011; Oppland-Cordell, 2014; Rodd & Bartholomew, 2006). Although the meaning of persistence varies across studies, it most commonly refers to an end-of-experience outcome, such as succeeding in a course or completing a degree (Borum & Walker, 2012; Ellington & Frederick, 2010; McGee & Martin, 2011). An analysis of the labor of managing racialized and gendered experiences of instruction by students from historically marginalized groups is critical to reveal the daily impact of classroom practices that accumulate and influence the long-term persistence documented in the literature. This is especially important in introductory mathematics where instructional quality affects persistence in mathematics coursework and STEM majors (Ellis et al., 2016; Leyva, McNeill, et al., 2021; Leyva, Quea, et al., 2021; President's Council of Advisors on Science and Technology, 2012).

In what follows, we unpack aspects of invisible labor reflected in a variety of studies to illustrate how it plays a role in student persistence. To do this, we draw examples from three relevant studies (Borum & Walker, 2012; McGee & Martin, 2011; Oppland-Cordell, 2014), with support from additional research. Our review highlights the need for labor to be taken up more centrally and examined in relation to instruction, an institutional practice that can mitigate or contribute to racialized–gendered labor in undergraduate mathematics education.

The literature has discussed the ways that underrepresentation and stereotypes specifically burden Black women with invisible labor (Borum & Walker, 2012; Joseph, 2017). Borum and Walker (2012) asked 12 Black women who finished doctoral degrees in mathematics to reflect on their college experiences in both historically Black colleges and universities and predominantly white institutions. Participants discussed managing feelings of isolation and low expectations that were a result of stereotypes about their race or gender. For example, one participant, Emily, described an experience from an organized study session during her undergraduate studies at a predominantly white institution in which a male peer expressed shock that she had received a higher exam grade than he did. Emily felt she needed to prove peers' perceptions wrong, a prevalent notion in the literature (e.g., McGee & Martin, 2011). However, proving people wrong brings responsibility to manage participation in ways that show intelligence and success while hiding instances of not understanding concepts, which exemplifies emotional and cognitive labor to address others' expectations. Joseph (2017) also discussed Black women needing to prove their worth and endure isolation, highlighting how Black women engage in additional labor to successfully persist in undergraduate and graduate mathematics.

Whereas Borum and Walker (2012) highlighted institutional supports and obstacles to persistence, McGee and Martin (2011) focus on the beliefs and actions that influenced persistence among 23 high-achieving Black men and women in mathematics and engineering. The authors introduced the concept of *stereotype management* to describe Black students' strategies of managing the constant presence of stereotypes. McGee and Martin described these responses as tactical, carefully planned strategies for navigating racially hostile academic environments. For example, students discussed nodding excessively in mathematics classes to manage expectations of not understanding and belonging in the class. This behavioral form of stereotype management reflects intentional cognitive labor to remind oneself to nod. This can be compared with another strategy that McGee and Martin highlighted: Black students intentionally carrying a calculus book to signal belonging in an upper-level calculus course. Students discussed how this strategy served to prevent peers from asking questions about whether they were in the right class—questions rooted in racial stereotypes of Black students' lack of mathematical ability. Students' conscious actions to ward off racialized perceptions of not belonging in mathematics are forms of cognitive and behavioral labor noted in the literature (Larnell, 2016; McGee & Martin, 2011). Whereas invisible labor is evident in this work, the discussion of experiences within mathematics instruction was left implicit.

Scholars have also noted interactions within peer collaboration as leading to labor for students of color. Oppland-Cordell (2014) documented Latina/o<sup>3</sup> students' transformation of their mathematics identities and participation during a semester-long supportive calculus workshop at a predominantly white research university. Much like the stereotype management strategies discussed previously, Latina/o participants consciously fashioned classroom behaviors to manage racialized and gendered stereotypes of mathematical ability. For example, a Latina woman, Vanessa, described avoidance of working with white men because she perceived them as having intimidatingly strong mathematical abilities. Oppland-Cordell interpreted Vanessa's behavior as a function of her "prior experiences, including managing societal, community, and institutional messages that supported the notion of a racial and gender hierarchy of mathematical ability" (p. 39). Vanessa choosing to limit her interactions with white men exemplifies the behavioral and cognitive labor of managing stereotypes of ability to protect herself from working with peers who posed a racialized–gendered threat to her ability as a Latina woman. However, the supportive nature of peer collaboration fostered the perseverance and the success of underrepresented students in undergraduate mathematics (Ellington & Frederick, 2010), and specifically allowed Vanessa to

<sup>3</sup> We use the term "Latina/o" here for consistency with adopted language in Oppland-Cordell (2014).

challenge internalized stereotypes of ability and build confidence in mathematics (Oppland-Cordell, 2014). Although labor was not the central unit of analysis in Oppland-Cordell (2014), the findings captured its role in persistence and explicitly attended to relations within instructional settings.

Our review of relevant research highlights examples of invisible labor among students from historically marginalized groups in response to or in avoidance of racialized–gendered events in undergraduate mathematics education. The present article extends this prior work in three ways. First, our study explores the relationships between labor and specific instructional events. Whereas the reviewed studies illustrated how labor influenced student persistence in mathematics courses and programs, this construct did not always serve as the focal unit of analysis and was largely underexplored in relation to instruction. This gap in the literature limits opportunities to implement change at the classroom level, especially in introductory mathematics courses that are often the first and sometimes only source of messaging in students' undergraduate careers about who belongs in mathematics. Our study fills this gap by detailing connections between labor among students from historically marginalized groups and racialized–gendered aspects of instruction in undergraduate precalculus and calculus.

Second, as further discussed in the Methods section, the design of the present study abbreviated the time between instructional events and the reflection on them by students from historically marginalized groups. The reviewed studies and other relevant work in undergraduate mathematics education (e.g., Ellington & Frederick, 2010; Rodd & Bartholomew, 2006) asked students to reflect on their undergraduate mathematics experiences through interviews conducted years after persisting in mathematics. Because of such delayed-response designs, prior work captured student responses only to specific classroom events that came to be understood as particularly salient or critical to students' mathematical trajectories. This methodology affords important insight into long-term strategies for dealing with racialized and gendered moments in undergraduate mathematics but leaves implicit daily efforts that accumulate and affect persistence in mathematics and STEM more broadly. Our study addresses such limitations through data collection procedures that documented students' perceptions of instructional events during the same semester.

Third, prior work on the undergraduate mathematics experiences of students from historically marginalized groups focused either on a specific race–gender intersectional identity (e.g., Black women in Borum & Walker, 2012) or examined a broad group (e.g., Latina/o students in Oppland-Cordell, 2014). Such sampling revealed variation in experiences among students who held a particular intersectional identity or among students across intersectional identities. This article extends this work by characterizing variation in responses to instructional events both within and across race–gender groups at the same university. In addition, we did not focus only on successful students or those who persisted, which allowed for a broader collection of student responses that more accurately reflects differences in the instructional impact of introductory mathematics.

## Methods

The goal of our phenomenological study was to understand the responses of students from historically marginalized groups to a variety of discouraging events in undergraduate mathematics classrooms, including experiences of invisible labor and strategies for managing such labor. Specifically, we sought to characterize the phenomenon of racialized and gendered labor in precalculus and calculus classrooms by exploring students' in-the-moment emotional and cognitive responses to discouragement during instruction, in addition to immediate and long-term coping strategies.

