Received: 23 February 2021 | Revised: 30 August 2021 | Accepted: 22 September 2021

DOI: 10.1002/sce.21688

Science Education WILEY

Facilitating marginalized youths' identification with STEM through everyday science talk: The critical role of parental caregivers

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Abstract

An individual's sense of themselves as a "STEM person" is largely formed through recognition feedback. Unfortunately, for many minoritized individuals who engage in STEM (science, technology, engineering, and mathematics) in formal and informal spaces, this recognition often adheres to long-standing exclusionary expectations of what STEM participation entails and institutionalized stereotypes of what it means to be a STEM person. However, caregivers, who necessarily share cultural backgrounds, norms, and values with their children, can play an important role in recognizing their children's interest and inclination towards STEM in ways that support children's authoring of their STEM identity in the face of these marginalizing discourses. To explore this idea, we conducted phenomenological interviews with STEM students attending a Hispanic-serving university, examining the nature of STEM-related conversations these students had with their parents during childhood. Participant recollections provide evidence of conversational content, contexts, and structures that supported their identification with STEM even when faced with marginalizing experiences. We found that though this phenomenon was recounted across parent profiles, participant narratives also reflected differences in conversation content, context, and structure based on factors associated with STEM

stereotypes, including gender, formal education or training in STEM, and parents' immigration experiences. Viewed within larger sociocultural discourses of whose knowledge "counts" in STEM, our work suggests the need for educational institutions to acknowledge and embrace families' ability to foster youths' affinity with STEM contexts, while also recognizing and responding to institutionalized impediments to authentic STEM participation.

KEYWORDS
conversation, family, identity, informal learning, STEM

1 | INTRODUCTION

Youths' level and quality of participation in STEM (science, technology, engineering, and mathematics), whether in the broad STEM enterprise and/or in disciplinary domains, is largely dependent on their self-perception or *identity* (e.g., seeing oneself as a "physics person", Dou et al., 2019; Hazari et al., 2010; Kim et al., 2018). This self-perception is significantly influenced by social interactions in which an individual is (or is not) acknowledged as a STEM person by meaningful others (Archer et al., 2012; Carlone & Johnson, 2007; Gee, 2000; Jackson et al., 2019; Rodriguez et al., 2019; Vincent-Ruz & Schunn, 2018). One consequence of the power of these recognition events is the internalization of a dominant "Discourse" (Gee, 2000) of who is or can become a "STEM person" as reflected in verbal exchanges, educational materials, behavioral expectations (e.g., using scientific jargon), and working professionals visible in these spaces (Dawson et al., 2020). In the United States (U.S.), this Discourse generally supports positive recognition of white, male, middle to upper class, English-speaking individuals in ways that often interfere with the recognition of others (Aschbacher et al., 2010; Dawson, 2018; Grossman & Porche, 2014; Wong, 2015).

Recent research points to a consequential role that parental caregivers play in their children's STEM identity development, suggesting that experiences with family can foster meaningful associations with STEM for children from diverse cultural contexts (Archer et al., 2012; Aschbacher et al., 2010; Dou & Cian, 2021; Ishimaru et al., 2015; Kayumova et al., 2015). As such, undervalued opportunities exist to support positive STEM identity development particularly for youths who also identify with communities traditionally marginalized and/or minoritized in STEM (Barajas-López & Ishimaru, 2020; Malone & Barabino, 2009; Morton & Parsons, 2018). Much of this study indicates a direct relationship between parental behavior and children's STEM identity development. For example, Tenenbaum and Leaper (2003) observed that parents' interactions with sons and daughters conveyed differential expectations of interest and capabilities in science, which in turn influenced children's expressions of science interest and self-efficacy. Nevertheless, little research exists exploring how parental caregivers tend to nurture (or discourage) engagement with STEM in ways that affect STEM identity specifically. Given the critical role that parental caregivers play in their children's socioemotional development (Vygotsky, 1980), the fact that the average U.S. high school graduate spends over 75% of their waking hours outside of school (Falk & Dierking, 2010), and that out-of-school or informal learning experiences have been shown to be "the single most important factor in determining children's future career choices in science" (ibid, p. 490), our objective is to understand the characteristics of children's engagement in STEM activities with parental caregivers and how those interactions may associate with positive STEM identification.

