

RESEARCH ARTICLE

Masculinized discourses of STEM interest, performance, and competence that shape university STEM students' recognition of a "STEM person"

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Abstract

How individuals come to perceive themselves in STEM is predicated on their understanding of what it means to be a member of the STEM community. This association is consequential when considering the perpetuation of white male ownership of STEM knowledge and power that forces learners identifying with groups systemically marginalized by racial and gender discrimination to adopt particular norms, values, and behaviors to gain recognition. In effect, these expectations help to maintain masculinized Discourses as STEM professionals are encultured to apply the same recognition criteria to which they were judged themselves. We examine how these Discourses are maintained even as learners who identify with groups that carry histories of systemic marginalization by racist, sexist, and elitist practices gain access to STEM communities. Specifically, we explore how university STEM students attending a Hispanic Serving Institution in the United States articulate gendered expectations of STEM membership through their characterization of themselves and others as (not) STEM people. Drawing from theories in

Discourse, social identity, and feminist critiques of science, we describe how students implicitly recognize STEM identity in gendered ways. We discuss how our findings illuminate the mechanisms by which STEM recognition is afforded by pointing to its dependence on masculinized displays of STEM performances, competence, and interests, leading to a cycle of marginalization as learners are encultured to perpetuate existing STEM Discourses in their recognition of others. We discuss research implications for measurements of STEM identity that do not account for gendered Discourses and offer practical implications for the design of learning experiences that co-opt existing Discourses to inoculate gendered perceptions of a STEM person prototype. Lastly, we present a case for elevating the role of maternal caregivers and family immigration histories in STEM identity construction.

KEYWORDS

gender/equity; STEM Discourses; STEM identity; student beliefs, values

Baird (2018) summarizes the “masculinized culture” of STEM as the “explicit and implicit beliefs, behaviors, policies, practices, and procedures” (p. 4) that position women as innately less competent than men, motherhood as incompatible with STEM careers, and traits such as objectivity and rationality as inherently scientific. We consider this delegitimization to be sustained by spoken and unspoken institutional “Discourses¹”, that is, expectant “ways of being certain kinds of people” (Gee, 2000, p. 110). While these onto-epistemological attributes apply to “STEM” broadly, they also vary by discipline (Cheryan et al., 2017), with especially pronounced instances of marginalization in disciplines that are assumed to require innate, fixed talent (of which women are presumed to possess less than men), such as mathematics and physics (Leslie et al., 2015). These masculinized overtones permeate wider-ranging Discourses across the STEM landscape as they are encoded in popular media (Steinke, 2017), sustained through social interactions (Rodriguez et al., 2019), and codified in governmental policy (Sengupta-Irving & Vossoughi, 2019). Thus, even as STEM participation expands to historically excluded populations, masculinized values, tendencies, and biases are reproduced when individuals are—explicitly and implicitly—coerced to suppress aspects of their identities that are incompatible with dominant STEM Discourses (McGee, 2016; van Veelen et al., 2019).

In the present work, we explore the characterizations of STEM fields and associated prototypes that inform undergraduate STEM students’ verbal expressions of STEM identity. We unpack the underlying “rules” that privilege masculinized forms of participation that these emerging STEM professionals uncritically and unconsciously adopt as they are encultured into

the STEM community (Allen & Eisenhart, 2017). While prior studies illustrate the formation of one's STEM identity through reflection on one's "fit" with taken-for-granted Discourses (Kim et al., 2018), how one shapes and reinforces their notion of a STEM person *through their positioning of others* is not well studied. As inclusion efforts invite more demographic diversity in STEM, there is also a need to think about how enculturation—critical to the persistence of individuals who do not identify with the dominant prototype (Espinosa, 2011)—may perpetuate inequitable Discourses even as the disciplines diversify. We attend to these ideas by engaging with college STEM students at a Hispanic Serving Institution (HSI) in the United States (U.S.), leveraging phenomenological and dialogic interviews to explore the emergent ways they describe themselves and others as (not) a "STEM person". In this way, we focus on Discourses that communicate gendered perceptions of a STEM person among a population of students identifying with gender, racial, and/or linguistic groups that experience systemic marginalization² in STEM and whose views are under-studied compared to those of white students (Nguyen & Riegle-Crumb, 2021). We further explore the hierarchical disaggregation of STEM disciplines in how disciplinary hierarchies may or may not align with gendered expectations. We undertake these purposes to identify and propose ways to inoculate Discourses that perpetuate the dominant STEM prototype. Our aims are guided by two overarching research questions: *How do university students pursuing STEM majors at a Hispanic Serving Institution evaluate themselves and meaningful others as STEM persons? In what ways do evaluative criteria and their application reflect and reinforce gendering of STEM?*

1 | A BRIEF WORD ON THE TERM "STEM"

As we discuss elsewhere (Dou & Cian, 2022), even within the confines of STEM education research, the term "STEM" has been used to reference a broad enterprise (e.g., Bybee, 2010), an integrated discipline (e.g., National Research Council, 2014), and collections of disciplines and subdisciplines (e.g., Shein & Tsai, 2015), often without overt definition (Martín-Páez et al., 2019). We use "STEM" and "STEM fields" as heuristics, referring broadly to domains, disciplines, and subdisciplines that are discursively associated with these terms in empirical education research and national Discourses codified in reports published by U.S. federal and state agencies. However, our aim is not relevant to the various meanings of the word "STEM", but rather the "practices that systematically form the object of which they speak" (Foucault, 1972, p. 49). As such, our analyses defer to participants' personal notions of who/what constitutes a "STEM person" to draw out the unspoken rules that govern their Discourses.

2 | BACKGROUND AND THEORETICAL FOUNDATIONS

2.1 | Framing STEM identity

As concerns about STEM workforce participation accelerated across contexts, researchers have sought to understand contributors to one's STEM identity, or self-perception as a kind of person (Gee, 2000) associated with STEM (e.g., Cian et al., 2022; Grimalt-Álvaro et al., 2022; Shanahan, 2009). We build on our prior work (Dou & Cian, 2022) that associates identifying as a "STEM person" with undergraduate students' pursuit of a STEM major, broadly speaking and

within specific disciplinary fields, including Biological Sciences, Engineering, and Chemistry. This prior work explicitly addresses the recent history of the terms “STEM”, “STEM identity”, and “STEM person” as it relates to their popular association with educational communities across a variety of disciplines, policy initiatives, and learning contexts, extending foundational perspectives described by Carlone and Johnson (2007) about “science” identity.

This framework defines *performance* as “social performances of relevant [STEM] practices”, *competence* as “knowledge and understanding of [STEM] content”, and *recognition* as “recognizing oneself and getting recognized by others as a ‘[STEM] person’” (Carlone & Johnson, 2007, p. 1191). These collectively shape the extent to which one perceives an embodied alignment with what they consider to be a STEM person (i.e., their STEM identity). We further include Hazari et al.’ (2010) conceptualization of “interest”, that is, “desire/curiosity to think about and understand [STEM]” (p. 982), which they introduce for its relevance to pre-career student populations.

2.2 | The critical role of recognition from STEM authorities

Across contexts and ages, women's sense of belonging in STEM and their perception of what it means to be a member of a STEM community is associated with social messaging they receive from others they view as affiliated with STEM communities, or, their *recognition* from others (Kim et al., 2018). Empirical research illustrates how the impact of recognition as a member of the STEM community depends on the authority of the individual conferring recognition, especially in relation to performances and competence. Avraamidou's (2022) case study of the intersectional identities of three women in physics points to the salient recognition they received from teachers and instructors “through words of validation and encouragement”, as well as “either explicitly or implicitly through high expectations and challenges, extra attention, and extra time outside of school” (p. 29).

Godwin and Potvin (2017) echo this role of STEM instructors' recognition through their depictions of Sara, a white rural woman encouraged by a high school chemistry teacher to pursue an engineering major but who left the field when made to feel that she did not have the “right knowledge” (p. 454; i.e., her “competence”) at the university. Carlone and Johnson (2007) describe Alethia, a Black woman who faced difficulty being recognized in her biology lab because of her reluctance to kill mice, which she felt “resonate[d] with stereotypes of squeamish, timid, ‘pretty’ girls” and made her feel that “established members of the lab were judging her for failing to be masculine enough” (p. 1204; i.e., her “performances”). As students like Sara are pushed out of STEM, and students like Alethia are forced to negotiate their identities with the expectations of masculinized performances, many women who remain in STEM are conditioned to recycle the STEM Discourses to which they had to adapt to persist. McGee (2020) notes,

What we really do not need in STEM is more of the same type of students, from the same institutions, taught by the same professors, learning the same curriculum, working at STEM institutions where everybody looks (and quite possibly thinks) similarly.

