BOARD # 400: NSF CAREER: Effects of Community Cultural Wealth on Persistence of Black and Hispanic Women in the P-20 Computing Workforce Pipeline in Texas

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This five-year, parallel mixed-methods research study [1], funded by the National Science Foundation CAREER award, investigates the influence of community cultural wealth (CCW) [2] on persistence among Black and Hispanic women in the computing pipeline. The study uses the CCW framework to explore the role of cultural capital in supporting educational and career trajectories in response to the persistent underrepresentation of women of color in science, technology, engineering, mathematics, and computing (STEM+C). Underrepresentation of Black and Hispanic women in STEM+C is a critical issue hindering diversity, equity, and innovation within these disciplines [3-6]. According to the National Science Foundation, while women constitute 49% of the overall U.S. population (ages 18-34) and 50% of the STEM workforce, they only account for 15% of the computing workforce [7, 8]. Their underrepresentation in P-20 STEM education and professions is largely related to systemic barriers that impede persistence and retention [9]. Barries such as stereotypes, double standards, bullying, harassment and lack of sense of belonging among others [10] negatively impact broad participation in STEM+C in the United States and beyond [5, 11-13]. Addressing these barriers requires a comprehensive understanding of the factors influencing persistence of Black and Hispanic women in undergraduate education and beyond.

This study is centered around Ashford-Hanserd's [1,14] modified community cultural wealth (MCCW) model, which adds spiritual capital to the six forms of cultural capital identified by Yosso, i.e., aspirational [2,15,16], familial [2, 17], linguistic [2], social [2,18,19], navigational [2], resistant [2]. Historically, Black, and Latino communities accessed spirituality and religion as critical sources of fortitude, resilience, and capital [20,21]. This MCCW model provides an asset-based perspective, and emphasizes how people of color leverage their strengths to navigate and resist forms of oppression and marginalization. This research highlights the forms of cultural capital that support persistence among Black and Hispanic women and illuminates how these factors influence decisions to persist in undergraduate computing education. The study addresses four research questions that explore: how MCCW impacts a national cohort of Black and Hispanic students in grades 9–12 in persisting through STEM+C degree programs or entering the workforce; how MCCW supports Texas-based women at Hispanic Serving Institutions (HSIs) and Historically Black Colleges and Universities (HBCUs) in computing pathways; what their successful trajectories are from grades 8–17; and how MCCW shapes their counter-life herstories in computing education and careers.

To explore the four research questions, a mixed-methods approach was used to combine secondary data from the High School Longitudinal Study of 2009 (HSLS:09) [22] with primary data from [deidentified] survey responses and semi-structured interviews. For the secondary data sourced from the HSLS:09, the research team, focused on 55 course-taking variables including math and science courses, AP and IB courses, and computer science-specific courses in the 2011-2012 academic year along with 67 MCCW variables to define a national cohort of STEM+C-capable students, and identify aspects of MCCW that influence their intentions to major in computer and information sciences. Primary data was collected from [deidentified] survey responses of Black and Hispanic undergraduate computer science majors during Wave 1 in Fall 2023. The survey included a Likert-scale questions assessing 23 factors influencing enrollment and persistence in computing majors based on the MCCW model. Demographic data, post-graduation aspirations, educational

background, and motivations for enrolling and persisting in their major were also collected. Upon completion of the survey, students who identified as Black and Hispanic females were invited to participate in the qualitative strand of the study. These one-on-one interviews were conducted via Zoom and utilized Ashford-Hanserd's counter-life herstories protocol [23], designed to elicit retrospective accounts of lived experiences of women of color.

In the quantitative strand of the study, the primary dataset included 209 respondents with complete responses from an initial total of 363 survey participants pursuing computing degrees at HSIs and HBCUs in Texas. This cohort consisted of 60.29% females (126) and 39.71% males (83), with 41 Black/African American and 80 Hispanic/Latino(a) females, and 23 Black/African American and 56 Hispanic/Latino(a) males. Among the Texas cohort of 126 females, 89.68% were pursuing STEM+C degrees at HSIs, while the remaining at HBCUs. Survey responses were analyzed quantitatively to identify patterns in gender, ethnicity, majors, course-taking behaviors, and the influence of aspects of MCCW on enrollment and persistence in computing majors. The secondary dataset comprised a national cohort of 214,362 Black and Hispanic students in grades 9-12 with aptitude in STEM+C, who are considering majors in computer and information sciences upon postsecondary entry. To compare male and female students in their intentions to major in computing, independent samples t-tests were conducted. The t-test was chosen as it allows for comparing means between two independent groups (male vs. female students) based on their course-taking patterns. The analysis was based on the specific math, science, and computing courses taken by students in grades 9-12.

