Can *Community Cultural Wealth* Guide Undergraduate *Women of Color* Toward STEM Careers?

Shuhan Ai*; Juan Pedro Ross*;
Tianji Jiang*; Marcelo Almora Rios*

*School of Education and Information Studies
University of California, Los Angeles

Land Acknowledgement

As we gather for the ASHE 2024 Annual Conference, it is important to acknowledge that we are currently on the traditional ancestral homeland of the Dakhóta Oyáte (Dakota people), the original inhabitants and stewards of the land and waterways of Minneapolis, Minnesota.

Overview

- Background & Research Question
- Conceptual Framework
- Literature Review
- Data and Method
- Results
- Discussion

Background

- **Underrepresentation of Women of Color (WOC) in STEM Careers**
  - Women represent only 35% of the STEM workforce (NCSES, 2023).
  - Black, Hispanic, and Native Americans make up only 24% of the STEM workforce (NCSES, 2023).
  - Persistent earning gaps exist, with male STEM workers earning higher salaries (NCSES, 2023).
  - Small share of degree earners in fields like engineering and computer science (Fry, Kennedy, & Funk, 2021).
  - Limited financial and social support hinder WOC's access to STEM career (Denton et al., 2020; Yap et al., 2024).
- **Research Gap**
  - Deficit-based perspectives dominate much of the research. Anti-deficit framework was used to emphasize strengths of WOC groups (Yosso, 2005).
  - Prior studies on CCW focus on qualitative methods; limited quantitative exploration of its impact in STEM contexts (Hiramori et al., 2024). This study uses CCW to examine WOC's STEM career aspirations quantitatively.

Research Questions

- **RQ1:** What are the demographic characteristics and family backgrounds of senior WOC students who aspire to pursue a STEM career? Do these characteristics significantly differ from those of students who do not have such aspirations?

- **RQ2:** Controlling for demographics and participation in college support structures (such as undergraduate research programs and career preparation programs), to what extent do different forms of CCW capital predict STEM career aspirations of senior undergraduate women?

Conceptual Framework

- Community Cultural Wealth
  - Students from URGs possess inherent strengths and cultural resources that can be leveraged for their future success.
  - Yosso (2015)

Aspirational

The ability to maintain future ambitions and goals despite facing significant obstacles.

Linguistic

The intellectual and interpersonal abilities gained from communication across various languages or expressive styles.

Familial

The repository of cultural knowledge embedded within family ties, such as memory and cultural insights.

Social

The network of community ties and resources that sustain and support individuals.

Navigational

The strategies and skills employed to maneuver through social institutions.

Resistant

The knowledge and abilities honed from confronting and seeking to rectify social inequality.

Literature Review

- **Underrepresentation & Barriers of WOC in STEM**
  - WOC are significantly underrepresented in STEM across education, employment, and wages (NCSES, 2023; Fry et al., 2021).
  - Challenges include the "broken pipeline," imposter syndrome, microaggressions, and alienation (Li et al., 2022; Miles et al., 2022).
- **STEM Aspirations & Persistence**
  - Aspirations shape graduate STEM pursuits but differ across race/gender (Chang et al., 2014; Espinosa, 2011).
  - Supportive programs like McNair Scholars, BUILD Scholars and research opportunities boost STEM persistence (Renbarger & Beaujean, 2020; Cuellar & Gonzalez, 2021, Eagan et al., 2023).
- **Key Factors Influencing Graduate STEM Career Aspirations**
  - Mentorship, academic support, and research experiences are crucial (Wilson et al., 2018; Eagan et al., 2023).
  - Cultural & social support enhances WOC persistence (Mau & Li, 2018; Castellanos, 2018).

