

Detailing the Potentially Marginalizing Nature of Undergraduate Mathematics Classroom Events for Minoritized Students at Intersections of Racial and Gender Identities

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Undergraduate mathematics instruction contributes to marginalization among women and racially minoritized individuals' experiences. This report presents an analysis from a larger study that details variation in minoritized students' perceptions of potentially marginalizing events in undergraduate mathematics instruction. With past research on undergraduate mathematics experiences largely focused on students' post-hoc reflections and one or two race-gender intersections, this analysis extends prior work by attending to variation in students' in-the-moment perceptions of mathematics instruction across various race-gender intersections. Findings highlight how issues of underrepresentation, stereotypes, and instructor care contributed to interpretations of instruction-related events as potentially marginalizing. The report concludes with implications for teaching practices in undergraduate mathematics that academically support and socially affirm students from historically marginalized backgrounds.

Keywords: equity, gender, instruction, race, student experience

Undergraduate mathematics instruction contributes to marginalization among women and racially minoritized students underrepresented in STEM (science, technology, engineering, and mathematics; Bressoud, Mesa, & Rasmussen, 2015; Seymour & Hewitt, 1997). Prior research has also documented minoritized students' reflections about marginalizing experiences in undergraduate STEM, particularly at one or two intersections of race and gender identities (e.g., Borum & Walker, 2012; McGee & Martin, 2011). The present analysis extends past research by detailing variation in minoritized students' perceptions of potentially marginalizing events in instruction across various intersections of racial and gender identities. Such research is especially critical in entry-level undergraduate mathematics courses, such as pre-calculus and calculus, that operate as racialized-gendered gatekeepers into STEM majors (Chen, 2013; Ellis, Fosdick, & Rasmussen, 2016). By drawing on minoritized students' in-the-moment reflections on classroom events that they found potentially marginalizing, this study also advances past research that has largely focused on students' post-hoc reflections on their mathematics experiences.

Research Questions

This research addresses two questions to detail intersectional (namely, race-gender) variation in minoritized students' perceptions of undergraduate pre-calculus and calculus instruction:

1. What aspects of undergraduate pre-calculus and calculus classrooms, including instruction, leave women and racially minoritized students feeling marginalized?
2. Why do students from different intersections of racial and gender identities perceive these classroom aspects as marginalizing?

Findings can inform the design of more equitable undergraduate mathematics instruction that academically supports and socially affirms students from historically marginalized backgrounds.

Theoretical Perspective: Positioning Theory

The focus on undergraduate students' interpretations of pre-calculus and calculus instruction as marginalizing of their race-gender identities was informed by positioning theory (Davies & Harré, 1990; Holland, Lachiotte, Skinner, & Cain, 2001). Positioning theory considers how different actors develop expectations about themselves and each other, as well as highlights what norms are structuring participation in pedagogical contexts (Esmonde, 2009). The racialized-gendered nature of mathematics classrooms, as documented in extant research (e.g., Battey & Leyva, 2016; Borum & Walker, 2012; Rodd & Bartholomew, 2006), can position white women and racially minoritized students as being less welcome to participate or as feeling an increased pressure to demonstrate their ability through participation (Engle, Langer-Osuna, & McKinney de Royston, 2014; Suh, Theakston-Musselman, Herbel-Eisenmann, & Steele, 2013). Use of positioning theory in this study, therefore, guided inquiry into variation in how students from different intersectional backgrounds interpreted features of undergraduate pre-calculus and calculus instruction as positioning them in marginalizing ways.

Research Methodology

The central goal of this analysis was to capture intersectional variation in historically marginalized students' perceptions of the ways they found particular features of undergraduate mathematics instruction to be discouraging. From a critical race theory perspective (Solórzano & Yosso, 2002), the analysis foregrounded the voices of undergraduate white women and racially minoritized students to challenge exclusionary framings (e.g., color- and gender-blindness of ability) and enactments of undergraduate mathematics instruction. To do this, the study was designed so undergraduate students can take note, share, and reflect on details about potentially marginalizing events from their mathematics classroom experiences. The study methodology, as detailed below, created space for participants to further examine shared events and reflect on why they interpreted them to be potentially marginalizing for different race-gender identities.