In this study, we present an exploration of both the characteristics of family science talk and the mechanisms by which these interactions contribute to a child's authoring of their STEM identity. Our purpose was to determine

associations between those interactions—with a specific focus on STEM-related conversations—and the students' sense of STEM identity, drawing out the salient characteristics of those experiences. Our research took place at Florida International University (FIU), a Hispanic Serving Institution (HSI) in Miami, FL. By conducting our study here, where many students have had recent immigration experiences and/or have spent their childhood in Hispanic-majority communities, we can understand the elements of home interactions that are particularly relevant to individuals from these populations and in these social contexts. Our objective is not to recommend that families change their ways of interacting into behaviors that are most associated with positive STEM identity development, but rather to highlight salient interactions that may be supported, nurtured, and/or accounted for in the design of informal STEM-learning experiences.

2 | THEORETICAL FRAMINGS

In our framing of STEM identity, we draw specifically from the work of Hazari et al. (2010), which operationalizes identity as seeing oneself as a "type of person." This conceptual and pragmatic (in terms of measurement) definition of STEM is grounded in prior studies that attend to individuals' perceptions of self in relation to STEM contexts and/or degree of association with STEM contexts (e.g., Carlone & Johnson, 2007; Rahm & Moore, 2016). Hazari et al. (2010) framework, which explores identity within the disciplinary domain of physics, and studies drawing from this framework (e.g., Close et al., 2016; Godwin et al., 2016; Merolla & Serpe, 2013; Trujillo & Tanner, 2014), posits identity as a factor of three interacting constructs: performance competence (i.e., sense of ability to understand content and execute successful performances), recognition (i.e., one's perception of how others recognize them in STEM contexts), and interest (i.e., affinity toward STEM topics and activities). Hazari et al. (2010) draw the constructs of performance competence and recognition from the work of Carlone and Johnson (2007), but they expand that framework to more explicitly center "interest" as a variable strongly associated with career pursuits and identity (e.g., Tai et al., 2006). This expansion is relevant for our study given that our participants found themselves at a critical point in their efforts to obtain a STEM profession. Other identity frameworks, like that presented in Burke (2003), also describe "interest" as a major aspect of identity formation.

Given that identity research points to "recognition" as the predominant factor contributing to STEM identity development (e.g., Archer et al., 2010; Vincent-Ruz & Schunn, 2018), we complement Hazari et al.'s identity framework with Gee's (2000) notions of identity formation and negotiation through Discourse. Gee defines Discourse as the larger context of social interactions that include but are not limited to various forms of talk and are shaped by underlying values, beliefs, and norms. He outlines how these larger Discourses define what it means to be a certain kind of person and, by extension, create the criteria individuals need to demonstrate to be seen as a part of a recognized community. In other words, Discourses of communities that may be found at school, in the home, or in popular culture consist of norms, ways of communicating, and values that shape group membership. Individuals acquire membership in these groups through cultivation of the community's normed Discourses.

The authoring of one's STEM identity, then, is as much an individualistic process as it is a communal process, as the sociocultural norms, capitals, and values of communities of STEM contribute to determining whose and what kind of identities are welcome. The various ways individuals perceive the attributes of a "STEM person"—and by extension their own congruence with STEM—arise from cultural Discourses that, in the United States, reinforce notions that people who do STEM are white, masculine, and nerdy (Chambers, 1983; Cheryan et al., 2011; Diekman et al., 2011), leading to exclusions of the bodies and lived experiences of individuals who fail to align with those notions. The implications of this are consequential—Avraamidou (2019) deftly argues that "individuals who fail to experience adequate recognition connected to negative societal norms and values suffer psychological harm as victims of racism and colonialism" (p. 9), further stating that "recognition is especially relevant in science identity research because science has traditionally been an elitist world from which certain groups are excluded" (p. 10).