Data and Method

- **Dataset**
  - HERI Surveys: 2015 Freshman Survey (TFS) and 2019 College Senior Survey (CSS), covering 2,670 WOC students from 55 institutions.
  - 38% Asian, 21% Hispanic, 11% Black, and 29% of two or more races.
- **Key Variables**
  - **Outcomes:**
    - STEM career aspirations from 2019 CSS coded as a binary outcome
  - **Predictors:**
    - Five forms of CCW—aspirational, navigational, social, resistant, and familial capital—operationalized using HERI constructs and survey responses from 2015 TFS and 2019 CSS
  - **Covariates:**
    - Background Characteristics: first gen, international, HS GPA, family background
    - College Experience: faculty interaction; undergraduate research programs, pre-professional club

Data and Method

- **CCW Measurement**
  - Aspirational Capital:
    - Measured by students' career goals and HERI's Social Agency construct, scored with IRT (mean = 50, SD = 10).
  - Navigational Capital:
    - Assessed through access to academic (tutoring, research projects) and career resources (advisor meetings, career support satisfaction).
  - Social Capital:
    - Evaluated via peer and faculty interactions, and the HERI College Involvement construct (e.g., clubs, community service).
  - Resistant Capital:
    - Measured by civic and political engagement, including HERI Civic Engagement and involvement in student-led activism.
  - Familial Capital:
    - Focused on community connection and belonging, including community service and campus sense of community.