### Study Context and Participants

The study was conducted at a historically white public university in the northeastern United States. The research team recruited undergraduate students enrolled in precalculus or calculus courses during the 2017–2018 academic year. At that time, the undergraduate population was 46% white, 26% Asian, 14% Latin\*, 9% Black, and 5% multiracial or some other race. Additionally, 52% of students were female and 48% were male.<sup>4</sup> Through a brief survey, interested students self-identified their race and gender. The research team recruited 20 students, 10 in the fall and 10 in the spring, to participate in interviews. We purposefully selected students that self-identified across five race–gender intersectional identities underrepresented in mathematics:<sup>5</sup> Black<sup>6</sup> woman, Black man, Latina woman, Latino man, and white woman. Participants were chosen on a first-come, first-served basis by race–gender intersection (see Table 1). All participants were first- or second-year students at the time of data collection.

<sup>4</sup> The university reports gender as a sex binary, female and male.

<sup>5</sup> All participants selected for the study self-identified as cisgender women or men.

<sup>6</sup> Our sample of Black participants was inclusive of students across the Black diaspora, including those who identified as African American and African.

**Table 1***Precalculus and Calculus Participants*

| Name <sup>a</sup> | Race–gender intersectional identity | Course <sup>b</sup> | Interview |
|-------------------|-------------------------------------|---------------------|-----------|
| Dwayne            | Black man                           | Calculus I          | Fall      |
| Ife               | Black man                           | Calculus I for STEM | Spring    |
| Parker            | Black man                           | Precalculus I       | Fall      |
| Quinton           | Black man                           | Calculus I          | Spring    |
| Jasmine           | Black woman                         | Calculus I for STEM | Fall      |
| Nadine            | Black woman                         | Precalculus         | Fall      |
| Regina            | Black woman                         | Precalculus II      | Spring    |
| Uzma              | Black woman                         | Calculus I          | Spring    |
| Andres            | Latino man                          | Calculus I          | Fall      |
| Adrian            | Latino man                          | Precalculus         | Spring    |
| Carlos            | Latino man                          | Calculus I for STEM | Spring    |
| Leonardo          | Latino man                          | Calculus I          | Fall      |
| Angelica          | Latina woman                        | Precalculus I       | Spring    |
| Beatriz           | Latina woman                        | Precalculus I       | Fall      |
| Delma             | Latina woman                        | Calculus I for STEM | Spring    |
| Victoria          | Latina woman                        | Precalculus         | Fall      |
| Amy               | White woman                         | Calculus I          | Fall      |
| Anne              | White woman                         | Calculus I          | Spring    |
| Erica             | White woman                         | Precalculus         | Spring    |
| Sarah             | White woman                         | Calculus I          | Fall      |

<sup>a</sup> All names are pseudonyms.

<sup>b</sup> Precalculus could be taken as a one-semester or two-semester (Precalculus I and II) course. In addition, Calculus I had an option for a STEM-specific section.

**Data Collection**

We drew on Leyva's (2016, 2021) interview methodology, which used stimulus excerpts from the literature that feature reflections from students across historically marginalized groups on different aspects of their mathematics experiences. Adapting this methodology, we used events developed from participants' journals as stimulus prompts during interviews. This builds on Leyva's methodology by reducing participants' distance to the phenomenon and maintains focus on calculus instruction at the university site. The events provided concrete starting points for participants to discuss their responses to similar events in their precalculus and calculus classrooms. The use of stimulus events in interviews allowed for a structured approach to elicit variation in participant responses to moments that captured a range of aspects in calculus instruction experienced in racialized or gendered ways.

**Event Journaling**

In the first stage of data collection, participants documented instructional events in their mathematics classrooms that they perceived to be uncomfortable or discouraging for themselves or others. Discouraging events could be explicit or implicit, meaning they could include both things that were said or done and things that were not said or done. Participants were provided a prompt that included this description as well as instructions for how to document these events. The prompt asked participants to take notes about event details, including time, location, people involved, and dialogue. After each class in which a discouraging event took place, participants submitted a description of the event and a short reflection using an online form. In total, students journaled 85 discouraging events, which are reported on elsewhere (Amman et al., 2020). Event journaling grounded the study in details of specific instructional events experienced at the university that all participants attended. This level of detail is often lost in studies that ask for a retrospective account of events from years of undergraduate mathematics classroom experiences that participants can recall from memory, which can limit insights into how participants thought and felt in the moment. Additionally, event journaling generated a deliberate collection of everyday

incidents as opposed to only notable moments in participants' memories. This collection provided a resource from which to develop stimulus events for participant interviews.

### ***Development of Stimulus Events***

We developed two interview protocols using the stimulus events derived from the event journaling. Each interview centered on four events (see the Appendix) that reflected variation in (a) likelihood to cause discomfort or discouragement, (b) frequency of occurrence, and (c) type of interaction (e.g., individual or whole class). Some stimulus events were composites of similar journaled entries (e.g., Ignored Student); other stimulus events were based on a single entry that represented a dimension of discouragement or marginalization not captured in other stimulus events (e.g., Calculator Accusation). Fall interview events included an instructor (a) confusing two women, (b) accusing a student of not owning a calculator, (c) not reviewing a student's problem, and (d) advising students to drop down a course level or not take Calculus II if they could not complete a problem quickly enough. In the spring, events included an instructor (a) ignoring a student, (b) laughing at a student's contribution, (c) cutting off a student who caught a mistake on the board, and (d) laughing at an entire class and individual student for struggling with a so-called easy problem.

When creating stimulus events, the research team edited the journal entries to add clarity as well as remove any student reactions to the original classroom instances, all while preserving student phrasing whenever possible. Reactions to the events were removed to allow participants to more freely imagine themselves in similar situations during the interviews, particularly when responding to events that they had not submitted themselves through event journaling. We redacted mention of race for all events and of gender for spring events,<sup>7</sup> allowing us to examine whether participants' perceptions changed when later provided with those details during interviews.

### ***Interviews***

All interviews were semistructured, were audiotaped, and lasted 60–90 min. The interview protocol was semistructured to allow the interviewers to probe various student-generated themes. To the extent possible, the team matched the race or gender of at least one of the two interviewers with the participant in an attempt to create space where participants felt comfortable discussing issues of race and gender; we recognize, though, that this matching does not guarantee such comfort. Interviews enabled students to place stimulus events in dialogue with their lived experiences as a meaningful way to explore their racialized and gendered nature. Participants were asked three sets of questions for each stimulus event: (a) what they saw happening and how frequently similar events occurred in their own classrooms, (b) if they or others would feel discouraged or marginalized and what their reasoning was, and (c) if and how their perceptions would differ depending on the instructors' and students' race or gender.

### ***Analysis***

Analysis of student responses began with an initial pass through the fall interview data in which the research team noted variation in how students found specific events discouraging, saw race or gender playing a role, and experienced the event or similar events. A pair of research team members used open coding on each transcribed interview (Strauss & Corbin, 1998). First, we used open codes to flag instances of how students would respond to the events presented or how they responded if they had experienced similar events. For each event, the research team took note of how students would process (or processed) the event as it was occurring, how students would react (or reacted) to the event in the moment, and any feelings or behaviors that would persist (or persisted) after initially experiencing the event. This analysis resulted in two broad categories that characterized students' responses to discouraging events: (a) invisible labor (both cognitive and emotional), and (b) moderating participation. Employing labor as an analytical lens, we coded an instance of wondering or processing a moment as cognitive labor. Emotional labor was coded for instances when students managed or suppressed emotions. Moderating participation encompassed instances of students changing participation inside and outside of mathematics classrooms in response to emotional or cognitive labor, thus reflecting a host of coping strategies for managing racialized and gendered labor. This last code does not align exactly with the conceptualization of behavioral labor as it was defined earlier because it can include dropping a class, which is not an immediate behavioral response.