This idea that individuals do not exist in separate spheres that isolate their science, racial, and gender identities is an integral component of the historical applications of identity research that drew from feminist scholarship applied to science contexts (e.g., Calabrese Barton, 1998; Harding, 1986; Roychoudhury et al., 1995), with more recent applications (e.g., Carlone & Johnson, 2007; Mensah & Jackson, 2018; Rosa & Mensah, 2016) drawing from intersectionality frameworks (Crenshaw, 1990) that critique single-axis examinations of identity (e.g., gender), citing the injustices experienced by Black women as only appropriately understood in the context of both their racial *and* gender identities. Given the justices afforded to individuals when encompassing their gendered, racialized, and cultural experiences, it behooves researchers using an identity lens to not simply consider the authoring of STEM identity, but also how gender, ethnicity, race, immigration status, social class, and other identity-related qualities intersect with socially implied assumptions of who and what STEM looks like and how those assumptions influence individuals' authoring of their STEM identities (Beeton et al., 2012; Calabrese Barton et al., 2013; Rodriguez et al., 2019). The implications for the intersectional forces acting upon STEM identity are substantial, particularly for children who are traditionally marginalized from STEM fields due to historical and sociopolitical STEM Discourses in the United States (Archer et al., 2010; Calabrese Barton & Yang, 2000; Dawson et al., 2020; Elmesky, 2005; Guerra & Rezende, 2017). This intersectional approach thus justifies the value of leveraging individuals' home experiences with close family as contexts where the intersections of their varying identities are likely to be best understood and from which much of their construction emanates (Halliday, 1993). Thus, by centering our exploration of identity influences on interactions that occur in unstructured settings like the home, where cultural values and practices of individuals are more likely to be validated, we can better contextualize and interpret their STEM-related experiences in formal settings.

An identity research lens could also support researchers and practitioners to think of individuals not so much considering *what* they will become but rather *who* they will become (Gee, 2000; Holland et al., 1998). Often researchers who explore STEM identity and/or disciplinary identity underscore links between identity and career goals or pursuits as desirable outcomes that motivate their work, including Hazari et al. (2010) framework. Some espousing differing worldviews make the case that to view science identity research exclusively considering producing scientists fails to account for the "broader agenda of science education for promoting equity and social justice…[and] discussions about what constitutes truth, knowledge, and power" (Avraamidou, 2019, p. 5). As such, we present our motivations for this study as supporting that individuals' identification with STEM should not simply be a service relegated to those who aim to pursue careers in those fields for the sake of technological advancement or economistic concerns, as emphasized in national reports and initiatives (e.g., National Research Council, 2011), but broadened to facilitate richer, more authentic experiences and connections with the natural world. Throughout this manuscript, we use the term "STEM" as a catchall phrase but recognize that like all language, its usage is dictated by sociocultural forces situated in specific contexts. For that reason, we ground our findings in the ways our participants used the term.

3 | LITERATURE REVIEW

3.1 | Socialization of "STEM"

Stereotypes of who does and can exist within the STEM enterprise abound in the STEM workforce (e.g., Eaton et al., 2020; Thébaud & Charles, 2018), the classroom (e.g., Aschbacher et al., 2010; McGee, 2016), and in informal learning institutions such as museums (e.g., Dawson, 2014, 2018). As such, these spaces communicate consistent and pervasive messaging that preclude the participation of minoritized groups. The ubiquity of these Discourses suggests a larger "culture of power" (Calabrese Barton & Yang, 2000, p. 871) that defines STEM in ways that align with the behaviors, values, and norms of dominant groups. Calabrese Barton and Yang (2000) note that this is reflected in a positivist portrayal of science as a discipline for an elite few who can master a large body of facts.