Study Context and Participants

This study took place in a large, public research university in the northeastern U.S. with a diverse yet predominantly white student population. The analysis presented in this report is based on data collection that took place during fall 2017 and spring 2018. A total of 16 first-year undergraduate students enrolled in a section of pre-calculus or calculus were recruited, including 4 Black women, 3 Black men, 4 Latinx women, 2 Latinx men, and 3 white women.

Data Collection

Journaling. Student participants journaled about events in their pre-calculus and calculus courses that made them and others feel discouraged or uncomfortable. Participants were asked to begin journaling during pre-calculus and calculus classes to capture in-the-moment details about the events and their interpretations.. Journal entries included the date and time of occurrence, whether it happened in lecture or recitation, an event description, and a reflection of why they found the event to be problematic. Events submitted as journal entries included instructor-student interactions, instructors' general comments to the whole class, and peer interactions.

After compiling participants' journaled events, the research team organized them into categories (e.g., the instructor ignoring a student response, laughing at a student's contribution). These categories guided the development of an interview protocol centered around 4-5 stimulus events from categories that ranged from being less to more commonly occurring. For example, a

more frequently occurring event was the instructor advising students to drop down a level in mathematics if they could not quickly complete steps to solving a problem. An example of a less frequently occurring event in the interview protocol was an instructor accusing a student of not owning a calculator that was provided by a university support program aimed to financially help underserved student populations at the university. Any details about racial and gender identities as well as emotionally-charged language from the submitted events were removed in the protocol, so participants had opportunities to experience stimulus events in different ways.

Interviews. The individual interviews with the 16 study participants were semi-structured, audiotaped, and lasted between 60-90 minutes. Participants were asked three sets of questions for each of the stimulus events. First, since events in the interview protocol may not have been submitted by the interviewed participant, we asked participants to describe what they saw happening in each event. Then, we asked if they found the event to be uncomfortable, why or why not, who they thought would feel uncomfortable, and if there is anyone who would not feel uncomfortable. Lastly, we asked participants if they saw the race or gender of the instructor or student(s) playing a role in their interpretations of each event. During the interview, interviewers probed about various student-generated themes that arose from their interpretations of the events.

Data Analysis

To address the first research question, the data analysis focused on aspects of undergraduate mathematics classrooms, including instruction, that participants described as positioning them or other students in marginalizing ways. We listened to the interviews multiple times and noted differences in participants' responses for each event, including whether or not they saw the event as potentially marginalizing, the extent to which race and/or gender played a role, and how they had or would have experienced the event as a student. After this initial pass through the interview data, we openly coded for features of undergraduate mathematics classrooms and instruction that influenced participants' perceptions of classroom events as potentially marginalizing. These codes were synthesized into three broad themes of features that made the events marginalizing: (i) underrepresentation, (ii) stereotypes, and (iii) instructor care.

To address the second research question, we examined similarities and differences in participant responses within each broad theme to document variation across as well as within intersectional subgroups. We used axial coding to identify such similarities and differences in participant perceptions across race-gender intersections of identity. For member checking purposes, we completed follow-up interviews with 10 of the 16 participants to ensure accuracy of the emergent themes. These member checks clarified participants' perspectives that were shared during the initial interviews and prompted participants to respond to themes from our analysis. Research team members (1 Black woman, 1 Latinx women, 2 Latinx men, 2 white men, and 3 white women) brought awareness of their respective positionality to the data analysis in efforts to minimize threats of both social proximity and distance to participants (Milner, 2007).

Findings

Below we elaborate on the three themes revealed across participants' perspectives about what can make events from undergraduate mathematics instruction potentially marginalizing: (i) underrepresentation, (ii) stereotypes, and (iii) instructor care. We infuse voices from participants across race-gender intersections to capture variation in students' perspectives within each theme.