Using axial coding in attending to race and gender, we then examined these categories to understand how they manifested similarly and differently for students within as well as across race–gender intersectional identities. Axial coding also allowed for examining whether certain events provoked more emotional and cognitive labor for certain groups of students. We brought our analysis back to participants in the form of follow-up interviews for member checking purposes. In these interviews, we clarified students' perspectives and had them respond to analytical themes derived as a validity check.

<sup>7</sup> The team inadvertently left pronouns signaling instructors' and students' gender in fall events. Despite this, we asked participants whether their event perceptions changed if the actors' gender identities were different.

During spring interviews we were able to check for themes that had arisen in fall interviews, while also allowing for the possibility of new themes to be generated.

### **Positionality**

Our research team's racial and gender diversity was important for multiple reasons. The team consisted of four faculty members, four doctoral students, and five undergraduate research assistants with a range of expertise in mathematics education. It was diverse with respect to race and gender and comprised two Black women, one Latina woman, three Latino men, three white women, two white men, and two Asian women. We ensured that interviews and coding were completed in pairs that included team members who did and did not self-identify with a participant's race or gender. These pairs allowed for the presence of multiple perspectives to inform follow-up interviews and develop analytical claims from coding. The research team member who did not self-identify similarly was more readily able to bracket their lived experiences from those of participants while still approaching the research with a critical lens. The team member who did similarly identify, while having an insider perspective beneficial to understanding race- and gender-related issues, consciously bracketed their experiences apart from those of participants in approaching interviews and data analysis.

### **Results**

The results are organized around the two major codes of invisible labor and moderating participation that students from historically marginalized groups experienced in their precalculus and calculus coursework. The purpose of these results is not to make quantitative claims about the prevalence of these responses among members of each race-gender intersectional identity. Rather, the results characterize ways that students across identities discussed how they experienced labor in response to potentially marginalizing events in undergraduate mathematics classrooms, which addresses the first research question. We also note moments when both forms of labor were discussed in relation to each other. Additionally, we explore how students discussed their race and gender as playing essential roles in coping with the labor resulting from the racialized-gendered instructional space by moderating participation, thus addressing the second research question. Throughout the findings, we specify when students were responding to a journaled instance used to develop the stimulus event or to a similar classroom experience, including how they would respond to it.

### **Invisible Labor**

Sixteen of the 20 students described responses to discouraging events that involved the performance of emotional or cognitive labor. Tables 2 and 3 list the number of students from the fall and spring interviews, respectively, whose responses to each stimulus event were coded as invisible labor and subcategorized as emotional or cognitive labor. The final column of each table represents the total number of students whose responses were coded in each category at least once. The total is not a sum across the individual events because some students indicated the same reaction category (for example, emotional labor) to multiple events. Some form of invisible labor was mentioned at least once for every event, though the Dismissed Student event in the spring had the most responses. Additionally, emotional and cognitive labor often went hand-in-hand as students tried to both understand what had just occurred in the event and manage emotions. Next, we explore the ways in which students discussed such invisible labor.

### **Emotional Labor**

Across the two interview groups, 13 of the 20 students mentioned that they would be affected by emotional labor stemming from how they perceived the discouraging events. Emotional labor started with feelings of frustration, anxiety, disbelief, anger, negative self-image, embarrassment, shock, and offense. In turn, students stated that they would need to control and moderate their emotions to avoid exhibiting what may be perceived as a negative emotion or acting in a manner that would align with racial or gender stereotypes. This meant that students had to manage these emotions privately in the mathematics classroom. In most cases, students discussed hiding emotions instead of altering them or purposefully displaying emotions to signal their discontent. Half of the white women, Latina women, and Latino men mentioned emotional labor related to at least one of the events. Seven of the eight Black students mentioned the emotional labor they would experience from at least one event. Overall, this category most commonly occurred in response to the Dismissed Student event (in which the instructor refused to explain an answer), so we review students' responses to that event complemented with their responses to other events. Given that seven of 13 respondents for this category were Black students, we focus on highlighting their responses around emotional labor.

Quinton, a Black man, described a need to suppress feelings of anger, frustration, and bewilderment when he responded to two events: Dismissed Student and Ignored Student. He reflected on experiencing similar events in a college environment: "It's important to react the correct way because you don't know where people are coming from." Quinton referred to not responding in the way that he normally would, but in "the correct way." Specifically, he continued that one has "to

**Table 2***Number of Students Mentioning Invisible Labor per Fall Event*

| Category        | Subcategory | Stimulus event     |                       |                    |             | Total<br>( <i>N</i> = 10) |
|-----------------|-------------|--------------------|-----------------------|--------------------|-------------|---------------------------|
|                 |             | Confusing students | Calculator accusation | Unreviewed problem | Course drop |                           |
| Invisible labor |             | 3                  | 4                     | 3                  | 4           | 8                         |
|                 | Emotional   | 2                  | 2                     | 1                  | 1           | 6                         |
|                 | Cognitive   | 1                  | 4                     | 3                  | 3           | 7                         |

**Table 3***Number of Students Mentioning Invisible Labor per Spring Event*

| Category        | Subcategory | Stimulus event  |                   |                    |              | Total<br>( <i>N</i> = 10) |
|-----------------|-------------|-----------------|-------------------|--------------------|--------------|---------------------------|
|                 |             | Ignored student | Dismissed student | Instructor mistake | Easy problem |                           |
| Invisible labor |             | 4               | 6                 | 3                  | 3            | 8                         |
|                 | Emotional   | 1               | 5                 | 1                  | 3            | 7                         |
|                 | Cognitive   | 4               | 4                 | 4                  | 3            | 8                         |

be professional, because you don't want to look like you're angry. No one is going to see the fact that you were ignored, everyone is just going to see the reaction." Quinton described his feelings of anger as being outside of the norms of professionalism, or the socially acceptable way to behave in a college environment. Quinton specifically tied the need to manage emotions to avoiding an intersectional stereotype: "You're just looking like you're going to be that angry Black guy in the classroom. . . . You have to manage it on your own." In this way, Quinton's response illustrates how racialized and gendered norms of mathematics classrooms necessitated him performing emotional labor to avoid being stereotyped as an angry Black man.

Regina, a Black woman, discussed a conflict between her emotional reaction and her thinking around her professor's wrongdoing in the Dismissed Student event. She discussed how she would respond to such an event, noting embarrassment in addition to tensions about feeling a need to apologize tied to her gender and racial identities:

I definitely would be embarrassed because it's like . . . I just really wanted to know . . . why this works and why this doesn't work. But yeah, I definitely would apologize too. I hate that. I would probably apologize as well because I feel like one, as a female, I feel females are always apologizing for situations even though they had nothing to do with what was wrong. And then also, as an African American person, I just feel like, I don't always like apologizing and my friends are always telling me that's not good, but it's like, OK, I just do it as a mechanism.

In this instance, Regina discussed a conflict between her embarrassment and her thinking in cases of a professor's wrongdoing. Following this event, her gendered socialization would kick in to make her apologize mechanically, even though she would hate doing so. Regina also described this apology being at odds with her African American identity. Specifically, the conflict arose because she apologizes in situations in which she considers something racialized has occurred. In this instance, Regina described her emotional labor as eliciting a mechanistic response despite it being at odds with other valued aspects of her life.