Consequently, children who do not personally align with and/or embody these cultures of power are steered away from STEM despite interest they may have or encouraged to reject other aspects of who they are to fit in with the expectations associated with these dominant Discourses. For example, McGee (2016) interviewed a student who described himself as coming from a neighborhood that is "Hispanic, economically depressed, but culturally and spiritually rich," recalling his professor's advice to "forget where he came from and embrace his more 'respectable lifestyle'" (p. 1644). Statements like this one position students' cultural and familial roots in contrast to the "respectable" position of a STEM person and suggests the impossibility of the coexistence of the two.

The expectations for a "STEM person" also fall along gender lines. Thébaud and Charles (2018) note that societal stereotypes of STEM align with the stereotypes and expectations of men and conflict with stereotypes and expectations of women (e.g., valuation of being analytical and ambitious, organizational structures that are rigid rather than open, significant out-of-work expectations such as extensive travel). In this way, when a man pursues STEM ambitions, he "can align his presumed abilities and interests with a high-status career, while also living up to prescriptive expectations of how he ought to behave," whereas women "may risk discrimination, dislike, or ostracism for being 'too' aggressive, ambitious, etc." (p. 9). Consequently, women are not only less likely to be seen as desirable hires, but they are also less inclined to pursue STEM careers because of internalized beliefs that they are incapable of doing the job well or simply will not enjoy the work.

3.2 | The familial nature of identity

The influence of social systems formally affiliated with STEM, such as classrooms and workspaces, cannot be understated in identity construction, particularly for minoritized individuals. However, other social systems, which are personally nurturing and affirming of one's interests and sense of recognition from others, can facilitate seeing oneself within STEM. Using nationally representative data collected from individuals who had obtained or were pursuing doctoral degrees ($N = 4285$) in physical science, Dabney et al. (2013) found that doctoral students who reported having family interested in science were more likely to develop their personal interest sooner, and much of this personal interest did not emanate from school science but rather hobbies and family encouragement. Jackson et al. (2019) observed that the social recognition first-year college students received from significant others (e.g., family, friends) regarding their interest in science strongly influenced their persistence in science in the face of obstacles, particularly for students whose self-perception in science was the most tenuous, for instance, due to cultural incongruity in school systems (Martin et al., 2013; Prewitt et al., 2007). In a critical ethnographic case study, Tan et al. (2013) compared the science identities narrated by non-White middle-school girls in specific figured worlds (i.e., formal learning spaces, informal learning institutions, the home). The authors observed that the way others responded to the young girls' expressions of their science identities influenced the extent and direction to which they continued to pursue science, noting that informal experiences in science clubs and with family members were more reflective of their individuality and better promoted continued interest, positive recognition, and aspiration than school experiences. These outcomes accentuate the distinctly important role of affirmation from significant adults in youths' STEM identity development, regardless of the parents' own positioning within formal STEM spaces.

3.3 | Talking science

Of the ways in which social interactions support the authoring of STEM identity, none are more agentic and accessible than "talk," or dialog between individuals. Gee (2000) posits Discourse—of which talk is an element—as a central tenet of the ways in which individuals both manifest and fashion their identities (e.g., Gee et al., 2001), but also the way individuals are positioned by others as certain types of persons (Calabrese Barton & Tan, 2010).

For example, Riedinger & McGinnis (2017) observed and interviewed middle-school participants attending a summer science camp, finding that, in contrast to the participants' rigid school curriculum, the informal learning context allowed youths to reconstruct their science identities through the way they spoke to one another. Research suggests that among these informal learning experiences, talking about science with close family (i.e., parents and siblings) is especially important in the trajectory of individuals' STEM identity development and STEM career aspirations (Archer et al., 2012; Dou & Cian, 2021; Gonsalves et al., 2021). In case studies of college science majors' science identity trajectories, Gonsalves et al. (2021) found that for students who grew up "in households permeated with science discussions" science was "promoted as an everyday matter," and such "they envisioned a career in science as a 'natural choice'" (p. 13). Survey research with STEM and non-STEM college students indicated that those who remembered "talking about science with friends and family"—parents and siblings in particular (Dou & Cian, 2021)—between the ages of five and nine were more likely to see themselves as STEM people in college than those that did not regardless of their race, ethnicity, gender, parental support, academic performance in middle and high school, and participation in afterschool clubs or summer camps (Dou et al., 2019).

