

Power, Resistance & Identity in STEM Education

Black Women and Belongingness: An Interrogation of STEM Education as a White, Patriarchal Space

Luis A. Leyva, Ph.D.
Assistant Professor of
Mathematics Education
[@LuisLeyvaEdu](https://twitter.com/LuisLeyvaEdu)

Nicole M. Joseph, Ph.D.
Assistant Professor of
Mathematics Education
[@profnicolej](https://twitter.com/profnicolej)

Vanderbilt University-Peabody College
November 19, 2020

What is the state of Black Women in STEM?

- ★ Low representation across the P-20+ pipeline including mathematics, computer science, engineering, physics, etc.
- ★ Black women are rarely *centered* in STEM education research; thus, gaps exist for understanding the nuances of their underrepresentation.
- ★ Millions of dollars spent for “broadening participation,” yet the needle rarely moves for increasing their numbers because interventions tend to focus on micro (i.e. motivation) and meso (i.e., curricular changes), rather than macro (i.e. structures/ideologies).

Joseph, N.M., Hailu, M. & Boston, D. L.(2017). Black Girls' and Women's Persistence in the P-20 Mathematics Pipeline: Two Decades of Children and Youth Education Research. *Review of Research in Education*, 41(1), 203-227.

Joseph, N. M., Marshall, S., & Harmon, M. (under review). NSF Funding and Broadening Participation: Examining and Problematizing A Case of Black Women in Mathematics.

Mathematical Sciences Doctoral Degrees

	2011	2012	2013	2014	2015	2016
Total (m/w)	849	852	912	948	900	982
Men	619	628	670	694	673	730
Women	230	224	242	254	227	252
White	155	163	170	179	161	157
Black	9	10	6	9	6	11
Hispanic	9	10	6	7	7	9

Recommendations for Research & Practice:

Research Priorities:

1. Asset-Based & Policy-Oriented Research Agenda
2. Cross-Departmental & Cross-Institutional Collaboration (Dr. Leyva's work)
3. Increased Quantitative Studies

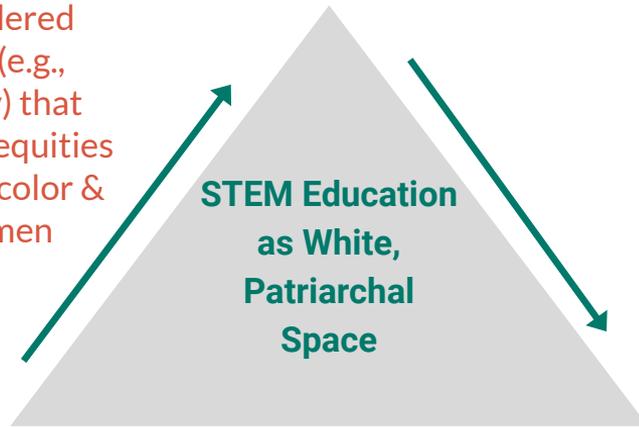
Practice Priorities:

1. Curriculum Reform in Teacher Education Program
2. Support for Pipeline Programs
3. Curriculum Reform in Doctoral Mathematics Programs (Dr. Leyva's work)

Joseph, N.M., Hailu, M. & Boston, D. L.(2017). Black Girls' and Women's Persistence in the P-20 Mathematics Pipeline: Two Decades of Children and Youth Education Research. *Review of Research in Education*, 41(1), 203-227.

STEM Education as a White, Patriarchal Space

IDEOLOGICAL
Racial-gendered ideologies (e.g., meritocracy) that perpetuate inequities for people of color & white women



INSTITUTIONAL
Racial-gendered exclusion in advanced math & access to high-quality instruction and support

RELATIONAL
Racialized-gendered interactions; Cognitive and emotional labor

Leyva, L. A. (in press). Black women's counter-stories of resilience and within-group tensions in the white, patriarchal space of mathematics education. To appear in the *Journal for Research in Mathematics Education*.