Some students described the pressure to perform emotional labor as so frequent that they needed to suppress emotions even after leaving class. Such experiences illustrate a connection between cognitive and emotional labor: consciously thinking about shutting down an emotional response. For example, Nadine, a Black woman, described grappling with a mixture of embarrassment and anger with respect to the Confusing Students event, in which an instructor confused two students' names. Nadine described her immediate response to similar events—namely, feeling pressure to conceal her emotional response because she would be cognizant of her classmates' attention. However, after leaving class, Nadine stated,

Whatever emotions I was feeling in that class would be muted. . . . I think it's more for my well-being. Yeah, I could think about it all day and be like, "He did this and he did this." You could start relating it to "Oh, is that probably why I didn't get this grade" and you start to think yourself into a negative mood and it's not going to help you because there's nothing about that person that you can change in that moment.

Nadine explained that allowing herself to fully engage with the anger and embarrassment from discouraging experiences would not only put her in a bad mood, but also do little to change her situation.

Uzma, a Black woman, described the type of emotional desensitization raised in Nadine's response as necessary for women in STEM fields. In the following quote, she discussed her conscious suppression of an emotional reaction in similar instances to the Confusing Students event:

I think [emotional suppression] mostly comes from this idea that women can't handle STEM fields. Any sign of quote-unquote weakness is validating that idea that women aren't supposed to be in STEM fields. As a woman, if my friends were like, "Oh, I didn't feel comfortable because this professor said something like this." I'd be like, "Well, you're even lucky to be there, so don't make it any worse for yourself by coming across as the over-emotional woman."

Uzma described emotional distancing as necessary for women in STEM to avoid stereotypes about women being overly sensitive. Specifically, Uzma stated that STEM fields are so masculinized that emotions are considered a sign of weakness and an affirmation that women do not belong, thus shaping the labor of needing to actively monitor and suppress emotions.

These responses underscore the range of ways that students experienced emotional labor related to discouraging events—from suppressing emotions, to distancing from emotional turmoil, to responding in mechanistic ways. Crucially, this labor reflected responses to ideological and institutional constraints that frame racialized-gendered notions of appropriate emotions in and beyond mathematical spaces (e.g., Quinton's response to stereotypes or Uzma's reflection on women suppressing emotion to signal belonging in mathematics).

### ***Cognitive Labor***

In total, 15 of the 20 students mentioned being affected by added cognitive labor because of perceived discouragement in instructional events. Students discussed asking why they were being treated this way, wondering whether peers were judging them, replaying the moment in their heads, and considering whether their contributions were valid. These moments led them to lose focus, be distracted, or shut down entirely. The ambiguity of events led many students to wonder whether the interaction was gendered or racialized. Half of the white women and Latino men, three of the four Latina women, and all eight Black students mentioned cognitive labor related to at least one of the events. Again, given that eight of 15 respondents for cognitive labor were Black, we focus more heavily on their responses in this analysis. We highlight responses to three events with high frequencies of reported cognitive labor: Calculator Accusation, Instructor Mistake, and Unreviewed Problem.

In general, wondering about and replaying interactions were common types of cognitive labor in response to events that were ambiguous with respect to race and gender. Delma, a Latina woman, responded this way to the Instructor Mistake event, in which an instructor gave excuses to justify a mistake that a student tried to correct, unlike in prior instances in which the same instructor thanked students. In Delma's response, she stated that if she experienced this event, she would grapple with this ambiguity by questioning, "Why is it that I get a 'Yeah, I know,' but other students get an 'I'm sorry?'" Why did he give me a different response than other students?" In this event, the professor's differential treatment is ambiguous, leaving Delma to engage in cognitive labor. This pattern of questioning the underlying reason for the discouraging event was present even in events in which no other students were mentioned. Dwayne, a Black man, discussed a similar reaction to the Calculator Accusation event, in which a professor saw initials written on a student's calculator that did not match the student's name, and claimed that the calculator did not belong to the student (the initials represented those of a program that supports college students from financially disadvantaged backgrounds). Although Dwayne had not personally experienced this event, he discussed similar questions to those Delma mentioned that this event would raise in his mind: "Why is it me, not the other students in the class?" In both cases, Delma and Dwayne described a pattern of questioning that turned inward to grapple with why this instructor treatment was deemed acceptable for them in particular. This cycle of wondering about events resulted in several students saying the added labor would distract them from attending to subsequent segments of instruction.

We argue that this cognitive labor is racialized and gendered for students from historically marginalized groups because of the added burden of wondering how notions of race or gender might be motivating instructors' responses. When discussing the Instructor Mistake event, Quinton, a Black man, responded with how he would think if put in a similar situation:

The key thing here is that [the instructor] has been corrected before and they thank other students. So now it's like "Why are you correcting me? I already know I wasn't wrong in the first place. Don't tell me what to do."

Quinton began by focusing on the differential treatment and wondering why the professor would try to correct him as opposed to other students. He then shifted to imagining the instructor's inner thoughts to reason through the instructor's defensiveness in the example. Quinton then went on to wonder whether the instructor's response was motivated by a racial

stereotype: “Maybe they look at Black students and they say these students only got here by sports . . . but that’s not really the case. There’s plenty of people that got here just through their academics just like any other student.” That is, Quinton wondered whether the instructor’s differential treatment was related to a racial stereotype that Black students were admitted to the university because of athletic ability, rather than academics, and therefore are not in a position to correct a professor.

Quinton went on to explain that the act of correcting an instructor’s mistake is particularly risky for Black students because “it’s like you have to prove your worth or if you don’t know this, then you shouldn’t be here.” Specifically, he noted the risk of not knowing something as signifying that you do not belong in mathematics if you are Black. Therefore, when a Black student takes the opportunity to correct an instructor, they are risking confirmation of a stereotype that they are just there for sports. As discussed in the literature review, this notion of proving people wrong has been discussed in prior research (e.g., McGee & Martin, 2011). In this instance, it appeared to be used as a longer term strategy for managing cognitive labor by allowing Quinton to make sense of discouraging experiences and decide how to react to them. This was one of only two long-term strategies noted by students in the study.

Cognitive labor about the possibilities of differential treatment was also raised in relation to gender. Amy, a white woman, discussed cognitive labor related to a similar experience as the Unreviewed Problem event, in which an instructor refused a student’s request to go over another practice problem.

If my friend were to ask a question, she would get like, “Oh, well, it’s right there on the board.” And if the guy three seats down from me asked, [the instructor] would be like, “Oh, well, I got it from here, and then I did this, and then I did that.”

Amy’s response connected the event to her gendered perception of how her calculus instructor engaged students’ questions by providing detailed explanations to men and not women, including her friend. This caused Amy to wonder about the underlying role of gender in her instructor’s behavior:

Why did she get that? Why didn’t she get the “Oh, all of these” answers? I don’t know if it was so much that they were standoffish because she was a woman or they were standoffish because they don’t really care if you learned or not.

Amy, therefore, experienced cognitive labor of wondering whether her instructor’s response was related to her friend’s gender as a woman, or whether he simply did not care about student learning. She also described the impact of such an instructional event as like a physical blow, “a punch in the chest, really quick, and then it goes away. It’s like getting the wind knocked out of you.” Although Amy noted this as a quick reaction, the physicality of it was significant and added to the cognitive labor she experienced.