Comparing male and female students in the national cohort (secondary dataset) who undertook rigorous math and science courses in grades 8-9, the t-test (10.25, $p < 0.0001$*) indicated a significant difference in their intentions to major in computing, with only 1.1% of females expressing intent to choose computing. Similarly, for rigorous courses in grade 12, the t-test (10.10, $p < 0.0001$*) revealed a significant difference, with 1.3% of females intending to major in computing. Analysis of the Texas cohort of 126 females revealed that participants' aspirations and personal motivation (aspects of **aspirational capital**) was the most influential factor in their decisions to enroll and persist, with mean scores of 4.159 and 4.254, respectively. This variable of influence was the most selected option, with 38.10% of females identifying it as a key influence in pursuing a STEM+C degree. Self-confidence and self-efficacy in STEM+C (aspects of **aspirational capital**), significantly supported their persistence, with a mean score of 3.841. Family support (aspects of **familial and social capital**), played an important role in persistence, reflected by a mean score of 3.762. Additionally, aspects of **social capital**, including peer support, role models in STEM+C, and mentorship experiences, influenced persistence of female participants with mean scores of 3.738, 3.397, and 3.063, respectively. Furthermore, the presence of STEM+C job opportunities, chosen by 30.16% of females, was a significant factor in their decision to pursue a STEM+C degree with a mean score of 4.183 for their decision to enroll and 4.365 for their decision to persist, respectively.

Qualitative data consisted of interview transcripts from 35 women of color. Thematic analysis was conducted to examine key patterns and insights from these transcripts. Findings from the thematic analysis highlighted the critical role of aspirational-, social-, and navigational capital in shaping persistence through peers, educators, role models, personal aspirations, and individual navigation skills (see below). Aspirational capital (e.g., career and financial aspirations), was the most influential in overcoming intrinsic and systemic barriers in computing. These findings

provide actionable insights for fostering equitable support regarding decisions to enter and persist in STEM+C education and career pathways.

- Theme 1: Aspects of **aspirational capital** has the greatest influence on decisions to persist in undergraduate computing programs, which pushed women of color to persist in their undergraduate computing programs despite encountering intrinsic barriers, lack of support, and social norms within a male-dominated career field.

  > That's it. I just wanna be stable… I hate asking my parents for money that that's why I work so many hours just so I can like, spend it on whatever. So I, I wanna be stable in a job that, um, I could make enough in order to not really need any financial help. Um, whether that be in software engineering or any other computer science aspect, like, I'm not really picky. That's also why I chose computer science. – Rianne

- Theme 2: Engagement in co-curricular activities and social groups, along with access to resources and interactions with teachers, advisors, professionals, and peers in computing allowed participants to "push forward" and leverage their **social capital**, strongly supporting their persistence in computing.

  > And when it comes to my persistence in STEM, it has definitely helped for me to make connections with people. Lately I've really been trying to talk to other classmates. Um, I've also been trying to join organizations and meet other people. Like, uh, this semester I joined [deidentified], which is the, I think it's stands for [deidentified]. And so there I've been meeting other, um, other people who are also Hispanic and in the engineering field and it's been really nice to meet other people in that. And also I also, um, have been going to meetings for [deidentified], which is, [deidentified]. Yeah. And there I've also been meeting a lot of girls and if it was nice to see that there are other people in the same boat as me and, um, talk about their perspectives and um, their experiences and everything and helping each other out in this, in this career path. – Emily

- Theme 3: **Navigational capital** influenced women of color's resilience in navigating barriers, engaging in self-exploration, and overcoming challenges such as failure and introversion, all of which contributed to their persistence in computing programs.

  > I guess I'm stubbornly persistent because once I knew I eventually wanted to get a bachelor's, I didn't care how I was gonna get there as long as I did get there. I don't know if that's, so that's more so a personality thing that now for sure, asking questions to like the, because as soon as I have a question that I cannot answer, I have an appointment with my advisor, you know, I call 'em up and I'm like, I gotta talk to my advisor. So I, I am very, I will find the person I need to talk to to get that question answered type. – Val

This study investigates the role of community cultural wealth (CCW) in shaping the persistence of Black and Hispanic women in the computing field using a mixed-methods approach. We examine how various forms of cultural capital influence educational and career pathways, particularly in addressing the underrepresentation of women of color in STEM+C disciplines. The findings from Wave 1 reveal that aspirational capital plays a pivotal role in supporting persistence, empowering women to overcome internal and external barriers. Familial capital, characterized by support from family members and community connections, reinforces a sense of belonging, helping participants to persist in STEM+C disciplines. Social capital, fostered through co-curricular engagement and support networks, bolsters persistence, while navigational capital enhances resilience in overcoming systemic challenges. Collectively, these forms of cultural capital often interconnect to sustain the persistence of Black and Hispanic women in computing, offering critical insights into fostering supportive and inclusive environments within STEM+C education and careers.

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