Parent–child conversations have long been seen as consequential in the nurturing of STEM learning (Crowley et al., 2001; Geerdts et al., 2015; Kisiel et al., 2012; McClain & Zimmerman, 2014; Zimmerman et al., 2015). The spark of childhood interests in STEM has been linked to family—particularly parents (Maltese et al., 2014). STEM interest development has also been linked to the ways that parents verbally praise their children during STEM-related activities, how they lead their children through STEM activities, and how they re-engage children who have lost interest in STEM activities (Pattison & Dierking, 2019). Considering the capacity for STEM-related conversations and interactions in the home to support STEM identity at its intersection with gender, ethnic, and/or cultural identity, this study suggests that family science talk could be a critical component of identity construction. This is an especially important context to explore with individuals from minoritized populations in STEM who may find that the values, language, and foci of the science they encounter outside of the home are in dissonance with their own cultural values, language, and interests (e.g., Archer et al., 2012; Dawson et al., 2020; Dawson, 2014; Guerra & Rezende, 2017).

Despite these understandings, *how* these conversations shape children's identification with STEM is less understood. Some important studies address factors related to identity, like interest development, but have a narrow focus on specific fields (e.g., Pattison & Dierking, 2019; Pattison et al., 2018). Moreover, despite their valuable contributions, these tend to draw from family conversations that occur in relation to structured activities at a specific learning institution (e.g., Kayumova et al., 2015). What has yet to be addressed fully are STEM-related conversations between children and parents that occur in everyday settings, like the home or during a car ride, and how the features of those conversations contribute to STEM identity.

4 | RESEARCH PURPOSE

The purpose of our research is to learn about the interactions and conversations with parents that college STEM majors recall from childhood and how these conversations are associated with their STEM identity. We are primarily interested in conversations between parents and children due to the potential of these interactions to shape STEM identity in the context of dominant STEM Discourses that function to marginalize many students. While prior studies point to the existence and importance of these conversations, as described above, little is known about their content, context, and structure. By *content* we refer to the subject matter that is being talked about, *context*, the setting in which the conversations take place, and *structure*, the organization of the conversations and the social positioning of individuals engaged in the conversations (Lemke, 1990). Understanding these elements can support a more granular appreciation of the parent role in STEM identity formation, which can help to inform educational programmes of the home-based assets that can be drawn upon in identity-supportive efforts for students traditionally marginalized in STEM. The following research questions guide our study:

- RQ 1: What is the content, context, and structure of STEM-related conversations that college STEM majors recall having with their parents during childhood?
- RQ 2: What household norms and histories do college STEM students recall that shaped these conversations?
- RQ 3: In what ways are specific memories of those conversations related to participants' sense of STEM identity?
- RQ 4: How do interactions with other individuals (i.e., siblings, aunts/uncles, teachers, and peers) contribute to participants' realization of their STEM identity?

Our use of the term "parents" is inclusive of nonbiological, primary caregivers, like stepparents. Moreover, when using the term in the plural our intention is to reference both the primary maternal and paternal caregivers (none of our participants reported having same-gender parents) and does not attend to the parents' relationship status (e.g., married). When referencing other family members as caregivers (e.g., grandparents) we specify the relationship using the participants' terminology.

5 | STUDY CONTEXT: FIU IN MIAMI, FL

FIU is unique in being one of the largest public universities in the country, serving a predominantly Hispanic community. Like similar community-focused institutions, most students at FIU live near the university in Miami-Dade County (MDC), primarily commuting to and from school. Nearly 70% of MDC's residents identify as Hispanic, and FIU is designated as an HSI. FIU supports many Hispanic STEM majors through degree completion (M. Hughes, 2020), thus making FIU an ideal place from which to sample students who are majoring in STEM and plan on completing their degree. Moreover, a large portion of families that live in MDC speak Spanish as their first language and are either first- or second-generation migrants (U.S. Census Bureau, 2019).