As with emotional labor, some students, such as Andres, a Latino man, discussed strategically disengaging cognitively with events to avoid such labor. Reflecting on immediate thoughts in response to a situation similar to the Unreviewed Problem event, Andres said, “I would feel kind of down, ’cause the professor just kinda dismisses your question, and then I would just feel like, ‘Oh, I look dumb,’ you know?” Like other students engaging in cognitive labor, Andres described that he would wonder about his own positioning in the class and would question whether he was good enough to be there. However, when Andres was asked whether this would affect him for the rest of class, he said, “It’d be for not that long. Like after class, I wouldn’t think about it really. I’m trying to think of it as, if I keep thinking about it, it’s gonna annoy me more.” In this example, Andres described deliberately avoiding persistent thinking about the event to prevent falling into a cycle of ruminating, which would produce negative emotions. Much like Nadine’s stance on emotional labor after leaving the classroom, Andres engaged in cognitive labor of consciously distancing himself from events to avoid emotional burden.

In general, students described their experiences of emotional and cognitive labor as immediately following each event. In part, this was due to avoiding additional labor once they left the classroom to limit the impact in their everyday lives. Some students even managed reactions within the moment to avoid confirming stereotypes. Quinton, in particular, raised an obligation to prove people wrong, a strategy that eight of the 20 students mentioned at some point in their interviews. This suggests that stereotype management, as theorized in McGee and Martin (2011), entails emotional and cognitive labor. Therefore, students experienced cognitive and emotional labor because of broader societal forces, such as existing racial and gender stereotypes. The form this labor took for our participants echoes findings in the sociological literature about the labor of navigating racialized and gendered spaces; our analysis extends this thinking on labor by applying it to the undergraduate mathematics context. Students kept their labor private as opposed to performing overt emotional labor. Although the invisible labor students experienced could be short-term in nature, it could also have long-term effects including a loss of confidence, a feeling of less mathematics competence, and missing out on critical pieces of instruction.

### **Moderating Participation**

Between fall and spring groups, 18 of the 20 students discussed strategies for moderating their participation to cope with invisible labor (see Tables 4 and 5). Only one Latina woman and one Latino man did not mention moderating participation

**Table 4***Number of Students Mentioning Moderating Participation per Fall Event*

| Category                 | Subcategory            | Stimulus event     |                       |                    |             | Total<br>(N = 10) |
|--------------------------|------------------------|--------------------|-----------------------|--------------------|-------------|-------------------|
|                          |                        | Confusing students | Calculator accusation | Unreviewed problem | Course drop |                   |
| Moderating participation |                        | 6                  | 6                     | 8                  | 4           | 10                |
|                          | Withdraw participation | 6                  | 6                     | 8                  | 4           | 10                |
|                          | Additional work        | 2                  | 1                     | 6                  | 2           | 7                 |
|                          | Stereotype management  | 1                  | 1                     | 1                  | 0           | 2                 |

**Table 5***Number of Students Mentioning Moderating Participation per Spring Event*

| Category                 | Subcategory            | Stimulus event  |                   |                    |              | Total<br>(N = 10) |
|--------------------------|------------------------|-----------------|-------------------|--------------------|--------------|-------------------|
|                          |                        | Ignored student | Dismissed student | Instructor mistake | Easy problem |                   |
| Moderating participation |                        | 5               | 4                 | 4                  | 5            | 8                 |
|                          | Withdraw participation | 4               | 5                 | 3                  | 6            | 8                 |
|                          | Additional work        | 1               | 2                 | 1                  | 3            | 4                 |
|                          | Stereotype management  | 1               | 1                 | 0                  | 0            | 2                 |

across any event. We grouped students' responses to invisible labor into three subcategories of moderating participation: withdrawing participation, doing additional work, and engaging in stereotype management. Within each subcategory, participants described different reasoning for engaging with the strategy and sometimes mentioned ways that they regulated their behavior specifically to cope with emotional or cognitive labor.

All 18 students who moderated participation in some form mentioned the strategy of withdrawing participation, ranging from not asking further questions in class (the most common response), to not attending lectures, to dropping the class. This strategy was used primarily to manage cognitive labor from discouraging events that would bring instructor or peer attention to participants. It was mentioned at least three times for each event.

In addition, 11 students mentioned engaging in additional work in response to labor from an event. Students discussed strategies of seeking academic support from friends, tutors, or teaching assistants as well as doing additional work on their own. However, students also described the risk and vulnerability involved in reaching out to other people for help, because this would present an opportunity to confirm racialized and gendered stereotypes of ability and belongingness in mathematics. Unlike withdrawing participation, this form of moderating participation was a coping strategy for emotional as well as cognitive labor from discouraging instruction. Out of four students in each race–gender group, two or three mentioned this strategy, thus resulting in similar representation for each group. This was the most common response to the Unreviewed Problem event.

Four students mentioned stereotype management (see McGee & Martin, 2011) as a form of coping with labor from instructional events, a response that cut across experiences of emotional and cognitive labor. It entailed regulating their classroom participation to navigate racial and gendered stereotypes of mathematical ability, a long-term persistence strategy (McGee & Martin, 2011). For example, students reported doing this by speaking up in moments when they knew the answer or not showing that they did not know something. Although the strategy of withdrawing participation may look similar, stereotype management was a short-term response to managing labor whereas withdrawing participation could be a short- or long-term response to avoid labor. Students also specifically discussed being mindful of how, when, and why they would need to behave in these ways to manage racial and gendered stereotypes. One Black woman, one Black man, one Latina woman, and one white woman discussed this strategy.

In what follows, we first discuss student responses to emotional labor before turning to coping strategies for cognitive labor.

### ***Coping With Emotional Labor***

As noted earlier, students engaged in emotional labor by muting or desensitizing themselves from their immediate emotional responses. As ways of coping with this emotional labor, students engaged in additional work outside the classroom space (e.g., created peer groups of support) as well as strategically asked questions or hid mistakes from peers. These strategies were not as varied as those for cognitive labor (which we will explore next). They also were not specific to any one event.

Adrian, a Latino man, discussed how he would cope with emotional labor by engaging in additional work of teaching himself content, seeking help from another instructor, and forming a peer support group. Adrian raised these strategies in response to discouragement and shock after experiencing something like the Easy Problem event (in which an instructor passed back a test, laughed at the class's mistakes, and dismissed a student asking for help):

I'd probably be really discouraged. I'd be pretty shocked, but then I'd be like, "Nah, you know what, I'm not listening to this guy. He's a jerk." Then I'd just teach myself from there. I'd go to my lecturer, if I have a different lecturer. If not, I'd just do self-teaching. . . . Just teach yourself and make friends in that recitation. Gather around, look at the syllabus, read the lecture plans, use the textbook. . . . Just survive off each other in the group where you can rely on each other, and help each other. . . . But you can't rely on this guy anymore. He's just going to make you feel worse. I'd make friends with the people who were like me, where they're like, "Wow this guy, he's a jerk." . . . Probably all those negative emotions would go to [the group], and then they'd be like . . . they'd be really distraught.