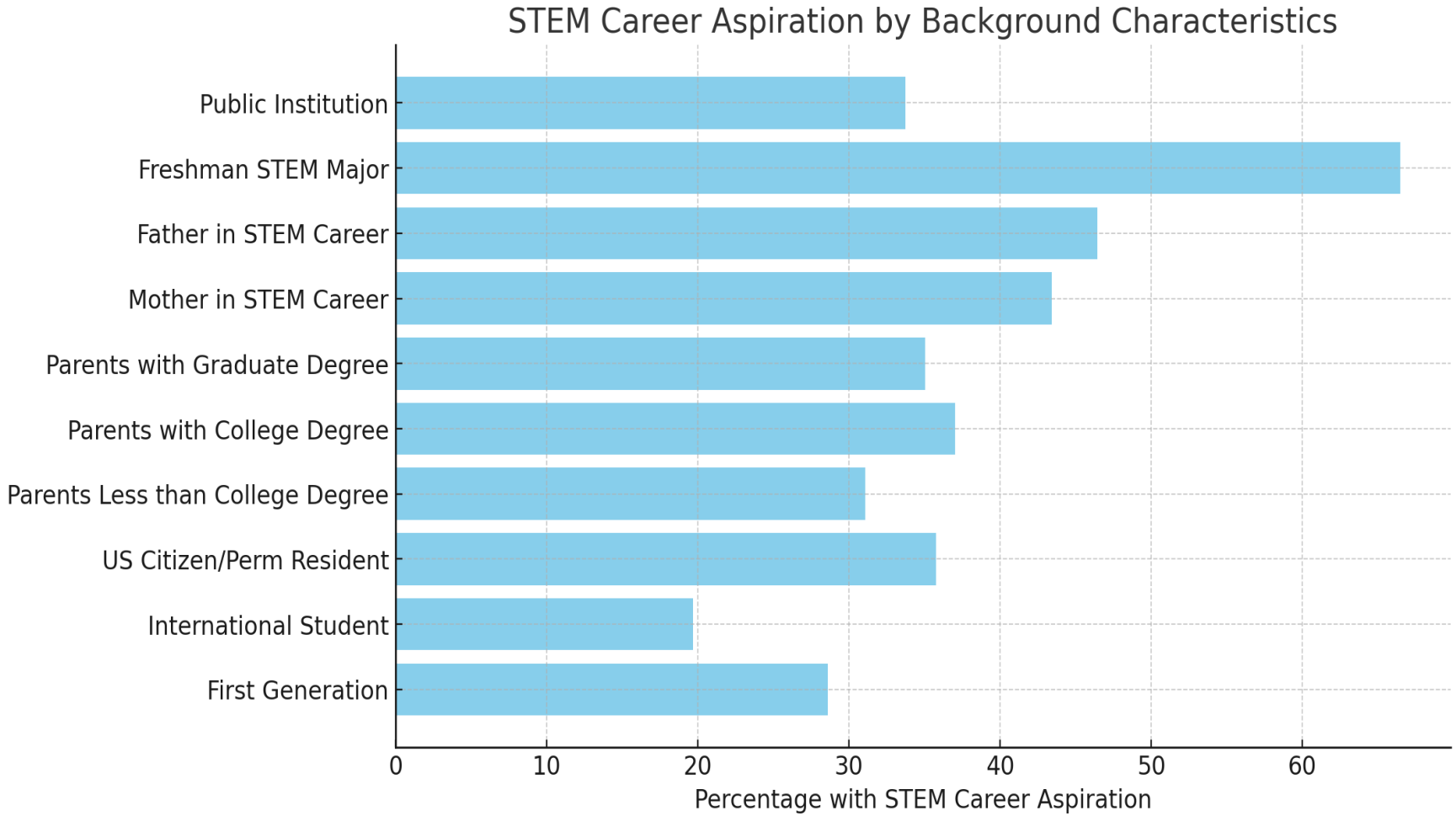
Data and Method

- **Method:**
  - **Stage 1:** Descriptive and inferential analyses (chi-square tests) to compare demographics and family backgrounds of WOC with and without STEM aspirations.
  - **Stage 2:** Logistic regression to examine the impact of CCW forms on STEM aspirations, controlling for demographics and institutional support, with odds ratios and significance set at $p < 0.05$.

Data and Method

- **Limitation:**
  - Secondary Data: Limited ability to capture all CCW dimensions as defined by Yosso, leading to a potentially incomplete representation.
  - Group Generalization: WOC treated as a collective group due to some small subgroup sample sizes; future research should explore subgroup variations.

Results Q1


STEM Career Aspiration by Background Characteristics
Public Institution
Freshman STEM Major
Father in STEM Career
Mother in STEM Career
Parents with Graduate Degree
Parents with College Degree
Parents Less than College Degree
US Citizen/Perm Resident
International Student
First Generation
0
10
20
30
40
50
60
Percentage with STEM Career Aspiration

Results Q1

- **Academic Choice:**
  - WOC who declared a STEM major as freshmen are more likely to pursue STEM careers as seniors (67% vs. 13%, $p < 0.05$).
- **First-Generation and International Status:**
  - Lower STEM aspirations among first-generation (29%) and international students (20%) compared to their non first-gen (36%) and citizen peers (36%) ($p < 0.05$).
- **Family Background:**
  - **Education:** Higher STEM aspirations among students with college-educated parents (37% vs. 31%, $p < 0.05$).
  - **STEM Careers:** Greater STEM aspirations if parents, especially fathers, work in STEM (mother: 43% vs. 33%; father: 46% vs. 32%, $p < 0.05$).

Results Q2

Table 3 *Logistic Regression Summary of STEM-Related Career Aspirations for Senior WOC*

	b	Std. Error	z value	Pr(>|z|)	exp(b)
Background Characteristics					
Mother in STEM career	0.378	0.182	2.076	0.038	1.459
Father in STEM career	0.554	0.164	3.373	0.001	1.74
College GPA	0.003	0.048	0.066	0.947	1.003
Public institution	0.515	0.151	3.420	0.001	1.674
CCW-Aspirational Capital					
Social Agency Score	-0.033	0.008	-4.208	0.000	0.968
Become Authority in Field	-0.235	0.087	-2.701	0.007	0.791
Make Scientific Contribution	0.544	0.072	7.554	0.000	1.723
CCW-Navigational Capital					
Tutoring Satisfaction	0.095	0.049	1.966	0.049	1.1
Research Project Participation	0.319	0.090	3.527	0.000	1.376