Underrepresentation

Classrooms. Twelve of the 16 participants related the potentially marginalizing effects of instructional incidents to racial-gendered underrepresentation in undergraduate mathematics classrooms. Black and Latinx students, in particular, expressed how events would impact them emotionally if they were one of the only women or racially minoritized students in the class. Such emotional impact includes pressure to prove themselves (Beatriz, Quinton), self-doubt about participation (Jasmine), hypervisibility of race (Jasmine), and “feel[ing] uncomfortable” (Parker). In response to an event about an instructor suggesting students drop down a course level, Jasmine (Black woman) described the importance of having a “support system” of same-race peers who could counter the instructor’s discouraging remarks. These same-race peers could also lessen the high stakes associated with the instructor’s remark for racially underrepresented students like Jasmine, managing pressures of “feel[ing] like [they’re] the representation of [their] entire ethnic group” in the classroom.

Quinton (Black man) similarly acknowledged how being the only Black student in an undergraduate mathematics class can limit opportunities to find affirmation from same-race peers about instructors’ potentially racialized interactions. Responding to the event about an instructor laughing at and disregarding a student’s question, Quinton described how a Black student in a predominantly white classroom experiencing this will not be able to check in with Black classmates about whether or not they also perceived the instructor’s actions as racialized. Quinton reflected, “You’re surrounded by white faces... a white professor... You’re looking like you’re the one who’s the problem... There’s no one to really say, ‘No, you’re [the professor’s] wrong. You need to answer the question.’” Furthermore, Quinton interpreted the instructor’s laughter and student disregard in the event as reflective of the instructor’s possible perception that the student “didn’t belong there [in the class].” He described how Black students, for example, are often viewed as getting into college through athletics rather than academic merit, leaving them with the burden of having to “prove [their] worth” and belongingness.

STEM fields. Participants also reflected on how racialized-gendered underrepresentation in STEM fields influenced their interpretations of instructional events as potentially marginalizing. Reflecting on an event where an instructor confused two students, Uzma (Black woman) conjectured that a woman would not feel as comfortable as a man because the “masculine presence in STEM majors” brings men to feel like they belong in the undergraduate mathematics classroom. Victoria (Latinx woman) perceived the instructor’s whole-class comment about dropping down a course level as discouraging women from persisting in male-dominated STEM fields. She argued how women may interpret the comment as confirming gendered representation in STEM, bringing them to think “Maybe STEM isn’t for me.”

In addition, women participants used racialized-gendered STEM representation as a lens to interpret events as reflecting inequitable opportunities for classroom participation. Amy (white woman) described how instructors may perpetuate notions of STEM as a “predominantly masculine field” through “giving them [men] more time” to ask questions and receive support. To illustrate, Amy referred to gendered patterns in the quality of her mathematics instructor’s responses to student questions that brought her to limit her classroom participation. Jasmine (Black woman) argued that racialized-gendered associations of STEM through representation shape instructors’ differential responses to student contributions based on students’ race and gender. For example, Jasmine referred to the lack of expressed gratitude for a woman or student of color correcting an instructor (a white or Asian man) as a “power move” because the instructor might perceive the correction as the student “encroaching on space that doesn’t belong

to [them].” She described these “very disheartening” classroom moments as contributing to the lack of representation and support for marginalized groups in STEM.

Summary. Participants, thus, varyingly interpreted the potentially marginalizing nature of events in relation to racialized-gendered underrepresentation in mathematics classrooms and across STEM fields. At the classroom level, racially minoritized students expressed how the absence of same-race classmates can bring them to interpret instructors’ actions and words with racialized implications about their academic potential and belongingness. Women participants raised how gendered representation in STEM can shape potentially gendered double standards of how instructors interact with students, such as allowing men to take up more space than women and deeming women’s contributions as less worthy of acknowledgment.