He considered not attending class after this as well, which would be a form of withdrawing participation, but noted that for his current class, "attendance matters" in grading. However, Adrian thought that if it did not count toward his course grade, he might stop going to class and instead perform the additional work of finding peers in a similar situation to support one another in learning the content and processing negative emotions from instruction. This formation of a peer group of support, therefore, served as a coping strategy for Adrian to "survive" the class with an unreliable instructor. Whereas Adrian's strategies exemplify agency in coping with emotional labor, choosing this course of action also meant that structural oppression in the form of unsupportive mathematics instruction was left unchecked and Adrian had to engage in additional work to compensate for it. This additional work can be particularly difficult for students from historically marginalized groups in mathematics who face inequitable opportunities to receive support when considering how faculty and peers are sometimes not willing to work with them because of stereotypes of mathematical ability (Oppland-Cordell, 2014).

Uzma, a Black woman, discussed adopting strategies of additional work and stereotype management to cope with emotional labor from instructional instances like the Unreviewed Problem event, in which an instructor refused to go over another practice problem. She reflected on the emotional labor she would experience of mustering up courage to ask questions and managing others' perceptions of her mathematical ability through participation, especially because "asking questions is an indicator that you're not getting it." To manage such labor, Uzma suggested she would moderate participation by not continuing to ask her question and instead figuring it out herself:

If this was me, if I was that girl, and I, one, had the balls to ask the question in the first place when I didn't know something . . . because I feel like a lot of people don't understand how much courage it takes, specifically in STEM courses, especially math, how much courage it takes to ask a question when you don't know. Then, two, to get dismissed, like, "I've already answered your question," and then to still feel like your question isn't answered, yeah, you turn to your own resourcefulness.

Uzma's coping strategy for managing the vulnerability of asking questions is a form of engaging additional work to overcome the lack of instructor support, which can be likened to Adrian's strategies of teaching himself the course content as well as seeking peer and faculty support.

In addition, Uzma's response to the emotional labor reflected stereotype management. She argued how the notion that "understanding math . . . is a direct indicator of your level of intelligence" coupled with stereotypes of women lacking mathematical ability made emotional labor from instructional moments like the Unreviewed Problem event a gendered experience:

Even if they say that really smart people are supposed to ask questions, it's the opposite feeling in math courses, that the more questions you ask, the more stupid you look. Girls don't want to show that they're not qualified to be in that certain math course, so they're not going to ask as many questions as their male counterparts will.

Uzma explained that the association of asking questions with a lack of intelligence is a feature of mathematics courses that is particularly harmful to women, who are stereotyped as lacking the qualifications to be in the course. Thus, Uzma's coping strategy of moderating participation by limiting her questions in the classroom, which she summarized as "If you don't know, you don't let anybody else know you don't know," is a form of managing gender stereotypes about

mathematical ability. The management of emotions around the risk of confirming this stereotype also leads to cognitive labor in the form of strategic question-asking for women. Therefore, coping strategies often apply to situations that require managing both cognitive and emotional labor.

Anne, a white woman, also discussed engaging in stereotype management during moments in her calculus class when she knew answers to an instructor's question, with the goal of either showing she was smart or avoiding being wrong. In these instances, as with Uzma, Anne was managing gendered stereotyping of mathematical ability and intelligence. She discussed this with respect to the Dismissed Student event, in which an instructor laughed at a student's question and provided no explanation. First, Anne discussed low expectations of women's ability to engage in STEM:

Women are underestimated a lot of the time when it comes to math and science, so I think that they definitely feel like they have something to prove . . . Girls have to show that they care just so that they fit in and are acknowledged as being on the same level as the guys.

Anne first mentioned that women need to prove themselves, as noted previously, because of being underestimated on the basis of stereotypes about their mathematical ability. She also noted emotional labor for women of explicitly showing that they care in order to fit in, which requires a shift in behavior.

Later, Anne further elaborated on this coping strategy of managing gender stereotypes as a form of moderating her participation, discussing how she hid her mistakes because she is a woman:

I know that I definitely will not show people if I get a question wrong . . . especially if it's a guy. If it's a girl, or it's my friend, I'll just usually say "I got this wrong. Did you get it wrong too?" If it's a guy, I almost never will say that I got it wrong just because either I want to impress them or I don't want them to think that I'm not as smart as they are.

Anne noted that she would particularly hide errors from men so they did not think of her as less smart, thereby confirming the gender stereotype. Thus, Uzma's and Anne's strategies of moderating participation because of emotional labor convey how not asking questions, hiding mistakes, and selectively answering questions are agentic ways that students managed stereotypes of ability and intelligence within calculus instruction. Although not asking questions or attending class are forms of nonparticipation that can signal inability in alignment with racial and gender stereotypes, these final two responses from Uzma and Anne show students engaging in such nonparticipation tactically to manage deficit positioning stemming from stereotypes, thus protecting their identities. Although agentic, stereotype management and engaging in additional work to cope with emotional labor add burdens on top of academics for students from historically marginalized groups.

### ***Coping With Cognitive Labor***

As evidenced previously, cognitive labor came in the form of students asking themselves why they were being treated in certain ways, wondering whether peers were judging them, cyclically replaying moments in their heads, and questioning the validity of their contributions. Students mentioned coping strategies of withdrawing participation ranging from not asking questions in class, to not attending lectures, to dropping the class. Specifically, withdrawing participation was used to manage cognitive labor from discouraging events that would bring instructor or peer attention onto participants. However, students also employed coping strategies of additional work and stereotype management. We present a continuum of these coping strategies invoked across participants' responses primarily to two events: Calculator Accusation and Unreviewed Problem.

Nadine, a Black woman, said she would withdraw in response to the Calculator Accusation event by making herself "as nonexistent in that class as possible." In discussing the impact of the event, she suggested that, if she experienced this, the cognitive labor involved in processing it would begin to distract her "because the entire rest of the class, I'd be running through, 'What is everyone else thinking about me? Why did the teacher think that? Should I say something?'" Nadine described the process of questioning why the instructor called her out as one that would prevent her from being able to concentrate for the rest of the lecture. She went on to describe how this event would affect her behavior even after class. In the future, Nadine stated, her "participation in that class would probably drop from where it was minimal to none." Nadine stated that she would avoid any interaction with her professor because she "wouldn't feel comfortable raising [her] hand or asking any questions again." She went on to describe her withdrawal as extending to any behavior that would draw attention to herself:

I'm talking to the point where if I needed to go to the bathroom, I probably would not get up. Because, you don't want everyone turning and looking at you. I would not raise my hand. I literally would not do anything to make the professor look my way. If usually I'd take my phone out, I wouldn't take my phone out because I don't want you to be, "Oh, now you have your phone out." . . . I'd try to draw as little attention to myself as possible.

Nadine explained that, in response to the cognitive labor, she would change her behavior to make herself “nonexistent” by not going to the bathroom, not raising her hand, and avoiding the use of her phone. To Nadine, any behavior that called attention to her presence in the classroom would create an opportunity for her professor to voice low expectations of her, which, in turn, would result in more labor. By withdrawing her participation entirely, she would be able to exercise some control over other people’s perceptions of her, albeit at the cost of not having her needs met.

Although Nadine’s response to cognitive labor resulted in her staying in the classroom, some students stated that they would need to withdraw their participation by leaving class—either for several days or for the rest of the semester. Victoria, a Latina woman, raised such withdrawal in response to instances similar to the Calculator Accusation event.

I would feel so uncomfortable and honestly when the student said, “As a result, I was not able to concentrate,” I would feel the same way. I would not be able to sit in class because I would feel like now these people in this class know that I can’t afford being here and also my parents don’t make this certain amount.

Like Nadine, Victoria mentioned that because of the cognitive labor from this event, she would not be able to concentrate, particularly because her financial status would be made public. However, Victoria went one step further and stated that the cognitive labor of wondering about classmates’ judgments about her would be so intense that she would not feel comfortable staying for the remainder of class.

