# *Matriarchs Matter:*
# *Family Influences to Scientific Thinking of Women of Color in the Community College*

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**Abstract**
In the University of California system, community college transfer students comprise of 48% of graduates with STEM bachelor's degrees. This demonstrates that two-year colleges help pave the career pathways of community college students, many of which are students from underrepresented backgrounds in STEM fields. To cultivate the potential of women of color in pursuing STEM fields in the community college, focusing on their standpoint will empower them in centering their own perspectives in their own retention and success. Learning more about their standpoint also highlights their knowledge production as future producers of knowledge in the STEM fields. To obtain the influences to their scientific thinking development, 35 women of color STEM majors answered a social network questionnaire by nominating these influences. Social network analysis was used to analyze their influential social networks. Results demonstrate that family members have the highest frequency of influence to scientific thinking, regardless of educational attainment at the high school or lower levels. These relatives also heavily consist of matriarchal figures, such as mothers and grandmothers, especially as influences to scientific observation and scientific justification. These findings signify the importance of family in cultivating intellect, whether or not the relatives obtained college degrees or higher. Significance also supports emphasis on the students' standpoint in self-determining their own success, and creates a campus culture that celebrates family-inclusiveness. Creating campus programming that caters to students' strong relationships with their families may promote even more persistence in their STEM career trajectories.

Keywords: community college, STEM, feminist standpoint theory, social network analysis, mixed methods, women of color STEM, Hispanic-Serving Institutions, first generation students

## Introduction

With an approximately 60% White male majority (Oh & Lewis, 2011), United States federal agencies such as the National Science Foundation and National Institutes of Health acknowledge the urgency of expanding efforts to broaden participation of underrepresented groups, such as women of color, in STEM fields (Valentine & Collins, 2015). Deficit perspectives such as inadequate preparation and training in navigating academia (Koenig, 2009) have been blamed for the underrepresentation of women of color in this field. However, women of color enter STEM majors in college "just as likely as their White peers" but face institutional obstacles and need to negotiate these complex environments that may not be very welcoming for women of color (Ong et al., 2011). This underrepresented group face "double bind" issues from their minoritized social status as both women and non-White in a field dominated by White males (Malcolm et al., 1976).

The magnification of women of color STEM majors' standpoint as they navigate community college invokes the framework of feminist standpoint theory, which recognizes the power of the oppressed and their potential in using their knowledge as a liberatory practice for dismantling patriarchy (Harding, 2004). An asset-based framework, this theory upholds the marginalized location of this underrepresented group in this field as an epistemological advantage of having the function in the world in which their position is located in a marginal location and also the specialized knowledge of their specific social location which has its own nuanced ways of knowing and seeing the world (Collins, 1989; Sandoval, 2004).

With the potential consequences of an individual's marginalized social location (Newman, 2010; Otte & Rousseau, 2002), employing social network analysis provide a potential avenue of analyzing the effects of standpoint on how women of color develop and eventually produce knowledge in the STEM fields. In the context of studying women of color STEM majors in the community college, social network analysis is a methodological tool in exploring how the concept of marginal location may influence an individual's standpoint, and hence, knowledge production. The implication of this may elucidate possible mechanisms of how broadening participation to members of underrepresented groups in the STEM fields can enrich the diversity of ideas and perspectives in the disciplines from their unique standpoint.

Potential influences to the scientific development of women of color STEM majors may range, depending on their social location and access to knowledge. Even as far back as middle school, parents with technical backgrounds have been shown to support creative technological activities of their children (Barron et al., 2009). In college, if they engage in research activities, students' faculty advisors have been shown to transfer research views to their mentees (Leahey, 2006). On the other hand, Espinosa (2011) found that frequency of interactions with peers—not necessarily professors—greatly impact retention of women of color in their STEM majors; the author also recommended women of color attend a private college and/or an institution "with a robust community of STEM students." However, a very limited number of women of color could afford to matriculate into private institutions.

Yet, there is great potential in reaching women of color STEM majors in community colleges and Minority-Serving Institutions (MSIs). In the University of California

system, community college transfer students comprise of 48% of graduates with STEM bachelor's degrees (Community College League of California, 2015). One-fourth of all Chicanx doctorate degree holders were also transfer students (Community College League of California, 2015). This demonstrates that two-year colleges help pave the career pathways of community college students, many of which are students from underrepresented backgrounds in STEM fields. To cultivate the potential of women of color in pursuing STEM fields in the community college, focusing on their standpoint will empower them in centering their own perspectives in their own retention and success. Learning more about their standpoint also highlights their knowledge production as future producers of knowledge in the STEM fields.

This study asks the following research questions:

(1) Who influences the scientific thinking of women of color STEM majors in the community college?
(2) How do nominees influence the scientific thinking of the participants?