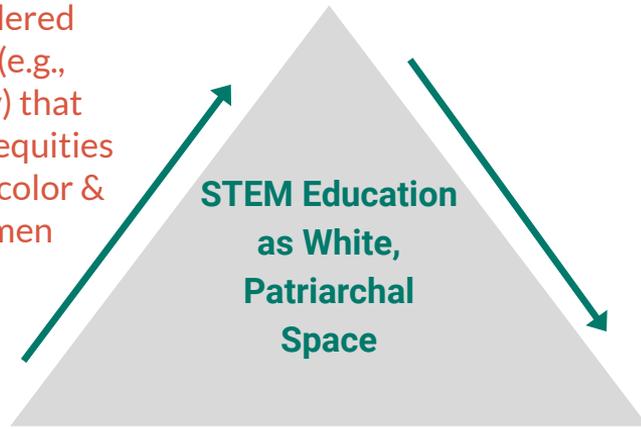
Leyva, L. A., & Alley, Z. D. (2020). A counter-storytelling of struggle and support in Black women's mathematical talent development and STEM pursuits across white, patriarchal educational spaces. In N. Joseph (Ed.), *Understanding the intersections of race, gender, and gifted education: An anthology by and about talented Black girls and women in STEM* (pp. 85-106). Information Age Publishing.

There is not a lot of representation in STEM fields for minority females, specifically in the major I'm going to. **Some African American women help each other, and some don't.** I know this from experience that other women don't want to help each other. We talked about this in a women's gender course [sic] that **there is that glass ceiling. We're obviously competing against each other, when we should be helping each other.** There is always that competition, that you have to do better than the other women.

Bia
African woman
Computer science (initial); Biomedical engineering

STEM Education as a White, Patriarchal Space

IDEOLOGICAL
Racial-gendered ideologies (e.g., meritocracy) that perpetuate inequities for people of color & white women



INSTITUTIONAL
Racial-gendered exclusion in advanced math & access to high-quality instruction and support

RELATIONAL
Racialized-gendered interactions; Cognitive and emotional labor

Leyva, L. A. (in press). Black women's counter-stories of resilience and within-group tensions in the white, patriarchal space of mathematics education. To appear in the *Journal for Research in Mathematics Education*.

Leyva, L. A., & Alley, Z. D. (2020). A counter-storytelling of struggle and support in Black women's mathematical talent development and STEM pursuits across white, patriarchal educational spaces. In N. Joseph (Ed.), *Understanding the intersections of race, gender, and gifted education: An anthology by and about talented Black girls and women in STEM* (pp. 85-106). Information Age Publishing.

It's different when you see someone else [like you], and you're like, "do I need to work as hard as I was working before to prove myself?" or "can I just be myself and take the math class without having to like feel I have to do well because somebody's watching me?" or "should I because I have to prove that it's not just her who can do well, it's everybody?" I have to prove that more than one minority can make it. It's not a special case.

Sierra

African American woman
Biomedical engineering (initial);
Anthropology & public health

Study Design



This material is based upon work supported by the National Science Foundation under DUE Grant Nos. [1711712](#) and [1711553](#). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.



Challenging, Operationalizing, and
Understanding Racialized and Gendered Events

Perceptions of calculus instruction from **20 historically marginalized students (including 4 Black women)** at large, historically white, and public research university in northeastern United States

Individual interviews centered on **4-5 stimulus instructional events** from undergraduate precalculus and calculus classrooms

White, patriarchal space (WPS) framework used to analyze racialized and gendered functions of undergraduate calculus instruction

How does calculus instruction reinforce STEM education as a white, patriarchal space that impacts Black women's sense of belonging in STEM?

Summary of Findings

(Leyva, et al., in press, *Cognition & Instruction*)

Leyva, L.A., Quea, R., Weber, K., Battey, D., & López, D. (in press). Detailing racialized and gendered mechanisms of undergraduate precalculus and calculus classroom instruction. To appear in *Cognition & Instruction*.

12 participants invoked **racial and gendered representation in STEM fields** as an institutional influence shaping their perceptions across instructional events

Over half of instances raised mechanism of **activating exclusionary ideas of who belongs in STEM**

Belongingness mechanism was most frequently reported by **women across racial groups** and most commonly for the **course drop event**

Two threads in how the belongingness mechanism of calculus instruction was raised:

- **Mathematics as a gatekeeper**
- **Distribution of mathematical authority**



Mathematics as a Gatekeeper

Math is a basis for a lot of other STEM fields... But that's often the feeling, and also just for instance, in terms of how higher education is set up. **If you don't pass your math courses, you can't move on to your other STEM courses.**

It just comes from that idea that **your math ability is directly correlated with your intelligence...** It's how other STEM fields relate to math... **If you're not good at math, then you're not good at all the other fields.**

I think it could have the potential to make everybody uncomfortable, but I think it's varying degrees... **Minority females would feel it more than everybody else...** I think it comes from just having two things stacked against you that, one, you're a female, and two, you're a minority. This idea that **not only do you not belong because you're a woman, you also don't belong because you're a minority,** and you're not a model minority. You're minority minority. I think it would definitely be seen as **'Well, then shit, then I guess I'm not supposed to be here'** type of thing.