Ife, a Black man, responded similarly to cognitive labor as a result of classroom moments akin to the one depicted in the Easy Problem event (in which an instructor passed back a test, said it was easy, laughed at the class’s mistakes, and then was dismissive to a student asking for help): “After everything has been said and done, I probably just wouldn’t look or even talk to the professor after that. I’m not even sure if I would come to class the next day.” Like Nadine, Ife mentioned that he would cut off all contact, even eye contact, with his professor in the future. However, like Victoria, he went a step further and stated that he might withdraw participation by not attending future classes because of the dismissive nature of the instructor’s response.

Sarah, a white woman, discussed how participation can be withdrawn beyond the classroom context in response to cognitive labor from moments like the Unreviewed Problem event, in which an instructor refused to go over another practice problem. As a woman who is a business major with a minor in mathematics, Sarah mentioned that the task of “overcoming the stereotype of ‘women aren’t in the field of math and science’” presented a heavy challenge to persistence. Sarah specifically mentioned that women are assumed to not belong in STEM fields, and that this necessitates engaging in cognitive labor of proving themselves in ways men do not need to. Sarah explained that the pressure to overcome stereotypes intensifies the impact of the event:

That could definitely have a greater effect than not just participating in class. It could have an effect on your performance. Like I said, if something happens in class, it might stop you from going to office hours, it might stop you from emailing the professor. That could also, of course, affect the grade in your class. In the long run, that would affect . . . if you continue in [the] math class and if you want to continue onto more math classes.

Sarah noted how a professor’s refusal to help could create additional cognitive labor that would affect her performance but also could ultimately have an impact on her decision to take future mathematics classes. Although this is an extreme form of moderating participation, it reflects one end of a range of strategies for coping with cognitive labor caused by discouraging events in calculus instruction events. For the most part, moderating participation in the form of withdrawal was more short-term in nature, such as not asking questions or not interacting with the instructor that semester. However, in the case of causing a student to drop the class or affecting their enrollment in future courses needed for majors, the implications can be even more consequential for student success.

To this point, we have discussed a range of ways in which students said they would essentially withdraw their participation in response to cognitive labor. Importantly, whereas students mentioned these agentic strategies as a form of self-preservation, most of these coping strategies reinforce racial and gendered forms of participation in the classroom. For example, not asking questions or attending class could be seen as students from historically marginalized groups lacking ability or not being engaged. Although challenging these racialized and gendered discourses is not students’ responsibility, these strategies of coping with cognitive labor do align with inequitable access to classroom participation.

Additional work was another coping strategy that arose in response to cognitive labor. Amy, a white woman, discussed ways that she performs additional work because of cognitive labor from instances like the Unreviewed Problem event. Her strategy is akin to how Adrian coped with emotional labor. Amy described the cognitive labor of thinking, “I didn’t do this one. I don’t understand this one. How am I supposed to understand three, four, five, six more?” These cyclical thoughts bred frustration and brought her to do additional work:

I would definitely redo the problem on my own time, do stuff like that. But I’d probably go to office hours. Probably not this professor’s office hours, just because they showed such a lack of interest in going through the motions and helping you get from point A to point B. There’s no reason to frustrate yourself and deal with that exact same person.

Amy mentioned that she would spend time seeking support from someone other than her professor during office hours to avoid encountering a similarly frustrating attitude. Her comment concerning the professor's lack of interest suggests that she would seek out a space where her questions would not feel burdensome. She also noted that she would use her own time to redo the problem, implying that she would rely only on herself to build her understanding despite not being able to do so in lecture. This combination of relying on oneself and seeking supportive others was common for students who discussed carrying out additional work.

Parker, a Black man, drew a relationship between asking questions and racial stereotypes. This is similar to what Uzma and Anne discussed with respect to combating gendered stereotypes in response to emotional labor. When discussing the Calculator Accusation event, which Parker himself had submitted in his journal, he addressed the cognitive labor that Black students experience in managing racial stereotypes of ability:

I feel like people, they don't want the stereotype to be true . . . because it's not true. But if the person asks questions . . . given that stereotype that Black people are not good at math, that will make her, she don't want to accept that stereotype, which isn't true, that will make her feel uncomfortable.

Parker discussed the fact that Black students do not often ask questions during class to avoid confirming a stereotype about Black inability in mathematics. He described the cognitive labor that Black students must manage even before asking questions in mathematics. Parker continued with how this affects attendance in office hours:

I don't see no minority students going to ask for help. . . . I know they're scared to go to office hours because they know they will get discriminated [against] and have people see that all people of this color are not as smart as people of this color and all that. I think that's one reason why people don't go to office hours, I have to be honest.

Parker noted how, despite going to office hours himself, he does not see other racially minoritized students there. He stated that Black students do not go to office hours to avoid asking questions or seeking help, which would confirm stereotypes of people of color being less intelligent. Parker's reflection captures how Black students cope with cognitive labor by avoiding discriminatory behavior. As a result, racially minoritized students adopt coping strategies of moderating their participation by not asking questions and avoiding office hours to protect themselves from confirming stereotypes.

Whereas some students stated that the events required additional work to cope, Parker highlighted how harmful stereotypes limit where that additional work can be pursued in racially affirming ways. Engaging in additional work because of managing cognitive labor from instructional events means that students from historically marginalized groups are left with the responsibility of seeking outside resources and support while managing the pervasive influence of stereotyping. Thus, as with withdrawing participation, although students enact agency in doing additional work and managing stereotypes, these strategies leave racialized and gendered access to instructor support unchallenged.

## Discussion

Students' responses to the stimulus events raised a range of ways in which they would react to discouraging events. Examining the dimensions of emotional and cognitive labor allowed us to analyze the immediate responses from students to such events. In particular, the suppression of emotions, such as embarrassment, frustration, and anger, meant that students sometimes could not attend to the mathematics being taught. In addition, the cognitive labor in response to an event—wondering what just happened, asking themselves whether it was racialized or gendered, and struggling with how to manage instructors' perceptions—shows the invisible labor that students need to manage in addition to learning mathematics. Our category of moderating participation captured both short-term and long-term strategies of coping with such invisible labor. These included not asking questions in class or seeking peer help, but extended to dropping the class altogether. Our findings add to the literature, which has generally employed delayed-response study designs, by illustrating contextual factors of undergraduate mathematics instruction that produce more immediate types of invisible labor among students from historically marginalized groups as they attempt to persist mathematically. In what follows, we discuss how the findings relate to the existing literature with respect to short and long-term strategies for dealing with marginalization.

Within the range of responses to discouraging events that the students in our study suggested, their short-term responses are ones that have not been specifically documented previously in mathematical spaces. One methodological strength of this study is that we asked students while they were still enrolled in calculus and precalculus classes how they would respond to events within that setting. In particular, this allowed for documenting invisible labor experienced in everyday situations. This labor is important to note because it is layered on top of what students are supposed to be accomplishing: learning mathematics. The theoretical perspective of labor helped us systematically explore this long-existing phenomenon in the racialized and gendered space of undergraduate mathematics in ways that existing work has not done.