**Methods**

*Study site*: The site is a two-year college that is designated as a Hispanic-Serving Institution (HSI) in an urban metropolitan area in Southern California. Student population in 2018 was approximately 20,000 students—of which at least 75% are students of color. Almost 60% of the student body were women. More than half of total school population identify as Latinx. Finally, approximately 45% of the campus study body was first generation college students; approximately 60% received financial aid.

*Participants*: Between January 2017-March 2018, 35 women of color STEM majors were recruited via snowball sampling, flyer distribution, and in-person recruitment. Eligibility for the study required affirmative responses to the following questions:

(1) Are you currently a student at the site?
(2) Are you majoring in STEM (Science, Technology, Engineering, and Mathematics)?
(3) Do you identify as a woman of color, e.g., Latina, African American, Native American, Asian Pacific Islander, or multicultural?

Participants consisted of these STEM majors: 42.86% Biology, 22.86% Chemistry/Biochemistry, 17.14% Engineering, 5.71% Physics/Astronomy, 8.57% Nutritional Sciences, and 2.86% Computer Science. The following races were also represented by this sample: 51.43% Latina, 17.14% Black/African American, 17.14% Asian Pacific Islander, and 14.28% Multicultural.

*Social network questionnaire:* A convergent mixed methods approach was employed via a social network questionnaire to obtain the influences to the participants' scientific thinking development. The questionnaire consisted of a name generator to specific aspects of scientific thinking—particularly, who has influenced (1) scientific observation, (2) scientific explanation, (3) scientific critique, (4) scientific justification, and (5) legitimization of scientific knowledge. The demographic characteristics of each nominated influence were obtained at the end of the name generation. Concurrently, participants were given the option to share any narratives

about their nominations, although this was not required. 100% of the participants offered qualitative insights regarding their influences.

*Data* analysis: Ego-centered social network analysis was used to analyze participants' influential social networks (Newman, 2003). Nominations were quantified by each aspect of scientific thinking and also in total. Nominee data were assigned categorical relationships according to their relationship to the participant according to the following shortcuts:
cc = College faculty and staff
fam = Family members
fri = Friends met outside the college
k12 = K-12 educators and school staff
loc = Local community members who are neither relatives nor friends outside the college
pf = Public figures such as Albert Einstein or popular media characters
rel = Religious figures
sm = Schoolmates or friends on-campus

Nominations were also disaggregated according to their demographic information, such as race, gender. Available narratives about nominations were then triangulated with the quantitative findings about the networks. The software Tableau was used to create data visualizations.

**Results**

*Social network questionnaire:* 450 nominees were named as influences to all participants. The nominations demonstrate diverse social networks of influences to the scientific development of the sample group. Figure 1 shows all of the categorical relationships represented by the nominations on the combined aspects of scientific thinking: 33.33% Family, 22.44% College faculty and staff, 11.78% Public figures, 11.33% K-12 educators and school staff, 6.89% Schoolmates or friends on-campus, 6.67% Friends outside the college, 4.89% Religious figures, and 2.67% Local community members.

Among all categorical relationships, family members have the highest frequency of influence to scientific thinking, regardless of educational attainment at the high school or lower levels. When network data was disaggregated by categorical relationship and race/ethnicity, Latinx family members had the highest number of nominations with 15.11%. Meanwhile, when network data was disaggregated by categorical relationship and gender, women relatives obtained the highest number of nominations in the following aspects of scientific thinking: scientific observation and scientific justification with 18.29% and 22.39% in each scientific thinking category, respectively.