Results Q2

Table 3 *Logistic Regression Summary of STEM-Related Career Aspirations for Senior WOC*

	b	Std. Error	z value	Pr(>|z|)	exp(b)
CCW-Social Capital					
College Involvement Score	0.008	0.007	1.130	0.258	1.008
Student Government Participation	-0.174	0.076	-2.286	0.022	0.84
CCW-Resistance Capital					
Civic Engagement Score	-0.026	0.014	-1.864	0.062	0.974
Student Protests Participation	-0.104	0.080	-1.294	0.196	0.901
CCW-Familia Capital					
Community Service Participation	0.277	0.140	1.975	0.048	1.32
College Experience					
Undergraduate Research Participation	0.939	0.139	6.752	0.000	2.558
Pre-Professional Club Participation	0.566	0.126	4.496	0.000	1.761
STEM Career Program Participation	0.639	0.159	4.015	0.000	1.894

Marked p<0.05 *, p< 0.01**, p<0.001***

Discussion

- **Background:**
  - Parental education and career occupation play crucial role in shaping WOC's STEM career aspirations, aligning with previous research (Xu, 2016; Archer et al., 2012; Castellanos, 2018).
- **CCW:**
  - **Navigational Capital:** Positively influences STEM career aspirations, with academic support and research involvement building skills and confidence essential for STEM success (Chang et al., 2014; Cuellar & Gonzalez, 2021; Eagan et al., 2023; Wilson et al., 2018).
  - **Aspirational Capital:** Our findings suggest a gap between STEM education and social justice goals, while the desire to make a scientific contribution positively predicted STEM aspirations, a high Social Agency Score (such as aiming to influence social values, aiming to promote racial understanding) and the goal to become an authority were negative predictors.
  - **Social, Familia, and Resistant Capital:** Participation in community service, such as building community gardens or volunteering in healthcare and science museums, positively influences students' STEM aspirations by demonstrating the societal impact of STEM fields (Lim et al., 2022; Rende et al., 2023).

Reference

Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2012). Science Aspirations, Capital, and Family Habitus: How Families Shape Children's Engagement and Identification With Science. *American Educational Research Journal*, *49*(5), 881–908. https://doi.org/10.3102/0002831211433290

Bourdieu, P. (1986). THE FORMS OF CAPITAL. *Handbook of Theory and Research for the Sociology of Education*, 241–258.

Castellanos, M. (2018). Examining Latinas' STEM Career Decision-Making Process: A Psychosociocultural Approach. *The Journal of Higher Education*, *89*(4), 527–552. https://doi.org/10.1080/00221546.2018.1435133

Chang, M. J., Sharkness, J., Hurtado, S., & Newman, C. B. (2014). What matters in college for retaining aspiring scientists and engineers from underrepresented racial groups. *Journal of Research in Science Teaching*, *51*(5), 555–580. https://doi.org/10.1002/tea.21146

Cuellar, M. G., & Gonzalez, A. M. (2021). Beyond the Baccalaureate: Factors Shaping Latina/o Graduate Degree Aspirations. *Journal of Hispanic Higher Education*, *20*(1), 59–74. https://doi.org/10.1177/1538192719830082

Denton, M., Borrego, M., & Boklage, A. (2020). Community cultural wealth in science, technology, engineering, and mathematics education: A systematic review. *Journal of Engineering Education*, *109*(3), 556–580. https://doi.org/10.1002/jee.20322

Dika, S. L., Pando, M. A., Tempest, B. Q., & Allen, M. E. (2017). Examining the Cultural Wealth of Underrepresented Minority Engineering Persisters. *Journal of Professional Issues in Engineering Education and Practice*, *144*(2), 05017008. https://doi.org/10.1061/(ASCE)EI.1943-5541.0000358

Dou, R., & Cian, H. (2021). The Relevance of Childhood Science Talk as a Proxy for College Students' STEM Identity at a Hispanic Serving Institution. *Research in Science Education*, *51*(4), 1093–1105. https://doi.org/10.1007/s11165-020-09928-8

Eagan, M. K., Hurtado, S., Chang, M. J., Garcia, G. A., Herrera, F. A., & Garibay, J. C. (2013). Making a Difference in Science Education: The Impact of Undergraduate Research Programs. *American Educational Research Journal*, *50*(4), 683–713. https://doi.org/10.3102/0002831213482038