Our findings around moderating participation are particularly concerning. Whereas prior studies have asked successful Black and Latin\* students to retrospectively discuss their strategies (e.g., Borum & Walker, 2012; Ellington & Frederick, 2010; McGee, 2016; McGee & Martin, 2011), asking students currently in these courses to discuss their responses unearthed a number of ways in which their agentic responses can be counterproductive for their mathematics learning. We are not saying that these responses are not appropriate or that they are not important in maintaining mental health, but that many of the ways in which students moderated their participation reinforced structural inequities of opportunities for mathematics success. For example, the most common response to a discouraging event was to not ask any more questions and possibly never speak with an instructor again. These actions are happening in mathematics classrooms where students from historically marginalized groups often do not have external supports, whether that is peer support because of underrepresentation or instructor support because of a dearth of faculty who understand their experiences or look like them. Therefore, the response of withdrawing participation can cut off learning opportunities, negatively affecting students' mathematics success. When this situation collides with ideologies in mathematics of innate ability that frame asking questions as a signal of lacking ability, students from historically marginalized groups can question their very belongingness in mathematics (Leyva, Quea, et al., 2021).

Longer term coping strategies seem to be the ones most discussed in the literature. This makes sense in light of the samples chosen for those studies (successful students) and the retrospective nature of understanding how students persisted. For example, proving people wrong and tactical performances of identity are long-term strategies of stereotype management that McGee and Martin (2011) theorized in their work with Black mathematics and engineering students. We build on this and other work that detailed the long-term strategies of students from historically marginalized groups for navigating undergraduate mathematics (work that often focused on only one or two intersectional identities) by looking across a variety of race–gender intersectional identities. Our analysis also extends prior work by detailing features of mathematics instruction that give rise to emotional and cognitive labor and prompt students from historically marginalized groups to adopt long-term strategies for coping and persisting.

Our findings raise the need for future research that further conceptualizes supportive mathematics teaching at the undergraduate level as not just instructionally sound or inquiry oriented, but also as providing social and relational support (Battey, 2013). The events to which our participants reacted often held more relational dimensions of instruction than content-related ones. They dealt with knowing who students are, how students' questions and answers are handled, and what it means for an instructor to be corrected. The issues that students highlighted were largely how instructors handled such moments, not their presentation of the content. Therefore, mathematics educators must map the socioemotional space of classrooms to understand its impact on students from historically marginalized groups and reconceptualize what good teaching in undergraduate mathematics looks like (Battey, 2013; Leyva, McNeill, et al., 2021; Leyva, Quea, et al., 2021).

However, we do not want to oversimplify this as specific moves such as doing this or not doing that. These findings show the numerous ways in which students read and responded to a variety of events in undergraduate mathematics instruction. Even within subgroups of students who shared racial–gendered identities, a range of responses to events was in evidence. This raises the need for instructors to not only understand the viewpoint of students who are often marginalized from participating in mathematical spaces but also find a variety of ways to meet students' needs. Often instructors may see these events as neutral (McNeill et al., in press), but need to understand the coded ways that their practices produce racialized and gendered forms of labor. The onus, then, is on mathematics departments to offer professional development to spur instructors' critical reflection on their own practices in order to disrupt and dismantle racialized and gendered inequities.

Whereas we mentioned that the immediacy of our interviews was a methodological strength of this study, a limitation is that we do not know who persisted mathematically. We do not want to suggest, however, that persisting means that participants became STEM majors. Persisting for some would mean that they finished the course to complete a major outside STEM. Often, the literature on the STEM pipeline equates persisting with staying in STEM; remaining in STEM may not be the goal and may not be what a particular student feels is right for them. Whereas some of our sample, especially those taking Calculus I for STEM majors, were intending to continue in STEM, others had no intention of that. Regardless of their goals, students from historically marginalized groups should feel supported while they are in mathematics courses. Therefore, for us, the goal would be to minimize the extra labor that students from historically marginalized groups must manage and to find ways to support students in persisting in mathematics for whatever purpose or goal they choose.

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## APPENDIX

### Stimulus Events

#### Stimulus Events for Fall Interviews

##### *Confusing Students*

My recitation teacher was going over math problems related to our quiz that we were about to take and she asked if any of us had any questions. I raised my hand and so did a girl that was to my left about a seat back in space. She pointed my direction and called out “[Name A].” I looked back thinking she was trying to call on the girl behind me. The girl shook her head at me and indicated that the professor was referring to me. I looked back at the professor and let her know I wasn’t [Name A]. I told her that my name is [Name B]. The professor looked over a couple of seats to my right and said that she had confused me with [Name A] that was a couple seats down because “we both have black hair” and “we both wear glasses.” Then she continued to say for me to just go ahead and ask the question. In this incident I felt very uncomfortable. This situation had everyone looking at me and by the time I realized I was able to ask my question I didn’t really want to anymore because it was a simple question that didn’t need everyone’s attention.

##### *Calculator Accusation*

During a lecture, Professor [X] was making a demonstration of how students should mark their calculators for identification for the exams. She collected mine and used it as an example. My calculator had an XYZ tag on it because the XYZ program gave me the calculator. As the professor was doing the demonstration she said “this calculator is not yours.” I told her that those were not initials and that XYZ was a program that gave me the calculator. As a result, I was not able to concentrate on what she was saying anymore.

##### *Unreviewed Problem*

I had just finished asking a question and the professor asked if anyone else had a question. This girl raised her hand and asked the professor to go over any question related to the domain of a function. The professor simply indicated that she had just finished going over a domain question so the professor didn’t try another one as the girl had asked her to. The professor continued and asked if anyone else had any questions. As the professor asked that question out loud and began to take a new question, the girl next to me turned to a guy next to her and said “I want to do a different problem, I’m going to do a different problem” and continued on to do a different question on her own. The class didn’t have many more questions after that one.

##### *Course Drop*

During class the professor said something along the lines of, “If you do not know how to do these steps quickly you might want to consider dropping down to a lower class or consider not taking Calculus 2.” As a student who wants to major in a STEM field it made me feel a bit uncomfortable because I did take a bit longer to do the steps. At the time of the event I thought to myself if I was good enough to go on to Calculus 2.

#### Stimulus Events for Spring Interviews

##### *Ignored Student*

The professor was going through a problem on the board and, in the middle of the problem, a student sitting towards the front of the classroom raised their hand to ask for clarification on a portion of the problem. After two minutes with their hand up, the student gave up on asking the question having been completely ignored. This also occurred 6 minutes prior, when the same student tried to ask a question.

##### *Dismissed Student*

The professor was writing the solution to a problem involving radicals. A student asked whether or not a number without a radical and one with a radical could be added to simplify the answer. Instead of explaining why this was not possible, the professor chuckled and repeatedly told the student “no.” The student repeatedly asked why and did not receive an answer. Eventually, the student apologized for asking the question in the first place and the professor moved on.

##### *Instructor Mistake*

Our professor was finishing a problem, but when recopying the step in the problem, the professor wrote a number incorrectly. A classmate and I raised our hands to bring it up, but it took almost a minute or so before being acknowledged. As I was explaining what was wrong, the professor cut me off saying “Yeah, I know” and gave a number of excuses to avoid seeming incorrect. The professor has been corrected before and would admit being wrong and thanked the students for catching the mistake, but did not do so when corrected by me.

**Easy Problem**

During recitation, we received part of our first exam back. The professor kept saying “This is easy” and “You guys should’ve got this” while laughing at us. One student came in late to class and asked about a problem from the exam that had just been reviewed. The professor said, “I just went over this, but this was such an easy problem everyone got wrong.” Additionally, I approached the professor after class about the problems I got wrong hoping to maybe get extra points. Instead, the professor told me “This is so wrong, I don’t know how you got credit for this” and just laughed.