Stereotypes

Racial stereotypes. Fifteen of the 16 participants interpreted events being potentially marginalizing due to the activation of stereotypes in and beyond STEM. One set of stereotypes was related to racially minoritized students’ limited mathematics ability and lack of academic effort. Angelica (Latinx woman) interpreted the event of an instructor not reviewing an “easy problem” during class and claiming a student’s exam problem solution was “so wrong” as being more likely to happen between a white instructor and student of color. In particular, Angelica perceived this event as an implicit form of racial bias with an instructor positioning students of color as “trying to get more points because they don’t want to try,” thus “undermining their intelligence and the effort they put in on an exam.” Both Jasmine (Black woman) and Quinton (Black man), in responding to an event about a student with their hand raised being ignored, acknowledged how such deficit stereotypes about students of color can also frame racially minoritized instructors’ teaching practices. Jasmine, for instance, explained how “the culture of... ‘these are what we interpret as the smart kids’” in STEM can produce “implicit biases... even within minority teachers” that could bring women’s and racially minoritized students’ contributions to be deprioritized.

Participants also acknowledged how the racial stereotype that Black and Latinx people are criminals could play a role in the event when an instructor accused a student of not owning a university-provided calculator (Amy, Beatriz, Leonardo, Nadine, Parker, Sarah, Uzma, Victoria). Leonardo (Latinx man), for example, reflected on how the event would bring him to “feel like the teacher thinks [he is] a thief.” If the student in the event was a Black or Latinx student, Leonardo conjectured that the instructor’s remark may be bring classmates to “assume ‘Oh, well it isn’t hers. She’s black. Well, she must have stole it.’”

Gender stereotypes. Another set of stereotypes raised in participants’ reflections about how the classroom events could produce discomfort or discouragement was related to gender. Participants referred to the gendered stereotype that women are less mathematically able than men in explaining instructors’ potentially marginalizing actions through teaching (Delma, Sarah) and women’s pressure to challenge others’ underestimation of their ability (Anne). Sarah (white woman), for instance, described how this gendered perception of ability can explain the logic behind an instructor’s disregard of a women’s request to do a similar follow-up problem, “Just because this one girl has another question doesn’t mean I have to do it for the rest of the class.” Anne (white woman) interpreted the event of a student apologizing for asking a question that the instructor curtly refused to answer as potentially gendered, particularly because the student was likely a woman who felt she must apologize for asking something that was simple or obvious.

Summary. These student reflections capture how they perceived the operation of racial and gender stereotypes in framing what could be experienced as potentially marginalizing instances of classroom instruction. Racial and gendered stereotypes of academic ability were raised in explaining disparities of student acknowledgment and participation due to implicit biases among instructors, including those from minoritized backgrounds. Furthermore, as exemplified in Leonardo's reflection, the influence of an instructor is evident in how their stereotypical framings of classroom interactions can bring students to similarly position marginalized peers in deficit or negative ways.

Instructor Care

Getting to know students. Thirteen of the 16 participants, especially among women of color, interpreted events as being potentially marginalizing due to the level of care that instructors exhibited. For example, instructor comments were interpreted as them not caring to know their students personally. Nadine (Black woman), in reflecting on her submitted event where an instructor confused her with another woman, shared how offended she felt when she learned that her instructor did not know her name mid-semester. As one of only two women in the classroom, Nadine described the instructor's confusion as "careless" which she took personally, especially since she had "taken the time to learn the professor's name and ... put effort into the class." Nadine states, "I always get really upset when that happens. It's an honest mistake, but the reaction after you're [the instructor] corrected shouldn't be like 'Yeah whatever.' ... I'm a person with my own identity and my name is a part of that." Sarah (white woman) similarly discussed how such confusion of two students could reflect the instructor "group[ing] them off in their mind based on race or gender." She argued that this captures how "a teacher really does decide not to get to know their students" at an individual level.