(p. 640)

While many well-meaning programs have worked to disrupt exclusionary expectations of female-identified individuals, researchers have noted design choices that inadvertently perpetuate Discourses that reinforce masculine dominance, and this has been especially documented in engineering. In Nguyen et al.'s (2022) study of the experiences of young women in a precollege engineering program for girls, participants described the ways their male peers excluded their participation by designating some hands-on tasks as “guys work” (p. 1460) and dominating problem-solving in ways that were even endorsed by their mentors. Bystydzienski and Brown (2012) found that engineering recruitment strategies directed at young women offered only simplistic depictions of engineering, and the female role models students encountered occupied managerial, nurturing roles, rather than technical positions. Rather than being inspired by these approaches, students reacted with ambivalence and disappointment as these depictions and models contributed to increased awareness of gendering in engineering careers. Such work illustrates that tactics to nurture women's identities in STEM fields will be insufficient if not coupled with changes in how gatekeepers, such as educators, understand and critically evaluate what engineering “for girls” can look like (Garibay, 2018; McGee, 2020).

2.2.1 | Recognition by family and friends—and its cultural intersections

While the above work points to the consequences of institutional recognition, less studied is the importance of recognition that is conferred outside of the STEM workplace or classroom (see review in Simpson & Bouhafa, 2020). Rodriguez et al.'s (2021) interviews with Latina college students highlighted the influence of family encouragement, such as Victoria's reflection that “my mom always told me I could be an engineer” (p. 265). However, the authors also point to how family values and norms can conflict with STEM pursuits, especially when there are no STEM workforce professionals in the family. While many students in their study spoke of family role models as influencing their decisions to pursue engineering, those who did not have those role models were more likely to talk of friction in their STEM pursuits. Samantha and Maite, both biological sciences majors, recalled their choices elicited skepticism from their families. Samantha related that her father questioned her career goals specifically in the context of her gender identity, asking: “When you get a job, who are they going to hire, a guy or a girl?” (p. 184). While Maite's family was less explicit in their attention to gender, by positioning her as “weird”, they communicated a dissonance between their perceptions both of Maite and of the type of person who pursues a STEM career.

Recognition as a STEM person differentiates culturally, such as through intersections of STEM pursuits and family expectations. Students in Rodriguez et al. (2019) spoke of intersectional challenges of “breaking the stereotype of being a *Latina* at home taking care of family” (p. 262, emphasis added). Similarly evidencing the influence of familial recognition on how one envisions their future possibilities in STEM, Black and Williams (2013) share how the social expectation to attend to family responsibilities impacted how Mary, an Asian muslim college student, imagined her future in engineering. Avraamidou (2022) describes the support that Zehra, an Islamic woman from Eastern Turkey, felt when her family chose not to oppose her pursuing a physics career. While Zehra did not describe direct, active support, she reflected on the power of the purposeful decision from her parents to *not discourage* her ambitions. Such stories exemplify that recognition can take multiple spoken and unspoken discursive forms, which may not be understood as such to observers.

2.3 | Secondary Discourses of STEM

Such *localized* STEM-related Discourses exist in a milieu of broader *societal and institutional* messaging around STEM participation. In raising alarm that “increasingly, the U.S. is seen globally as an important leader rather than the uncontested leader” (p. 2) to call for investment in STEM education, the National Science Board (2020a) conveys a national imperative in masculine terms of competition and domination (Mansfield et al., 2014; Sengupta-Irving & Vossoughi, 2019). That “STEM” is often used to describe opportunities in engineering and technology (Martín-Páez et al., 2019) further implies more attention is being awarded and value attributed to fields associated with masculinity and where women, especially those marginalized by intersecting racist standards, remain critically underrepresented (National Science Foundation, National Center for Science and Engineering Statistics, 2017). This is further exacerbated by the federal *exclusion* of health fields—where women are more equally represented—from federal characterizations of “STEM” (Dou et al., 2021; National Research Council, 2003; National Science Board, 2020b), such as in research funding programs (e.g., National Science Foundation, 2023) and strategic plans (Committee on STEM Education, 2021).

Gee (1989) describes these taken-for-granted characterizations embedded in institutional messaging as “secondary Discourses” that represent the social language, behavioral expectations, and ideologies of “institutions in the public sphere” (p. 8). Participation in these institutions, which can include schools and workplaces, depends on one’s fluency with their Discourses. Such expectations either dissuade or reject participation by those who do not comply, or require vigilant self-monitoring of discursive performances—a challenge that is not experienced by individuals advantageously positioned within those dominant secondary Discourses (Barth et al., 2018; Master & Meltzoff, 2020; Zimmerman, 2012) and is especially pronounced in those who face intersecting social barriers to STEM participation due to gender, religious, racial, and/or linguistic marginalization (e.g., Black & Williams, 2013; Sengupta-Irving & Vossoughi, 2019).

2.4 | Defining “masculine” and “culture” in the context of “masculine STEM culture”

In addressing the masculinization of STEM Discourses, we align with Fausto-Sterling (1993, 2000) who rejects the dichotomous presentation of “biological sex” as male or female. Such presentations adhere to “Western” views while excluding notions of “intersexuality”, like those represented across cultures and in their artwork and texts. In using terms like “feminine” and “masculine”, we refer to “gender” expression as an act of “doing” which “involves a complex of socially guided perceptual, interactional, and micropolitical activities that cast pursuits as expressions of masculine and feminine ‘natures’” (West & Zimmerman, 1987, p. 126). We recognize that, within STEM fields, Western notions of masculinity (biologically defined and constructed) have historically and cross-culturally elevated the status of those socially recognized as masculine over those socially recognized as feminine, though the “depth” to which these stereotypes are ingrained “varies across cultures” and disciplines (Sachdev, 2018, p. 310).

We align with Cheryan et al.’s (2017) definition of culture as “a dynamic system of individual behaviors and psychological tendencies that influence, and are influenced by historically-derived ideas and values, everyday interactions, and societal structures” (p. 4).

We use “STEM culture” to refer to localized, sociohistorical expectations of performances associated with STEM, such as those encountered in formal and informal learning settings, as well as in reference to sociohistorical expectations of gender performances. While we may use “culture” to reference social patterns or expectations, we avoid its use as an encompassing representation of ancestral norms and traditions associated with particular countries of origin. Rather, we use phrases like “dominant culture” to refer to behaviors and tendencies aligned with onto-epistemologies derived from the eurocentric, sociopolitical histories of STEM disciplines.

2.5 | Femininity and masculinity as culturally situated Discourses (in STEM)

Interviews with graduate students in physics and computer science suggest that many of these individuals perceive STEM fields to be devoid of culture, insisting that the neutrality and rationality of science obviate such influences (Ottemo et al., 2021). In the same attestations of cultural and gender neutrality, however, interviewees described the “kind of person” who does STEM in ways that echo the divisions that historically defined gender roles in Western cultures, positioning characteristics associated with femininity as frivolous. This finding illustrates that while individuals may not consciously recognize enculturation in STEM disciplines, such culturally gendered expectations do exist. Ottemo et al. (2021) and Gonsalves (2014) both note how women in physics described their belonging in the discipline, at least in part, to how their interests differed from “other” women, self-distancing from feminized performances as a way of defining themselves in STEM.

This disconnect between the feminine and the scientific appears in youth aspirations as well. Archer et al. (2013) noted in their study of 10- to 11-year-old girls who did not aspire to science professions ($n = 25$) how they positioned science as “not feminine” (p. 181). However, the disconnect between feminine and scientific performances is not always so obvious to the individual. For example, parents and youth participating in Francis et al.’s (2017) study expressed anger at the idea of labeling “girly girls” as incapable of pursuing physics, yet they later expressed negative associations between “girly-girls” (as well as caregiving professions) with STEM-likeness.

Such examples illustrate that the challenge of STEM participation is not simply a matter of women’s choice but rather the structures that restrict their access (Dale, 2005; Keller, 1985). Harding (1986) articulated that science is gendered in three ways that facilitate this exclusion, which we extend to “STEM”, building on previous literature cited above that supports the existence of this gendering in “STEM” and across STEM fields. This gendering of STEM occurs *symbolically* in the association of masculinity with ontology of STEM as rational, objective, and value-free. Symbolic gendering is maintained *structurally* through labor divisions that delineates some tasks as “feminine” and others as “masculine”. This structural division predisposes male affiliation and precludes that of females such that women who wish to fully participate in STEM are often required “to exchange major aspects of their gender identity for the masculine version” (ibid. p. 53). The *individual* pursuing a STEM profession faces pressures to enact their identities in alignment with symbolic and structural gendering—to either discontinue professional STEM pursuits or to adopt masculine ways of being to succeed in those pursuits—which maintains the cultural Discourses of STEM, reinforcing symbolic and structural gendering.