The ethnic and cultural diversity of children from families who attend FIU reflect both shared and unique life histories that provide nuanced and transferrable understandings about the development of STEM identity across cultures and values. However, we do acknowledge that by situating our research in a city with a robust immigrant community, we also position our work in a context in which immigrant families can more easily join U.S. communities where they are still able to express and leverage the culture, values, and language of their home country—a privilege denied many immigrant families in the United States. While we take care in our research not to treat students as a monolith based on demographic data, 64% of FIU students self-identify as Hispanic and 57% self-identify as female. In using the term "Hispanic" we apply the terminology used by the 2008 Higher Education Opportunity Act in the designation of Hispanic Serving Institutions and the language used by the university's first-time applicant system from which this data is compiled. We recognize not all individuals with cultural connections to countries whose official language is Spanish refer to themselves as "Hispanic."

6 | AUTHORS' PERSPECTIVES AND POSITIONING RELATED TO RESEARCH PROBLEM

We bring a constructivist perspective to this inquiry, meaning that we understand experiences to be significant to STEM identity development in how they are perceived by the individual rather than in their objective reality. This includes their understanding of events they believe contributed to their interest in STEM (or lack there of) and their interpretation of how others recognized and responded to their STEM-related activities. In this way, we aim to diminish researcher eisegesis by turning over the identification of the important elements of our study to our participants through phenomenological interviews that encourage their self-directed narration (van Manen, 2014). As detailed below, we approach our research with the objective of retaining—as much as we are able—the purity of our participants' constructions. These efforts include peer checking by members of the research population

(i.e., undergraduate STEM students), sharing our own background and its relation to the stories we hear with our interview subjects, and taking time within interviews to voice our interpretation and ask for confirmation from interviewees.

Despite these efforts, we acknowledge the fact that our own histories as individuals and researchers shape the research questions we pose, our methodological decision-making (e.g., asking follow-up questions during interviews), and meaning making of that data we collect (Lincoln & Guba, 1985; Secules et al., 2021). We constructed our research team to (a) leverage the expertise of our relative positions, (b) bring to light our inherent biases, (c) and compensate for tendencies to overlook certain experiences that do not align with our own definitions of who and what constitutes STEM. We were driven to the pursuit of understanding the influence of childhood conversations on STEM identity construction from our own reflections on our childhood experiences around STEM and our interest in supportive pluralistic forms of STEM engagement through identity-based approaches. The first author is a white woman who grew up in a rural community in South Carolina and moved to Miami for research. All other researchers grew up in Spanish-speaking homes in the study area and identify as Latine. "Latine" is a gender-neutral term we agreed upon in favor of "Latinx" or "Latin@" due to Latine's origins in South American social movements and relative congruency with Spanish language pronunciation (Gutierrez, 2020). The third, fourth, and fifth authors are undergraduate research assistants pursuing STEM degrees whose stories are included in the data of this study. They contributed to data collection, coding, interpretation, and manuscript development and provided member-checking throughout the research process. Authorship order and contributions were prenegotiated before commencing the study.

7 | METHODS OVERVIEW

This study is part of a larger study examining the relationship between childhood science talk and STEM identity development. This manuscript presents the portion of this study qualitatively studying the formative childhood science experiences of current college STEM students. Our focus on "science" talk (as opposed to "STEM" talk) was predicated on several factors, including our quantitative work that indicated a significant positive relationship between childhood "science" talk with immediate family members (e.g., parents, siblings) and "STEM" identity (Dou & Cian, 2021), challenges in the validity of using the term "STEM" to ask about talk experiences that occurred in most cases over 10 years before the interviews when the word "STEM" was less recognized by nonacademics and less likely used in home settings, and, finally, our participants' application and appropriation of these terms.