Reference

Eagan, M. K., Romero, A. L., & Zhong, S. (2023). BUILDing an Early Advantage: An Examination of the Role of Strategic Interventions in Developing First-Year Undergraduate Students' Science Identity. Research in Higher Education. https://doi.org/10.1007/s11162-023-09745-8

Espinosa, L. (2011). Pipelines and Pathways: Women of Color in Undergraduate STEM Majors and the College Experiences That Contribute to Persistence. Harvard Educational Review, 81(2), 209–241. https://doi.org/10.17763/haer.81.2.92315ww157656k3u

Fry, R., Kennedy, B., & Funk, C. (2021, April 1). STEM Jobs See Uneven Progress in Increasing Gender, Racial and Ethnic Diversity. Pew Research Center. https://www.pewresearch.org/social-trends/2021/04/01/stem-jobs-see-uneven-progress-in-increasing-gender-racial-and-ethnic-diversity/

Hiramori, D., Knaphus-Soran, E., Lamar Foster, J., & Litzler, E. (2024). Critically quantitative: Measuring community cultural wealth on surveys. Race Ethnicity and Education, 0(0), 1–19. https://doi.org/10.1080/13613324.2024.2306382

Lareau, A., & Horvat, E. M. (1999). Moments of Social Inclusion and Exclusion Race, Class, and Cultural Capital in Family-School Relationships. Sociology of Education, 72(1), 37–53. https://doi.org/10.2307/2673185

Lareau, A., & Weininger, E. B. (2003). Cultural Capital in Educational Research: A Critical Assessment. Theory and Society, 32(5/6,), 567–606. https://doi.org/10.1023/B:RYSO.0000004951.04408.b0

Li, X., Kim, Y. H., Keum, B. T. H., Wang, Y.-W., & Bishop, K. (2022). A Broken Pipeline: Effects of Gender and Racial/Ethnic Barriers on College Students' Educational Aspiration–Pursuit Gap. Journal of Career Development, 49(4), 753–768. https://doi.org/10.1177/0894845321994196

Lim, T. C., Wilson, B., Grohs, J. R., & Pingel, T. J. (2022). Community-engaged heat resilience planning: Lessons from a youth smart city STEM program. Landscape and Urban Planning, 226, 104497. https://doi.org/10.1016/j.landurbplan.2022.104497

Reference

Martinez, M. A., Chang, A., & Welton, A. D. (2017). Assistant professors of color confront the inequitable terrain of academia: A community cultural wealth perspective. Race Ethnicity and Education, 20(5), 696–710. https://doi.org/10.1080/13613324.2016.1150826

Mau, W.-C. J., & Li, J. (2018). Factors Influencing STEM Career Aspirations of Underrepresented High School Students. The Career Development Quarterly, 66(3), 246–258. https://doi.org/10.1002/cdq.12146

McKee, K. D., & Delgado, D. A. (2020). Degrees of Difference: Reflections of Women of Color on Graduate School. University of Illinois Press.

Miles, M. L., Agger, C. A., Roby, R. S., & Morton, T. R. (2022). Who's who: How "women of color" are (or are not) represented in STEM education research. Science Education, 106(2), 229–256. https://doi.org/10.1002/sce.21694

Monarrez, A., Frederick, A., Morales, D. X., Echegoyen, L. E., & Wagler, A. (2024). Hispanic/Latinx STEM Majors Applying to Graduate School: The Role of Family, Peers, and Undergraduate Research Programs in Facilitating Community Cultural Wealth. Journal of Latinos and Education, 23(1), 205–219. https://doi.org/10.1080/15348431.2022.2122973

NCSES. (2023). Diversity and STEM: Women, Minorities, and Persons with Disabilities 2023. Special Report NSF 23-315. Alexandria, VA: National Science Foundation. https://ncses.nsf.gov/pubs/nsf23315/report