3 | PURPOSE AND STUDY CONTEXT

In the present work, we describe how a group of university students identifying with diverse gender, racial, and immigrant groups articulate what it means to be a STEM person for themselves and others. This purpose expands the field beyond considerations of the hypothetical other (e.g., “draw-a-scientist”) to consider how university students characterize individuals who played meaningful roles in their development. This approach allows exploration of the multifaceted ways students *both construct and reproduce* personal and societal expectations of a STEM person, while revealing the underlying rules that govern their STEM discourses. We posit this not as a deficit of the individual, but as an important, underexplored, and generally unseen reproduction of marginalizing STEM Discourses, which may highlight further consequences that befall students encultured in STEM contexts and mechanisms for disrupting these Discourses.

We invited the participation of university students enrolled in a public, federally designated HSI that primarily serves students residing in a region of the U.S. predominantly populated by residents who identify with historically marginalized linguistic and racialized groups (i.e., Spanish-speaking, Latine persons). In characterizing our participants' demographic backgrounds (Table 1), we frame Latine³ as a “racial” category (Gómez, 2022), cognizant of the power that the term “ethnicity” has to perpetuate the invisibility of racist practices against individuals categorized by “ethnic” groupings (Zentella, 2017). We presuppose an undefined level of access to the STEM community based on our participants' status as STEM majors past their first year of studies, achieving an aim of proponents to diversify STEM fields. Thus, we undertake this exploration with a population of emerging STEM professionals poised to reproduce or dismantle STEM stereotypes.

4 | RESEARCHER POSITIONALITY AND PARTICIPANT POWER

One aspect of supporting quality in our work is the process by which we consider—and take steps to learn from—how our experiences and identities shape our interpretations (Secules et al., 2021). Heidi, a white woman from an economically depressed rural region, came to realize throughout the study the influence that her marginalizing experiences in STEM contributed to childhood choices—both in school-based and out-of-school engagement with STEM—that ultimately shaped her career trajectory. These reflections she leveraged to empathize with participants, but she also voiced them throughout the research process to make the research team aware of how her experiences may shape her interpretations. In identifying as Latino and as a STEM education faculty member at an HSI, this study gave Remy opportunities to contrast the experiences of the racially marginalized from those more commonly experienced by women at the intersection of their gender and racial identities. That said, given the ignorance experienced by dominant groups in STEM fields (i.e., men), Remy took on the role of both learner and contributor, openly sharing both his challenge and desire to cease the reproduction of unquestioned, masculine characterizations of who constitutes a STEM person.

To foster a more equitable power balance, we involved five members of our participant population (i.e., undergraduate students enrolled in STEM majors) as student researchers. They assisted in most of the interviews described here by posing questions and commentary that

TABLE 1 Demographic details of participants.

Name	Major	Gender	Race/ethnicity	Immigration generation
Mary ^a	Biology ^b	F	Latine ^c and Indian	Second
Carla ^a	Biology	F	Latine	Second
Sandra	Physics	F	Latine	First
Nicki	Physics	F	Latine	Second
Saul	Computer Science	M	Latine	Second
Naomi	Biology	F	Indian	Second
Selena ^a	Computer Science	F	Latine	First
Chloe ^a	Biology ^b	F	Latine	Second
Jake ^a	Engineering ^b	M	South African	International student
Kelsey	Engineering	F	White	N/A
Victoria ^a	Biology ^b	F	Italian	Third
Alex	Chemistry ^b	M	Latine	First
Allie ^a	International Business ^b	F	Latine	Second
Marcos	Computer Science	M	Latine	First
Mandi	Liberal studies ^b	F	Latine	First
Jacq	Engineering	NB	Mestiza	Second
Mia	Biology ^b	F	Black	Third
Daniel	Computer Science	M	Latine	International student
John ^a	Engineering	M	Latine	Second
Saffi ^a	Biology ^b	F	Latine	N/A ^d

Note: Names listed are pseudonyms either selected by the participant or assigned using a random-name generator at the participant's request. We present individuals in the order in which they were interviewed. All students were undergraduates at the time they were interviewed unless otherwise indicated.

^aParticipated in follow-up interview.

^bOn a pre-med track.

^cWe use the term “Latine” as a gender-neutral reference to individuals who identify primarily with Spanish-speaking cultures of South America, the Caribbean, and Europe. We recognize that in practice this may include individuals who identify only as “Hispanic” or those who speak Portuguese (e.g., Brazilian people). The origins of the term “Latine” are rooted in South American social movements and its use is more congruent with a Spanish-language pronunciation.

^dIs second generation from Puerto Rico and not considered an immigrant to the United States.

helped to establish rapport through shared experience (Roulston, 2010). They also participated in organizing data and preliminary analyses (see “Acknowledgements”).

5 | METHODS AND METHODOLOGY

This work is part of a broader phenomenological study exploring the contributions of informal conversations about science during childhood to STEM identity development. This broader study includes the participation of university students, families, and school-age children, and was approved by Florida International University's institutional review board for human subjects research (IRB-18-0429-CR02). Our choice of phenomenological design was guided by our

interest in understanding the experiences of individuals—as they recalled them—in everyday interactional events (van Manen, 2014). Specifically, we explore how individuals construct their experiences of STEM interactions in everyday life and how their interpretations and responses to those experiences guide their interpersonal interactions around STEM.

Although we did not initially set out to explore our participants' gendered articulations of how they defined a STEM person, during our data collection we recognized distinctions in their narratives that suggested differential positioning of individuals within STEM contexts based on how participants framed individuals' gender. In response, we built data collection events in our research plan to further explore this gendered positioning. We also attended to concerns of quality by pursuing opportunities to both enrich the data we collected and the sense we made of that data to explore the complexity of the ideas we were developing through *crystallization* (Richardson, 2000).

5.1 | Data collection

5.1.1 | Initial interviews

We reviewed responses to a STEM identity survey (Dou & Cian, 2021) completed by over 500 students enrolled in introductory STEM courses at the university to select 20 individuals to invite for one, 60–90 min phenomenological interview about their STEM trajectories. We prepared to follow-up participants' recollections by prompting them to recount specifics of recalled events, mental impressions, and emotions (van Manen, 2014). Prior to data collection, we piloted and revised the protocol (Appendix S1) with student researchers.

Interviews were predominantly unstructured but generally followed a three-stage process of the interviewee sharing experiences, recalling details of family- and school-related events, and reflecting on the way those experiences affected their views of themselves, STEM, and the people with whom they interacted (Seidman, 2006). Guided by our STEM identity framework, the protocol included opportunities for participants to talk about the development of their interests in STEM, when they felt recognized in STEM, their assessment of the quality of their STEM performances and competence, and from where those impressions arose. As participants recounted their experiences, we asked questions to elicit details about childhood science conversations. In the latter portion of the interviews, we asked participants to discuss their impressions and interpretations of the interactions they recalled, drawing from data-interpreting interview techniques (Dinkins, 2005; van Manen, 2014). Inviting these conversations allowed us to consider the perspectives of interviewees and, as part of our analysis, identify unconscious or taken-for-granted aspects of how they articulated their experiences and perspectives. When conducting these interviews, we took care to avoid offering or suggesting definitions for the term “STEM” to avoid priming interviewees. Instead, we reflected participants' use to the best of our ability.

We carried out the interviews over approximately 5-months. We selected interviewees in clusters, first inviting those whose survey responses indicated that they strongly identified with STEM and had talked with their families about science during childhood. We evaluated interviews concurrently with data collection to develop tentative ideas to explore in later interviews (Miles et al., 2020; van Manen, 2014). We purposefully selected subsequent participants to test the durability of our developing ideas and to identify areas of nuance as part of crystallizing our understandings (Richardson, 2000). We also considered concerns raised by an external advisory

committee—whose members held expertise in STEM identity research and issues of social justice in STEM—about the extent to which our findings would be unique to Latine families by including data collection from individuals who did not identify as such. As interviews occurred concurrently with a reflexive and collaborative coding process, we continued data collection until we had developed confidence in our ability to represent the complexity of our ideas through the diversity of experiences we could relate with our data (Richardson, 2000).

5.1.2 | Follow-up interviews

In our ongoing analysis, we noticed that participants spoke about STEM—in defining the concept and describing themselves and others as (not) STEM people—in subtle but undeniably gendered ways. To explore their gendered discourses in more depth, we invited seven women and two men for follow-up dialogic interviews (Dinkins, 2005) to further discuss experiences they related in their initial interviews that reflected complex ways of conceptualizing STEM and/or gendered ways of considering individuals as STEM people. Follow-up interviews began 2 months after we completed all initial interviews and they occurred over 3 months. During these conversations we asked participants to elaborate upon their expressions in the initial interview, which included inquiring their reasons for evaluating some individuals a STEM person (or not), as well as the ways they differentiated their evaluations for specific individuals. We did *not* directly ask any participant how they differentiated “men” and “women” in STEM since our interest was in unconscious gendered Discourses. Rather, we asked them to reflect on the degree to which they associated significant persons in their lives (e.g., parents, siblings, friends, and admired celebrities) with STEM. These interviews were unstructured and individualized to evoke specific reflection on events and perceptions introduced during initial interviews.