Uzma, Black woman, unspecified STEM major

Leyva, L.A., Quea, R., Weber, K., Battey, D., & López, D. (in press). Detailing racialized and gendered mechanisms of undergraduate precalculus and calculus classroom instruction. To appear in *Cognition & Instruction*.

Uniquely disheartening for Black and Latin* women with activation of racial & gendered ideas of who belongs in STEM

Mathematics as a gatekeeper in STEM higher education makes stakes for persistence high for underrepresented Black & Latin* women

Equating mathematical ability with STEM potential, coupled with instructor's gatekeeping messages, produces undue pressures and questioned STEM competence

Distribution of Mathematical Authority

Math is supposed to be a **White, Asian, male type area**. And anyone who doesn't fall into that, [the correction] just seems a challenge or **'You're encroaching on space that doesn't belong to you or that society says doesn't belong to you.'** And that's very disheartening in the sense that **women are already not going into STEM fields for these exact reasons.... Women and minority STEM applicants just don't feel supported in that sense.**

Just **very shut down**. As if you're not even included in the conversation... I'm pursuing computer science and they welcome teamwork... It becomes very disheartening when you feel like, **'If I correct someone or if I offer another suggestion, they're going to feel threatened or... feel like 'Why are you even trying to come at me?'** And I'm like, "I'm not. I'm just trying to collaborate with you because I thought that was the purpose of this."

Jasmine, Black woman, computer science major

Leyva, L.A., Quea, R., Weber, K., Battey, D., & López, D. (in press). Detailing racialized and gendered mechanisms of undergraduate precalculus and calculus classroom instruction. To appear in *Cognition & Instruction*.

Double standards for correcting instructors, who are traditionally positioned as holding all authority in calculus classrooms

Racialized and gendered access to collaboration, a value in the disciplinary culture of computer science

Calculus instruction as source of **racialized and gendered messaging of STEM belongingness** among Black & Latin* women

Implications for STEM Educational Practice:

- (1) Creating **STEM affinity groups for Black women** to process & engage in critical dialogue of racial-gendered oppression (Allen & Joseph, 2018; McGee & Bentley, 2017)
- (2) Approaching pedagogy with **consciousness of whiteness and patriarchy embedded in seemingly neutral STEM instructional behaviors** (Haynes & Patton, 2019)
- (3) Formalizing opportunities to build **within-group peer connections** (e.g., study groups across course sections) to foster solidarity & mitigate influences of underrepresentation in STEM (Borum & Walker, 2012; Ellington & Frederick, 2010)

Allen, E. L. & Joseph, N. M. (2018). The Sistah Network: Enhancing the educational and social experiences of Black women in the academy. *NASPA Journal About Women in Higher Education*, 11(2), 151–170.

Borum, V., & Walker, E. (2012). What makes the difference? Black women's undergraduate and graduate experiences in mathematics. *The Journal of Negro Education*, 81(4), 366-378.

Ellington, R.M., & Frederick, R. (2010). Black high achieving undergraduate mathematics majors discuss success and persistence in mathematics. *The Negro Educational Review*, 61(1–4), 61–84.

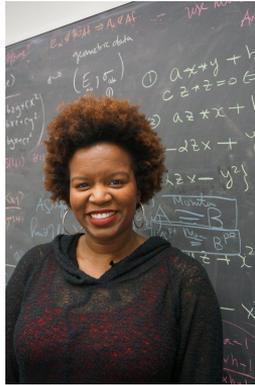
Haynes, C., & Patton, L. (2019). From racial resistance to racial consciousness: Engaging White STEM faculty in pedagogical transformation. *Journal of Cases in Educational Leadership*, 22(2), 85-98.

McGee, E. O. & Bentley, L. (2017). The troubled success of Black women in STEM. *Cognition & Instruction*, 35(4), 265-289.

Black Women **DO** BELONG in STEM



Euphemia
Lofton Haynes



Chelsea
Walton



Turner
Frank



Marjorie Lee
Brown



Gloria
Hewitt



Mikayla Sharrieff, India
Skinner, and Bria Snell



Gloria Granville



Talitha
Washington



Talithia
Williams