Nhien, C. (2024). How Southeast Asian Students Develop Their Science Self-Efficacy During the First Year of College. The Journal of Higher Education, 1–28. https://doi.org/10.1080/00221546.2024.2339173

Renbarger, R., & Beaujean, A. (2020). A Meta-Analysis of Graduate School Enrollment from Students in the Ronald E. McNair Post-Baccalaureate Program. Education Sciences, 10(1), 16. https://doi.org/10.3390/educsci10010016

Rende, K., Jones, M. G., Refvem, E., Carrier, S. J., & Ennes, M. (2023). Accelerating high school students' science career trajectories through non-formal science volunteer programs. International Journal of Science Education, Part B, 13(1),

Reference

Rincón, B. E., Fernández, É., & Dueñas, M. C. (2020). Anchoring comunidad: How first- and continuing-generation Latinx students in STEM engage community cultural wealth. International Journal of Qualitative Studies in Education, 33(8), 840–854. https://doi.org/10.1080/09518398.2020.1735567

Robinson, T. N. (2022). The myths and misconceptions of change for STEM reform: From fixing students to fixing institutions. New Directions for Higher Education, 2022(197), 79–89. https://doi.org/10.1002/he.20429

Sablan, J. R. (2019). Can You Really Measure That? Combining Critical Race Theory and Quantitative Methods. American Educational Research Journal, 56(1), 178–203. https://doi.org/10.3102/0002831218798325

Sausner, E. B., Wentzel, C., & Pitarresi, J. (2024). “I know what I need to learn”: The intersection of aspirational and navigational capitals for marginalized-identity STEM students. Journal of Engineering Education, 113(2), 488–508. https://doi.org/10.1002/jee.20595

Sharkness, J., DeAngelo, L., & Pryor, J. (2010). CIRP construct technical report. Higher Education Research Institute, UCLA.

Valencia, R. R. (2010). Dismantling contemporary deficit thinking: Educational thought and practice. Routledge.

Wilson, A. E., Pollock, J. L., Billick, I., Domingo, C., Fernandez-Figueroa, E. G., Nagy, E. S., Steury, T. D., & Summers, A. (2018). Assessing Science Training Programs: Structured Undergraduate Research Programs Make a Difference. BioScience, 68(7), 529–534. https://doi.org/10.1093/biosci/biy052

Xu, Y. J. (2016). Aspirations and Application for Graduate Education: Gender Differences in Low-Participation STEM Disciplines. Research in Higher Education, 57(8), 913–942. https://doi.org/10.1007/s11162-016-9411-5

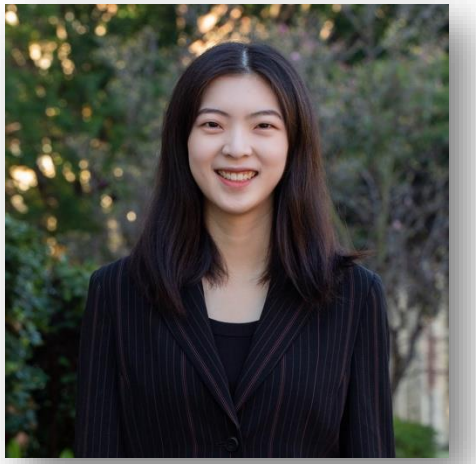
Yap, M.-J., Foriest, J., Walker, K., Sanford, S., & Rice, A. (2024). Family Helps Transform the STEM Pathways of Community College Women of Color STEM Majors. CBE—Life Sciences Education, 23(1), ar10. https://doi.org/10.1187/cbe.21-09-0273

Yosso, T. J. (2005). Whose culture has capital? A critical race theory discussion of community cultural wealth. Race Ethnicity and Education, 8(1), 69–91. https://doi.org/10.1080/1361332052000341006

Thank you for Listening!

Welcome Contact and Further Discussion!

Presenters:



Shuhan Ai
aishuhan@ucla.edu

Juan Pedro Ross
juanrosso123@ucla.edu