5.2 | Data coding

Because we wanted to study what it meant to be a STEM person from the perspectives of our participants, we used open coding (Saldaña, 2016) to develop codes for the criteria participants applied to (dis)associate individuals with STEM. We developed codes using our follow-up interviews since this was when we explicitly asked participants to reflect on their understanding of the construct of a “STEM person,” then applied the codes to the initial interviews. Recognizing that the gender, racial, linguistic, and geographic diversity of our research team would contribute valuable perspectives in defining and applying these codes (Richardson, 2000), we spent time reviewing and coding data independently before meeting to discuss and align our codebook. We worked in this sequence throughout the coding process, iteratively developing and refining our codebook (Appendix S1), memoing ideas that we identified through our conversations and personal reflections, to inform later analysis (Braun & Clarke, 2021).

We note that participants never associated a person with STEM using just one criterion. For instance, they may have identified their father as a STEM person because of their perceptions of his interest in STEM (“interest” code), his STEM knowledge (“intelligence”), and his STEM career (“work”). Our analyses also recognized that, even when referencing the same type of criteria, participants varied in how they defined and applied the criteria. For example, “intelligence” often exhibited more subjective variance than “work”, which, for many participants, was a binary evaluation of whether an individual worked in what they considered to be a STEM

profession. Though the construct of a “STEM profession” can also be fluidly defined, our participants generally shared an agreed-upon notion of what qualified. We recognized our participants’ nuanced applications of criteria—at times using bounded characterizations, and at other times based on less defined determinations—as opportunities for theme development.

We purposefully avoided codifying relationships between participants’ racialized identities and their application of STEM criteria given our aversion to overgeneralizations of Latine culture and values. However, we do recognize the cultural situatedness of all experiences, and that feminine expectations can vary across cultures. When identifying gendered articulations, we explored the transcripts to understand the holistic characterization of individuals, particularly attending to allusions of social context and immigration histories. While writing our findings we revised drafts and themes as we consulted transcripts for these contextual details.

5.3 | Data visualization and meaning-making

To thematically engage with the data through visualization (Miles et al., 2020), we constructed a matrix (Figure 1) of individuals our participants talked about, the STEM criteria applied to these individuals, and participants’ perception of each individual in relation to STEM. This matrix included a column indicating the reported gender identity of our interviewee and a

Name	Major	Participant Gender	Person (mom, dad, uncle...)	Person gender	Seen as a STEM Person	Criteria notes	Codes
Alex	Chemistry Premed	M	Friends (in school)	Unspecified	Yes	Friends in his highschool electives "so that started like some encouragement within ourselves to be ilke oh yeah STEM is actually pretty cool"	STE-INT
Allie	International Business Premed	F	Mom	F	No	Tends to interact with her mom about emotional or personal matters. Compares her mom loving animals and wanting to pet them to her dad having information about animals; her mom "doesn't seem interested" in that sort of thing" and doesn't seem to grasp that sort of thing as much	STE-GEN STE-INT (-) STE-INL (-)
Allie	International Business Premed	F	Grandparents	M & F	No	The grandfather was a shoemaker and the grandmother stayed home.	STE-WRK (-)
Allie	International Business Premed	F	Friend	F	Yes	She was interested in STEM, very smart, and wanted to pursue a science-related career.	STE-INT STE-INL STE-WRK
Chloe	Biology Premed	F	Dad	M	No	Not in a STEM career.	STE-WRK (-)
Chloe	Biology Premed	F	Mom	F	Yes	"She was a dentist in Cuba and she's a dental hygienist here so the science was always like there like in my household" "I knew she loved it"	STE-WRK STE-INT
Chloe	Biology Premed	F	Teachers	unspecified	Yes	"I think teachers can also be STEM people if they're practicing it and encouraging it, like being interested in it"	STE-WRK STE-INT

FIGURE 1 The STEM criteria matrix we constructed reflected participant pseudonyms, their self-reported demographic information, as well as the specified gender of individuals discussed, and their descriptions of those individuals. The parenthetical negative was used to indicate that a person was evaluated as not having the trait represented by the documented code.

column identifying the individual referenced as either male- or female-positioned based on interviewees' self-reports or usage of gendered language (e.g., “mother”, “her”). We included individuals or groups mentioned by participants without ascribing gender, such as in cases where participants discussed friends without indicating their gender or talked about a population of individuals characterized by a type of career, such as “doctors”, in the matrix without a gender designation.

We used our matrix to develop word clouds of STEM criteria used in relation to all participants and individuals mentioned. This gave us a general sense of how our participants described themselves and others as STEM people according to the gender positioning of the person referenced and guided the code queries we would use to develop our ideas. We generated three word clouds: one specific to descriptors applied to individuals referenced as male ($n = 48$; Figure 2), one for those referenced as female ($n = 54$; Figure 3), and a combined word cloud (Figure 4), which also included individuals or groups of individuals for which gender was not indicated (e.g., friends, doctors). Except for one participant who self-identified as “non-binary”, participants used binary male–female pronouns when describing themselves or others.

To make theoretically aligned meaning of the word clouds, we considered how their content aligned with Hazari et al. (2010) and Carlone and Johnson (2007), particularly by illustrating the relative strength of codes that suggested carrying out a “performance”, demonstrating “competence”, or exhibiting “interest”. Participants did not directly discuss “recognition” as a criterion but instead used these other components to communicate their recognition of themselves and others, aligning with models of STEM identity development that posit STEM identity as mediated by recognition through evaluations of performances and competence (e.g., Dou & Cian, 2022; Godwin et al., 2016). We clustered related codes to carry out code queries that explored their use across the interviews. For instance, we generated code lists of “intelligence”, “education”, “natural ability”, and “problem solving” to read across uses and understand the nuanced ways competence was evoked by our participants (Figure 5). We memoed these reflections to draft our themes, which we tested by re-reading transcripts and reviewing additional

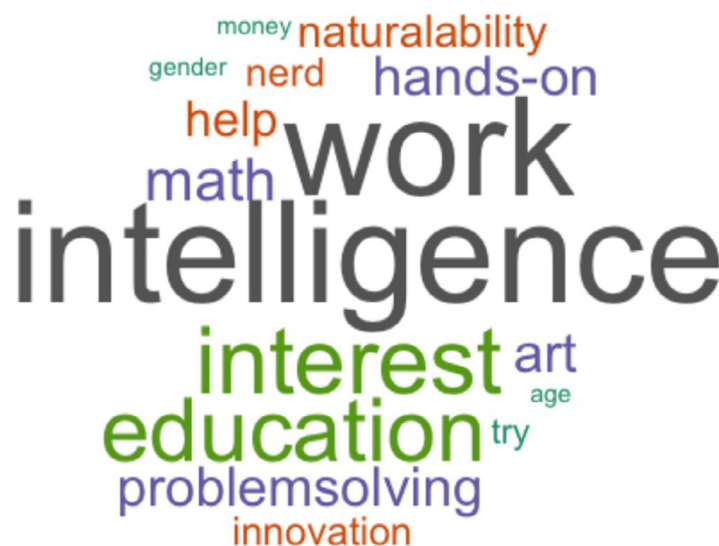


FIGURE 2 The word cloud above includes criteria codes applied to individuals described as male, including male participants' descriptions of themselves. The most prominent codes in the word cloud are *intelligence* (used 25 times), *work* (used 24 times), and *interest* (used 15 times).

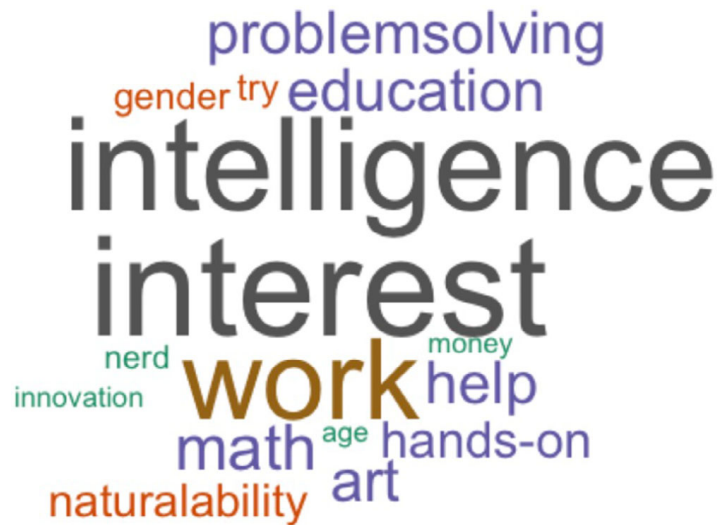


FIGURE 3 The word cloud above includes criteria codes applied to individuals described as female, including female participants' descriptions of themselves. The most prominent codes in the word cloud are *interest* (used 27 times), *intelligence* (used 25 times), and *work* (used 21 times).