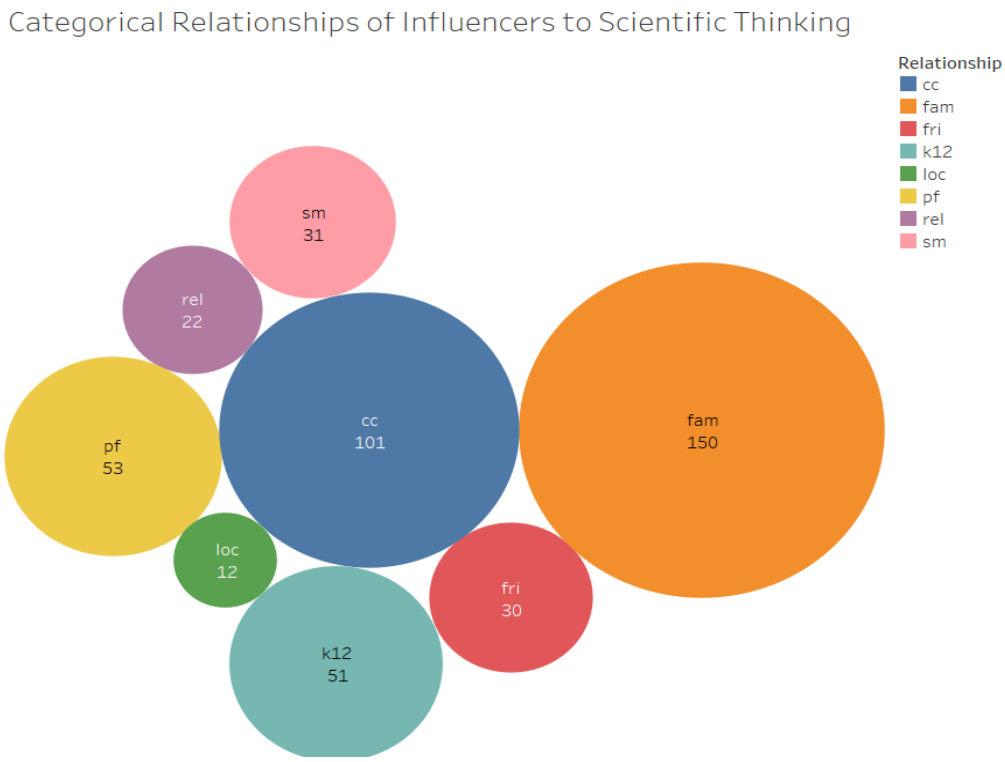


Figure 1. Total Number of Nominations To the Influence to Scientific Thinking of Participants By Categorical Relationships. Results show diversity of influences with family (fam) having the highest number of nominations at 33.33% of all nominations.

Hence, a substantial portion of the influences are women relatives (as well as Latinas, possibly due to more than half of the participants also being Latina-identified). These relatives also heavily consist of matriarchal figures, such as mothers and grandmothers, especially as influences to scientific observation and scientific justification. Scientific observation refers to the act of making observations, while scientific justification alludes to the act of justifying knowledge or taking a position and asserting it.

Qualitative narratives

Although optional, all participants shared stories that elucidate their rationale behind nominating their influences concurrently during the social network questionnaire. Based on the quantitative results of high frequency of women relatives, qualitative data was triangulated with these findings. Henceforth, this paper now narrows its focus on the impact of women relatives on the scientific justification development of the participants.

In alignment with the highest frequency of nominations for scientific justification, qualitative narratives demonstrate that assertive and analytical matriarchs impacted this aspect of women of color's scientific development. The matriarchs that have been nominated include mothers, grandmothers, aunts, and older sisters. The stories about these matriarchs share common characteristics of being strong and empowering family figures who have been shaping the participants' minds even before they entered college, even though the relatives may not have finished high school or college.

An example of these matriarchal influence stories is from a 28-year-old Latina Biochemistry major named Gwen who nominated her mother—the family figure who has raised her to always "have to defend [her] own." When Gwen was in high school, she was very shy—struggled to vocalize her opinions; she recalled having a teacher who bullied her—told Gwen that she was wrong even though she knew that she was correct since she did a class project on her own. Gwen's mother then encouraged her to "defend her own"—to voice out her ideas in class and not let the teacher discredit her own opinions. Gwen's mother taught her daughter how to be fearless in asserting her ideas and position even to the high school teacher, a figure of authority. Since then, Gwen has translated this familial lesson into the realm of the classroom in which she can now confidently justify her own ideas and assert them.

Another matriarch who has influenced one of the participants is the older sister of 24-year-old Latina Molecular Biology major, Elsa. Elsa credits the development of her scientific justification to her sister who "always argues with [her]" and "has a strong opinion on things." Elsa's opinionated sister--who sounds like a devil's advocate—may have inadvertently sharpened Elsa's critical thinking throughout their lives growing up side-by-side. Seemingly contentious debates between sisters actually impressed the younger sibling--whetting the mind for disputing ideas and taking positions on some. Elsa applied these same critical thinking skills in asserting her own ideas in the classroom.

Convergent findings

Data triangulation of the qualitative stories of matriarchal influence on the critical thinking of participants with the quantitative findings of high frequency of nominations for women relatives highlights the impact of family—community wealth capital—on the scientific thinking development of women of color STEM majors in the community college. Regardless of the educational attainment (oftentimes high school or lower educational level), relatives still made an impression in the minds of the participants throughout their lives—and the participants transferred these critical thinking skills in how they think about and do science in the classroom.

## Conclusion

These findings signify the importance of family in cultivating intellect, whether or not the relatives obtained college degrees or higher. Matriarchs in the family also impact the scientific observation and scientific justification development of women of color STEM majors in the community college.

The findings on the significance of family on the intellectual growth of participants align with the importance of community wealth capital. Situating it in the academic realm of feminist standpoint theory, this study magnifies the standpoint of an understudied group in the literature: women of color STEM majors in the community college. This study also contributes to critical social network analysis—focusing on everyday lived experience of the participants instead of relying merely on indicators to predict influence.

Significance also supports emphasis on the students' standpoint in self-determining their own success, as well as inspiring the creation of a campus culture that celebrates

family-inclusiveness. Creating campus programming that caters to students' strong relationships with their families may promote even more persistence in their STEM career trajectories. Implications of this study also include focusing on the standpoint of the actual participants—women of color STEM majors in the community college—as primary stakeholders and central self-agents in their own academic success and STEM field retention.

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