Student support in understanding. Another interpretation of classroom events was instructors not caring to make sure students understand the material. Jasmine (Black woman), in response to an event with an instructor declining to review an "easy problem" and laughing at a student's request to earn more points, described how most mathematics instructors do not worry much about having rushed through the material and whether students understood what was presented in class. In particular, she commented on how instructors may not ask themselves, "Maybe I missed something? Maybe it was a rushed job? Maybe I didn't teach it at all?" Jasmine further acknowledged how, if she was the student in the event, the instructor's lack of care "discourages [her] from asking a question about [her] exam or just asking a question about a concept." Sarah (white woman) interpreted an event (namely, one with an instructor ignoring a student's question) as the instructor rationalizing that they can't "waste time" if only some students don't understand the material, thus communicating "a lack of care for explaining and helping other students." In Sarah's reflection, she described being brought to "feel a little unimportant" and, similar to Janiya's reflection about discouraged participation, may cause students in general to not ask questions because the instructor has "no interest in helping them." Beatriz (Latinx woman) commented on how instructors ignoring students' questions makes her feel as though she needs to "practice what [she] need[s] to practice and just look out for [herself]" since she "can't rely on the professor" to answer her questions.

Impact of classroom interactions. A final interpretation students had was that instructors may not be aware of the potential impact their behaviors and words on white women and racially minoritized students. For the event when an instructor asked a student if they owned the calculator that a university support program provided low-income students, Uzma (Black

woman), perceived the instructor as having a “level of ignorance in how certain programs in the university work” that could bring the student to feel the instructor was not “sensitive to [their] situation.” Sarah (white woman) believed that the instructor’s actions for the calculator-related event could be an “innocent mistake.” However, Sarah felt that the instructor should still be responsible in learning about the support program to avoid offending future students, “If a professor were to learn what it [the program] is, they would see why the mistake could be offensive.” For the event where the teacher told students they should consider moving down a course level in mathematics, Victoria (Latinx woman) commented on how instructors might not realize some students, particularly from minoritized backgrounds, might interpret comments in discouraging ways, such as “If you can’t do this, you might as well not be a doctor”.

Summary. Participants perceived events as reflections of instructors’ lack of care in building relationships with students, deepening students’ understanding of content, and acknowledging students’ social backgrounds and life circumstances beyond the classroom. These reflections highlight how such lack of care could be disrupted through instructors getting to know students more personally and providing more opportunities for student support in instruction.

Implications for Teaching Practice

Findings from this analysis raise implications for socially affirming teaching practices in undergraduate mathematics education across different intersections of students’ racial and gender identities. The theme about underrepresentation captures the importance of teachers challenging racialized-gendered frames about students’ ability to shape instruction in ways that establish equitable participation opportunities and affirm underrepresented students’ sense of belongingness in STEM. In addition, the theme about instructor care raises considerations about the extent to which instructors design classroom learning opportunities to build relationships with their students and learn more about them as whole individuals. Participants reflected on how instructors learning more about their students, including their names and university program affiliations, could allow them to feel their individuality appreciated rather than being positioned as one of the only white women or racially minoritized students in the classroom. Such intentional considerations for the relational spaces of undergraduate mathematics classrooms is especially important in entry-level mathematics classes and larger institutions of higher education where high enrollment can present challenges in getting to know students personally.

Furthermore, the fast-paced instruction and lack of student support opportunities that characterized the theme of instructor care points to the significance of designing undergraduate instruction that prioritizes student understanding. Instructor acknowledgment of how students’ questions and volunteered answers (regardless of correctness) advance the understanding of content can contribute to building supportive learning environments that challenge the construction of status or hierarchies of ability. With women and minoritized students of color navigating deficit stereotypes of ability, such broadening of instructor support can minimize the discouragement that participants felt about asking questions and seeking help due to instructors’ lack of care. Findings related to the role of stereotypes capture the importance of instructors being mindful of how whole-class messages can be interpreted in more or less discouraging ways among students from different social backgrounds and histories of educational experience. Findings from this study, thus, build on previous research by outlining how specific actions in undergraduate mathematics instruction might be marginalizing for students underrepresented in STEM, rather than attributing such experiences of marginalization to an ethos.

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