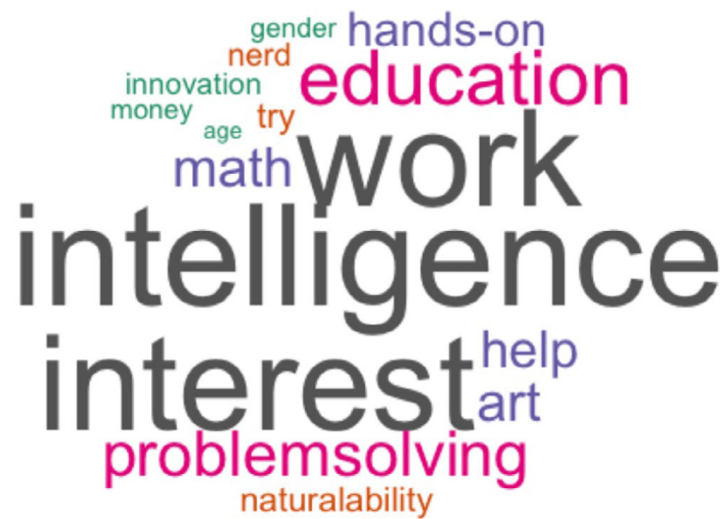


FIGURE 4 The word cloud above includes criteria codes applied to all individuals, regardless of gender and including groups for which a gender was not specified (e.g., doctors, teachers, and premed students). The most prominent codes in the word cloud are *intelligence* (used 57 times), *work* (used 54 times), and *interest* (used 53 times).

code lists relevant to our developing ideas (Braun & Clarke, 2006), looking closely at the language our participants used when they discussed their positioning of others. This process also involved checking intersections with codes that did not explicitly align with our framework (e.g., “age”). We consulted with our student researchers as a form of member checking throughout (Birt et al., 2016). Figure 6 illustrates our meaning-making process.

As we began to feel more confident in our themes, we further critiqued and refined them considering our guiding theories, which involved additional revisits of transcripts (Charmaz &

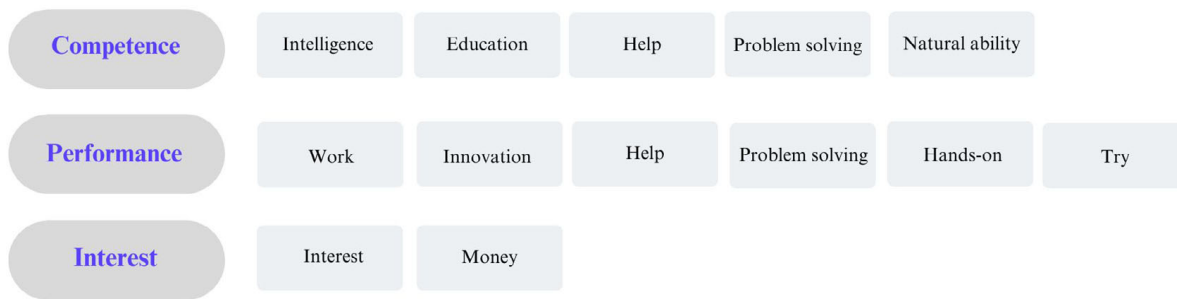


FIGURE 5 The codes that we considered in our word cloud aligned with theoretical contributors of competence (e.g., “intelligence”), performance, and interest that we discuss in our Insights and Interpretations section.

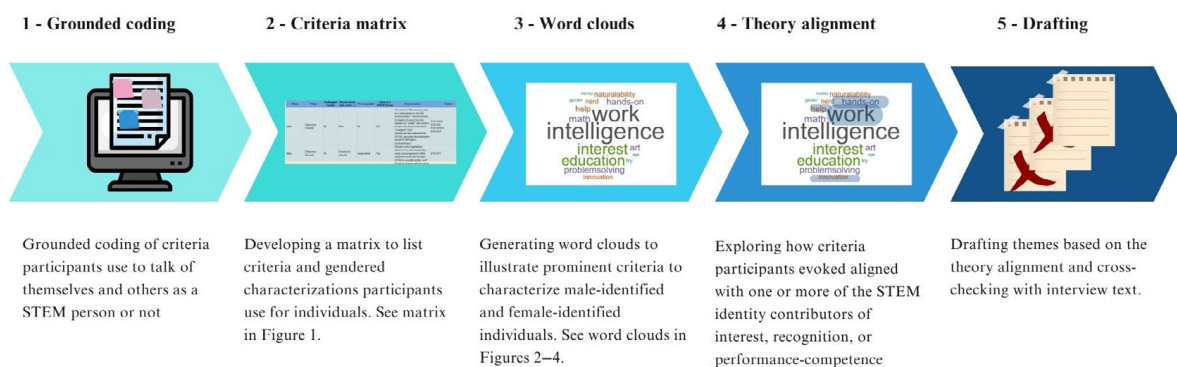


FIGURE 6 The meaning-making process involved (1) code development, (2) reflecting on characteristics of participants and the person evoking the criteria, (3) generating two word clouds to summarize criteria according to gender identification, (4) considering the criteria in the clouds as it aligned with our guiding theory (see Figure 5), and (5) drafting themes.

Thornberg, 2021) and the rewriting of our themes to account for the layers of interpretation to the phenomena described (Richardson, 2000). In these rewrites, we attended to contextual factors and Discourses that were conveyed in participants' statements, particularly the layers of gendering that our participants evoked in alignment with Harding (1986) (i.e., individual, structural, and symbolic). This involved a consideration of social contexts described typically in terms of participants' disciplinary pursuits and their families' values. We applied a social identity perspective most directly in the development of our Discussion as an organizing framework for our implications related to disrupting masculinized STEM Discourses.

5.4 | Limitations

Our analysis considers how individuals positioned as female or male are described in relation to STEM. While this approach implies a gender binary, we adopt it to authentically reflect our interviewee's gendered articulations. Similarly, in making interpretations that describe characteristics as “masculine” and “feminine” we use these terms not to mean “for men” and “for women,” but to reflect the construction of gender through dialectic interactions and contextual positioning (Fivush & Buckner, 2003; West & Zimmerman, 1987).

While we conducted follow-up interviews with nine individuals, we included all 20 participants in our analysis because we found stories in these follow-up interviews that helped to enrich our understanding of how our participants perceived STEM identity. Still, this means that some of our participants' narratives are overrepresented in our data compared to others, but we note that these individuals were identified purposefully due to suggestions made in their initial interviews that their experiences and impressions may provide additional insight.

6 | INSIGHTS

6.1 | Intelligence as a definitive and masculinized characteristic of a STEM person

Participants' evaluations of others as a STEM person predominantly aligned with our theoretical conceptualization of competence that is associated with STEM-related content knowledge or ability to recount STEM-related facts. We labeled these statements using "intelligence" to differentiate from procedural knowledge and align more closely with our participants' use of the term. Our analysis coded "intelligence" frequently; participants evoked it when characterizing 50 gender-specified individuals and seven additional categories of people (e.g., teachers) or individuals (e.g., friend) who were not identified with a binary gender. Narratives often suggested that "intelligence" was not just a criterion for assessing someone's STEM identity; it was *one of the definitive criteria* they applied. Victoria, a pre-medical (i.e., pre-med) student and third-generation Italian immigrant, said "a STEM person I perceive as someone who knows everything about that subject". The significance of STEM intelligence, typically articulated by participants as the ability to articulate a large, generally static body of knowledge without aid of outside information sources, is compounded by the frequency of codes related to similar credentials associated with knowledge possession and demonstration (see Figure 5).

Since we used the code "intelligence" when someone was seen or not seen as a STEM person because of both perceived mastery or lack of knowledge, we categorized uses of *intelligence* criteria as an attribute (supporting STEM identity) and as an implied deficit (detracting from STEM identity). Of the 50 unique individuals described, 36 were described in ways that positively associated intelligence as an attribute. The remaining 14 were explicitly described as lacking sufficient intelligence to qualify as a STEM person. Of those described as having STEM related intelligence, 40% (i.e., 15) were positioned as women. Of those described as *lacking* STEM related intelligence ($n = 14$), 70% were positioned as women (i.e., 10). Most of these deficit characterizations were made by female-identifying participants.

6.2 | Disciplinary differences in "intelligence"

Even though our participants expressed a strong sense of identity and personal competence in STEM on their surveys, our interviews indicated fissures between how they perceived themselves and how they perceived a STEM prototype, which was often reflected in how our female participants deprecatingly spoke of their own intelligence. Carla was a biological sciences major who was encouraged by her father to become a doctor—a profession her father had to abandon to care for his family in Cuba. Carla reflected on how she would rank different STEM professionals as STEM people, determining that she would place physicists above others, including

herself. She reasoned, “physics, at least for me, it comes so difficult. I just took a physics exam like a couple of hours ago and I feel so dumb after”. Possibly primed by the recent experience of taking a physics exam, Carla follows this statement with an interesting juxtaposition of the attributes that characterize what “physicists” and “nurses” know and do:

I don't know much about what a physicist does, but when I think of a physicist... [I think of] having that ability to understand a concept so much that you're able to prove it and then kind of apply that to other things...And when I think of nursing... it also has characteristics of problem solving, but I feel like a lot of it is also like knowledge that has been given off to you that you just learn and then apply.

Here, Carla describes characteristics of both roles almost in parallel in terms. Yet, the context of her expressions, the tone in which she spoke, and her subsequent statements all suggest that she perceives physicists—a profession typically depicted as held by men—as embodying intelligence or the development of knowledge more so than nurses—a profession typically depicted as held by women—despite similarities in her illustrations of the two professionals.

6.2.1 | A higher standard for STEM intelligence for mothers

Among categories of individuals mentioned, primary caregivers identified as mothers were most frequently described as lacking STEM-related intelligence. This dismissal was consistent across the STEM disciplines represented by our participants, including the three most popular: biology or pre-med studies, computer science, and engineering. In the biology/pre-med group, all five of the individuals described as lacking qualifying intelligence were participants' mothers. The one male chemistry student on a pre-med track spoke positively of his mother's STEM identity in terms of her intelligence (his mother was a pharmacist), though the pre-med engineering male student did not (his mother was a radiographer). One person was described by a computer science student as not having the kind of intelligence that they related to a STEM person; this was the interviewee's mother. Among engineering participants, three individuals were described as not having STEM-related intelligence: two mothers and one girlfriend.

Occasionally, these impressions were expressed even when two parents were described as knowledgeable in similar ways. For instance, Mary, a pre-med student, contrasted her perceptions of her parents. She expressed that she believed that her subcontinental Indian mother “didn't have as much a solid foundation about the information” as her Cuban father because her only sources of information were “what she saw on the news...or what she learned many years ago.” Mary's characterization of her mother paralleled that of her father, stating that “he's into going online and reading articles” and “also went to school a long time ago,” but she considered him to be “a little bit more informed”.

Like Mary, some of our participants did not consider either of their parents to have formal STEM career training. Yet mothers' competence in STEM was sometimes dismissed regardless of the formalized experience and education they had in STEM, particularly when they left STEM careers. Jake's mother had worked as a radiographer in South Africa, and he recalled,

She only changed professions because she didn't need to work anymore, sort of, she became a housewife in a sense, because of us [children], obviously...You know, gotta feed the kids, gotta look after them and all...obviously if she was still in the

profession and knew more about it...I would've seen her much more as a STEM person.

While here Jake talks about his mother, he echoed this sentiment when reflecting on his *father*. He articulated his reasoning by describing the absence of “passion for science” that his father, a podiatrist, demonstrates in his career. He reflected that his parents may have started their careers with that “passion” but surmised that it faded with “having kids” and the stable career in STEM became more of a “necessity” to support the family.

This phenomenon of devalued STEM experience and expertise is uniquely illustrated by participants whose mothers discontinued their STEM professions when they immigrated to the U.S. Both Saul's and Marcos' mothers (an engineer and a computer scientist, respectively) were unable to continue their STEM careers when they immigrated to the U.S. due to household labor demands. Despite Saul's and Marcos' perception of their mothers' general support of their educational goals and the stated fact that both interviewees were at the time pursuing STEM careers similar to their mothers', neither participant engaged in content-area conversations with them, highlighting the persistent dismissal of their mothers' knowledge and credentials as relevant to their STEM identity. We uniquely saw this with Marcos, who despite recalling that software systems his mother developed are “still used today” in Cuba, also said he did not speak to her about what he learned in his university computer science courses because her knowledge was “from a long time ago”. Saul recognized that his mother worked as an engineer, but when asked how he would talk to her about topics that he was excited to learn in elementary school, he reflected that he would have to explain it “in layman's terms”. While both expressed gratitude for their mothers' efforts in supporting and celebrating their STEM pursuits and successes, they consistently spoke of their mothers' STEM affiliations as relics of the past.

6.3 | Determining STEM identity through STEM performances

Carlone and Johnson (2007) defined science performances as “social performances of relevant scientific practices” (p. 1191). We noted the “relevant scientific practices” that our participants articulated, which intersected with gendered expectations of social performances.

6.3.1 | Privileging context-specific types of hands-on STEM performances

Though our participants did not talk about doing “hands-on” STEM as a quality of a STEM person when discussing others, it came up frequently in their self-evaluations, and we noted gender differences in the context and qualities of those hands-on experiences. Women, particularly those pursuing biological sciences and/or pre-med tracks, usually discussed performing hands-on work in adult-led, controlled environments such as schools, or with structured tools such as science kits designed for children. For instance, Victoria expressed, “Whenever I'm in [the science] lab, I really feel like a scientist or biologist or whatever you call it. I know that's cliché, 'cause obviously you're in [the] lab, you're mixing chemicals”. While our male participants also endorsed the formative value of those experiences, they emphasized the significance of hands-on STEM experiences outside of structured settings, most often related to building and engineering, such as building a haunted house (Jake), developing new mathematics formulas (Marcos), and building an emulator to play video games (Daniel).

As also reflected in our “innovation” and “problem-solving” codes, both female- and male-identifying participants across fields of study often articulated that a STEM person is someone who creates something new, contributes new knowledge, or thinks creatively, rather than follows a script to reproduce something already known—STEM-related performances commonly seen in structured educational settings (Wade-Jaimes et al., 2023). Thus, the hands-on performances in which our male-identifying participants engaged (e.g., unstructured, open-ended) aligned with our participants’ overall concept of what it means to be a STEM person, whereas the hands-on performances of our female-identifying participants did not.

6.3.2 | Differentiating performances of “helping” others

While the incongruity of “caregiving” and STEM identification were reflected in some of our participants’ dismissal of their mother’s knowledge and in Carla’s juxtaposition of physicists and nurses (discussed above), this did not preclude both our female- and male-identifying participants from associating “helping” with STEM identity. More than half of our participants ascribed “helping” as a characteristic of a STEM person. Yet, as in the ways our participants spoke about intelligence and performance, we noticed that “helping” meant different things to our male- and female-identifying participants.

One way that helping was invoked across interviews was in how our participants spoke about their career aspirations, particularly those intending careers in healthcare. Female students on a pre-med track often discussed their visions of their futures to be driven by a desire to help communities with which they identified and enact values instilled by their caregivers. Mandi recalled growing up in Honduras and being impressed with a value of helping others from her grandmother and mother, which fueled her desire to become a doctor. Mia, a Black woman, recalled witnessing inequities in her Brooklyn community as motivation for her interest in addressing disparities in healthcare access in her future career. However, Jake and Alex did not speak of helping others in the same way. Jake’s medical ambition was inspired by his admiration for Elon Musk—whom he noted as a fellow South African—to make innovative contributions to “get things going” for “the good of mankind”. As such, male students tended to reference more general, less relational accounts of helping others as a trait of being a STEM person.

6.3.3 | Interactions between “helping” and “intelligence”

The gendered ways that “helping” was associated (or not) with STEM also manifested in the ways our participants alluded to helping others with school assignments as a performative display of STEM competence. This attribute was most often used in characterizing a male-positioned student who projected natural ability. When reflecting on their school-related interactions with parents, participants counted on fathers to provide *quick* answers about topics they knew about, which they used as a rationale for considering their fathers a STEM person. They turned toward their mothers for help with more time- and labor-intensive, relational tasks for which immediate answers were not accessible—a task that none associated with STEM performances. In fact, several participants explicitly clarified that their mothers did not help them through the sharing of specific content knowledge. Allie reflected that her mother would help her access knowledge resources or tools, distinguishing this contribution from her father’s

shared knowledge, which took the form of factoids and which she attributed to his expertise and experience in real estate development across South and Central America. Carla similarly contrasted the utility of her father's and mother's knowledge when recalling the creation of school science fair projects with her mother: "She would always help me. *Not so much on like the actual science of it*; she would help me to make sure that I'm not getting hurt with whatever I'm doing...she'll help me put together the board and stuff" (emphasis added).

6.4 | Having STEM interests is not enough

Holding STEM-related interests also factored into our participants' assessments of STEM identity in gendered ways. This was especially noted by participants pursuing biological sciences and/or on pre-med tracks, all of whom brought up interest at least once when describing individuals as a STEM person. These students also tended to more often describe others as (not) STEM people in terms of interest rather than in terms of intelligence—the only discipline-defined group to do so. Despite a fairly equal representation of gender-identified individuals overall, interest was used to characterize 27 women (21 positively and six negatively) and only 15 men (12 positively and three negatively). This difference is notable given existing research that indicates interest to be the *least* contributive to STEM identity—less than the indirect effect of performance-competence on STEM identity through recognition (Dou & Cian, 2022). Thus, while women in our study tended to be associated with interest in STEM more so than men, the role of interest in their positioning as a STEM person is predicted to be minimal and easily dismissed if weightier criteria, such as intelligence, are perceived as lacking.

6.4.1 | Performances of intelligence superseded performances of interest

Participants often spoke of both intelligence and interest characteristics as contributing to a person's STEM identity. Yet, in these instances, intelligence was positioned as superior to interest. Allie illustrated this difference in how she thinks about herself and her father:

I think I consider my dad a STEM person because he just has so much knowledge, like a scientist. I guess I connect [being a] scientist with a lot of knowledge cause they're usually the ones that are in charge of providing knowledge to the people so...But, in my case, I don't consider myself such a knowledgeable person...I consider myself a STEM person because of the interest that I have, that I don't feel like my dad does.

Allie later talked about her perception of being able to "provide" knowledge as the *most* important descriptor of a STEM person, despite not seeing herself in this way. This self-characterization suggests that she considered someone interested in STEM as a STEM person to a lesser degree than someone with STEM knowledge.

Our participants' reflections suggested that even the absence of interest would not disqualify STEM identity if coupled with adequate knowledge and credentials, but the reverse did not hold; a person who was recognized for expressing STEM interests may have been dismissed as a STEM person for perceived intelligence deficiencies. Mary recalled that her mother was "interested in science" but reflected that her mother's tendency to trust experiential and cultural

knowledge from India over scientific facts is “what kind of takes me away from wanting to consider her a STEM person”. Naomi similarly reflected that her parents were interested in science, but their adherence to explanations rooted in their culturally acquired knowledge interfered with their accepting the “scientific” knowledge that Naomi shared, which in turn affected her perspective of their possession of STEM-related competence.

6.4.2 | Structurally feminine ways of expressing interest conflict with the STEM prototype

While Carlone and Johnson (2007) speak of performances in terms of “relevant scientific practices”, we also noted that our participants articulated that only certain performances associated with expressing interest were relevant to being positively recognized by STEM authorities. Carla recalled a salient childhood experience that exemplified this. She expected to receive a recommendation to an advanced 6th-grade science class from her 5th-grade teacher, feeling encouraged when she noticed a male peer, whom Carla felt “never did any work in class”, receive the recognition. But, when she received her teacher's recommendation, Carla recalled, “she's like, ‘Oh, I don't think that this is a good choice for you.’...And I was like, ‘Ouch.’”. Carla further reflected that she may not have been selected because, “I didn't speak out so much in class, ... [my teacher] probably thought I wasn't *interested*...or I just didn't know what to say” (emphasis added). Here, Carla coupled interest with intelligence, reflecting on her teacher's assessment of her STEM capabilities to perform in an advanced class in terms of her ability to express interest through public verbal demonstrations. Carla's perception of the freedom her teacher gave her peer to act out his masculinity also reflects the permissiveness afforded to male-identified students (e.g., Due, 2014). This differential permissiveness is reflected in Carla's remarks that her peer “never did any work in class; he was never doing anything” but felt that she was not recommended for the course for lack of engagement despite her personal interest and positive perception of her engagement during science lessons.

Our interviews also affirmed Gonsalves (2014) findings that *lack of interest* in activities associated with “girliness” appeared to reify a positive assessment of STEM identity for female-identifying participants. Mia reflected, “I was always like catching lizards... those little things they would say girls were squeamish about”. Mia further discussed that her mother was instrumental in supporting her to overcome racial and gendered stereotypes she experienced throughout the authorship of her STEM identity. Yet, her characterization of girls as squeamish reflects the durability of the systemic gendering of STEM despite the presence of actors encouraging the breakdown of feminized stereotypes.

7 | DISCUSSION

7.1 | The shape of STEM Discourses

To support the participation of women in STEM fields, an understanding of the marginalizing STEM Discourses to which they may assimilate and the ways these are assimilated is key. It is well understood that institutional Discourses often carry with them underlying, unspoken “rules” that define the shape of what participation looks and sounds like (Gee, 2000; Verdín et al., 2018), that is, how it is *recognized* (e.g., Kim et al., 2018). Yet, few studies home in on the

nature of these rules and the social contexts in which they are encountered. We found evidence of this phenomenon in the ways undergraduate students pursuing STEM degrees at an HSI positioned themselves and others as (not) a STEM person.

Despite their varied histories and personal goals, the STEM Discourses our participants related suggested a shared set of “proper” performances, competence, and expressions of interest in STEM, with little room for deviance. These expressions were often associated with masculinized defaults of STEM participation (Baird, 2018) and were unconsciously imposed when evaluating individuals they positioned as female. We also recognized participants’ own experiences as subjected to these kinds of evaluations and, uniquely, their activity in subjecting others to similar expectations. Consequently, we suggest that the underlying criteria for recognizing STEM participation are aligned with gendered performances and expressions of competence and interest *in ways that facilitate their continuity*. Below we explore how these findings may be leveraged to foster inclusive STEM spaces.

7.2 | STEM interest displays associated with masculinized performances of competence

Confirming stereotypes of STEM professionals across disciplines as “geniuses”, “intelligent”, and “nerdy” (e.g., Dou et al., 2021; Miller et al., 2018; Verdín et al., 2018), we found competence to be central to participants’ perceptions of an ideal version of a STEM person, regardless of STEM field or discipline referenced. While having other traits, such as “interest”, were associated with being a STEM person, our participants discussed the significance of this characteristic primarily in terms of its utility for competence displays. While participants’ articulations suggested that they perceived an ideal STEM person as both intelligent and interested in STEM, qualifying displays of interest align with masculinized presentations of STEM competence and performance, such as blurting out answers or disassociating oneself from “girly” interests (Francis et al., 2017). These types of interest displays contributed to more positive evaluations of someone as a STEM person than feminized displays, such as embodying a “good student” identity (Archer et al., 2013), and in some cases, were even used to dismiss STEM identity depending on its symbolic femininity (Harding, 1986).

7.3 | Views within and about care for other

We also found a similar pattern in the ways our participants associated “helping” with identification as a STEM person. While many associated “helping” with STEM identity, they coupled this trait with the exercise of STEM knowledge in academic contexts, such as helping peers successfully complete STEM homework (reinforcing the notion of a STEM person as intellectually superior), or with contributions to non-relational social contexts, such as developing technical solutions for “mankind”. “Helping” in a more relational sense—a trait often emphasized in interventions aiming to recruit and retain women in STEM fields (Diekmann et al., 2015)—was less present in participants’ descriptions of characteristics that make someone a STEM person. Relatedly, many of our female-identifying participants were pre-med students and pointed to care for others, in a relational sense, as a motivation for their studies, aligning with the higher social agency motivations of students pursuing health careers (Garibay, 2015). While many students referred to the care ethics instilled by their caregivers—especially their mothers—when

they spoke of these motivations, this attribution did not translate to seeing their mothers as STEM persons by dint of embodying that value.

Despite categorizing healthcare professions within the purview of STEM, we saw differences in how person-care-oriented professions were explicitly contrasted with STEM professionals who carry out research. We note this in Carla's positioning of physicists relative to nurses—caregiving professionals stereotypically symbolized as women and in many cases considered separate from or of lower rank in STEM (Block et al., 2018). We also noted that our two male participants with pre-med pursuits did not speak of being motivated by a similar desire to care for others.

7.4 | Gendering through positioning of “caregivers”

Often, our participants defined appropriate Discourses and identity through the “prohibition” of incompatible Discourses (Foucault, 1972, p. 216)—that is, Discourses that are structurally feminine (Harding, 1986), such as providing childcare. While a few female-identified participants spoke about this in reflecting on their *own* STEM identity, we often saw this when referencing caregivers—especially maternal caregivers. Our participants tended to implicitly invalidate their maternal caregiver's STEM interests and intelligence even when they supported participants' STEM-related pursuits by describing that support as not related to competence (an “intelligence” display). When mothers work to provide useful support to their child's schoolwork (e.g., Allie), for example, their knowledge is not visible to be recognized by their children. However, this perception was not uniquely applied to female caregivers, as we noted in Jake's positioning of his father, whose STEM identity Jake seemed to reduce because of the structurally feminine role his father adopted in adjusting his STEM career commitments to respond to family needs. Broadly, these findings suggest that affectively positive descriptions of “caregivers” may contribute to a devaluing of STEM identity as the Discourses of “caregiver” and “STEM person” are structurally misaligned in students' discourses.

7.5 | Immigration histories and family culture

While our analyses do not specifically consider identity intersections, we found many instances where our data illustrated the context of STEM identity performances within immigration histories. These were often associated with caregivers' ability to maintain employment in a STEM-recognized profession after migrating to the U.S. Participants related obstacles to maintain a STEM profession after migrating as a factor of caregiving responsibilities—a role that typically fell to maternal caregivers. These perceptions not only contributed to their caregivers' status as a STEM person but also the relevance and value of their STEM competence, interests, and performances. We saw further evidence of this when caregivers were dismissed as STEM persons due to their adherence to experiential and ancestral wisdoms over what participants referred to as “scientific knowledge”. With that said, participants positively referenced family histories as a discursive tool used by caregivers to motivate their children's pursuit of STEM careers—though a full understanding of this is beyond the scope of the present paper. Thus, we posit that while immigration histories tended to disassociate caregivers from being identified as a STEM person, these same histories played an important role in the development of participants' personal identification with STEM. Our data suggest that family values and expectations, often rooted in

family's immigration histories, promoted youth performances associated with STEM identification (e.g., completing STEM assignments, pursuing STEM careers in college, persisting through challenging academic circumstances). We found evidence of this even when participants did not discursively position these influences directly with STEM (Onuma et al., 2022; Sengupta-Irving & Vossoughi, 2019). A fruitful direction of further study may be in understanding how this phenomenon manifests across diverse immigration experiences.

8 | IMPLICATIONS AND RECOMMENDATIONS

When mechanisms that regulate Discourses are understood and leveraged, discursive *barriers* can become discursive *opportunities* for social movements that can “shape an issue to fit the Discourse, avoid aspects of an issue that have no chance of positive response, or provoke other actors” (Baumgarten & Ullrich, 2016, p. 7). Questioning STEM Discourses in order to “shape an issue” requires understanding the underlying rules that guide those Discourses, particularly by hearing from those on the margins of STEM as they wrestle with conforming to its unspoken expectations for what is “normal” versus “pathological” (Foucault, 1972). In considering how individuals think of themselves *as well as* others in their social orbits, we observe not only the ways that individuals react to STEM Discourses but also the ways that the Discourses are reproduced through in-the-moment recognition events, ensuring their durability. By uniquely attending to these recognition events and their consequences in sustaining Discourses, we propose theoretical and practical implications for STEM education and education research.

8.1 | Co-opting and redefining STEM discourses

Identifying and subsetting characterizations of a STEM prototype as masculine, innately knowledgeable, employed in degree-requiring STEM fields, and with little or no caregiving responsibilities allows for intentional actions that include a *co-opting* of these characterizations, rather than a complete (and impractical) rejection. While we could suggest that intelligence, understood as displaying competence through knowledge of facts, should not be a defining characteristic of a STEM person in order to support inclusivity, this argument fails to account for entrenched societal perceptions of STEM professionals as intelligent. However, amplifying that mastery of facts does not exclusively constitute intelligence and that intelligence is *more fully* displayed in the pursuit and application of knowledge, tools, and resources in problem-solving (e.g., Cho & Lin, 2010) could create opportunities for recognizing displays of intelligence beyond those primarily associated with masculinity. Such a reframing of STEM related intelligence would create opportunities for the positive recognition of performances not associated with masculinity, such as mothers' contributions to their children's science fair projects, and when extended to educational and training contexts where STEM knowledge is formally evaluated, such as in classrooms.

8.2 | University students as agents of change

While existing research explains the discriminatory Discourses to which learners are subjected, simply managing the effects of these false ideals on individuals ignores learners' power as

change agents representing the STEM community within their social orbits. This power likely results from their STEM educational affiliations and career aspirations, as supported by their perceptions that teachers, family, and friends recognize them as STEM people (Dou & Cian, 2022). As such, the ways they discursively position their friends, family, and peers in relation to STEM can shape how those individuals and others in the learners' orbits perceive what it means to be a STEM person (Gee, 2000). This social framing of identity, extending beyond the individual to consider the networks and communities to which they belong, repositions STEM majors as empowered to break gendered stereotypes, not just in terms of demographic representation, but also through their power to contribute to the symbolism of who counts as a STEM person.

Yet, modeling diverse and inclusive ways of being a STEM person is generally not rewarded in STEM institutions and may be seen as a lack of understanding or alignment with STEM ideals. Students are simultaneously striving to receive recognition from STEM insiders whom they consider more central to the community and whose recognition is highly consequential to their futures (e.g., university faculty). This complex positioning—both as STEM insiders to one set of socially significant actors and aspiring STEM insiders to another—coerces learners to yield to the colonizing enculturation of STEM classrooms (McGee, 2020). A focus on STEM identity as extended both *to* and *through* the individual learner may be a worthwhile framing for programs whose missions include broadening STEM participation.

While empowering students as agents of change offers underexplored opportunities, we also recognize that STEM Discourses are primarily driven by those in power, more central to the academic STEM community: university STEM faculty. We point to research like Günter et al. (2023), whose discourse analysis of university science faculty applications revealed ways in which applicants positioned “researchers” as having unique access to knowledge and therefore its transfer—reproducing notions of STEM faculty as unquestionable holders of knowledge. This work points to the importance and need for additional studies of how faculty communicate gendered STEM Discourses, while highlighting systemic structures that invite their reproduction.

8.3 | Implications for school-home learning practices

Our research (Cian et al., 2022) and that of others (e.g., Ciciolla & Luthar, 2019) indicates that mothers are more heavily involved in their children's general education than their fathers, so school-home connections that involve caregivers in scientific study could shift youths' perspectives of their mothers' capabilities and interests in STEM, while playing off the talents mothers already bring to school-related interactions with their children. As family members have a substantial influence on youths' perceptions of what it means to be a scientist (Parson et al., 2021) and their STEM identity (Dou & Cian, 2022), inclusion of female-identified adults in STEM activities with their children could bring attention to the participation of “mothers in STEM”, as opposed to “women scientists”. For instance, Sengupta-Irving and Vossoughi (2019) point to glimmers of promise in how a dissection evoked memories of Stefanie's mother preparing chicken. While the authors acknowledge the value in juxtaposing home activity with experiences in institutional STEM contexts, they are also careful to note that the goal is not that caregivers are “rehabilitated or rendered more respectable because their work approximates a scientist's, but rather science is rehabilitated through its association with our elders” (p. 497).

Such studies, and our own work, illustrate that when program developers present models of female-identified scientists, they should weigh the advantages of presenting models of scientists as nuanced and complex people who play multiple roles against simplified strategies used to achieve programmatic goals.

8.4 | Implications for “hands-on” learning performances

We found that hands-on performance opportunities in institutional learning spaces are valuable in girls' developing self-perceptions in STEM. However, our participants tended to differentiate the practices of male-positioned individuals (e.g., tinkering) from those of female-positioned individuals (e.g., participating in a predefined lab experience) in favor of the former (Kuchynka et al., 2022). Such Discourses may be inoculated by emphasizing the value of structured, hands-on performance opportunities as contributing to the necessary procedural knowledge of STEM professionals. Additionally, in STEM spaces, girls are often assigned managerial and artistic roles within peer groups, further distancing them from the perceived practices of STEM professionals (e.g., Due, 2014; Nation et al., 2021). Our work supports efforts to ensure girls' contribute problem-solving solutions, as opposed to management or creativity, and that the quality of those solutions are positioned in relation to STEM.

8.5 | Implications for measurement

All participants indicated on their survey that they thought of themselves as STEM people, which they reiterated in their interviews. Yet, our findings show that the concept of a “STEM person”, disconnected from self and “me as a STEM person”, may not align, as existing surveys do not seem to be equipped to identify the subtleties between unconscious Discourses that individuals perceive versus those they reflect outwardly. Specifically, we suggest that surveys of “STEM” (as opposed to discipline-based) identity may fail to capture nuances in participants' perceptions of who constitutes a “STEM person” in terms of the hierarchical relationships between the disciplines. Thus, surveys for measuring university students' “STEM identity” may not be—as stand-alone data collection instruments—suited for differentiating the hierarchical Discourses existing within student populations pursuing degrees across STEM disciplines. Or, STEM identity surveys for university students may require further development to account for these nuances and provide valid discrimination between how members of this population, pursuing a variety of disciplines, think of themselves in STEM.

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ENDNOTES

¹ We use “Discourses” with a capital D in reference to this definition, as opposed to a lower-case “discourses” which refers to in-the-moment use of language by which Discourses are established and maintained.

² We use the term “systemic marginalization” to refer to individuals identifying with social demographic groups whose participation has been pushed to the boundaries of STEM due to institutional and historical expectations of what kind of person participates in STEM (Paris, 2012; Silverman et al., 2023). The phrasing evokes the action of system actors in restricting participation, suppressing the power of individuals who do not align with the dominant group’s cultures, norms, and behaviors, and historically and pervasively depriving the field of the unique contributions made possible through innovative ideas that can arise from more just participation (Paris, 2012).

³ We use “Latine” as a socially constructed term when categorizing our participants to frame our discussion through the lens of gender inclusivity. Our preference for the use of the gender inclusive “e” in “Latine” emanates from its more natural pronunciation in Spanish and its origin in Spanish-language social movements (Papadopoulos, 2022).

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