We used phenomenological interpretivist approaches to explore science talk and its relationship to expressions of STEM identity. This approach aims to describe the structure and essence of everyday life occurrences as experienced by the individual and how these events are situated in and affected by context (van Manen, 2014). Phenomenology guides our inquiry because we are interested in how our population experiences everyday science talk and how the nature of that talk and its consequences appear to be influenced by the social context, all of which are personal to the individual and their circumstances. We rely on Lincoln and Guba's (1985) framework as we consider the rigor of our interpretivist research, which advices seeking evidence for trustworthiness that supports (a) credibility or the degree to which conclusions are believable, (b) transferability or the ability of ideas to transfer to new contexts, (c) dependability or the appropriateness of methods employed, and (d) confirmability or the appropriateness of conclusions based on the data. Our efforts to address each are discussed below.

7.1 | Interview protocol development

We designed our interview protocol to elicit holistic memories of conversations, particularly the context, content, and structure of conversations related to identification with STEM. We view recollections of these experiences as

episodic memories that "when drawn upon become self-defining as to who people think they are" (Hazari et al., 2018, p. 1563). As such, we consider their recollections of these conversations as manifestations (and reinforcements) of participants' sense of identity in relation to STEM at the time of the interviews (Blagov & Singer, 2004). We, therefore, framed our interviews to explore experiences in light of relevant aspects of our identity framework (i.e., Hazari et al., 2010), including recognition events (e.g., direct affirmations from others of a participants' "belongingness" in STEM), formative interest-related events (e.g., experiences that led to increased, decreased, or sustained STEM interest), and detailed descriptions of events that contributed to their sense of performance competence (e.g., reflections on mastery of content after a particular event). We also structured our coding and interpretation of the interviews, detailed in subsequent sections, in alignment with our theoretical framework. This approach to inquiry may be particularly valuable for understanding the formative STEM-related experiences of participants who identify with one or more minoritized groups in STEM; as framed by Hazari et al. (2018) in the context of students' physics identity: "A strong memory reminding them of their interest, competence, or recognition in the field may help them navigate such hurdles and continue to see themselves as physics people" (p. 1564).

We designed our interview protocol to elicit details of identity-formative events that participants recalled occurring during their childhood, though participant narratives often extended into college years (van Manen, 2014). For instance, we asked the participant to recall when they recognized they were interested in STEM or to describe the first science activity they remembered doing. To adhere to our research purpose, we developed strategies to follow up their responses with encouragement to share details of these STEM-related experiences, specifically asking them to discuss the people with whom they interacted and contexts of those interactions, including setting, roles in conversations, and feelings associated with those interactions. As an example, when a participant described doing science experiments with her friends, we asked her to tell us about who directed the activity and whether they shared what they had done or learned with anyone in their family. Following piloting of the protocol and debriefing with the third and fourth authors, we recognized that there were opportunities to follow-up on shared experiences that were not adequately realized, as well as sequences of follow-up questions that restricted the depth of the participants' narrative (e.g., by redirecting the telling of an experience that could have been further explored). For example, we noticed instances where an extended family member was mentioned but we did not ask questions to learn more about their relationship with that family member. We developed further follow-up techniques and ideas to encourage our participants to describe experiences and their interpretation of those experiences (e.g., feelings, reactions) that would generate informative data in relation to their talk experiences and STEM identity development. To support dependability of our protocol, we refined the protocol with the guidance of an external advisory board of experts in informal learning and STEM identity.

7.2 | Participant selection and data collection

Participant sampling was informed by responses to a STEM identity survey sent to undergraduate students in STEM courses at FIU (see Supporting Information). First, we identified survey respondents who indicated that they had a high affinity for STEM and that they were willing to participate in a 1-h interview to tell us more about their childhood science experiences. From this list, we employed purposeful sampling to identify individuals who represented distinct profiles based on their responses to specific items on the survey (e.g., those who talked to particular combinations of people, those who expressed particular profiles of STEM identity). We also sought to maximize the diversity of interviewees based on survey responses that inquired about family education, gender, and field of study. We selected interviewees in small clusters of up to five at a time, reflecting after each set of interviews on what the interviews suggested about profiles we needed to capture to enrich our understanding of the phenomenon (Crist & Tanner, 2003). We continued rounds of interviews until

we reached data saturation (i.e., redundancy of essential elements of experiences, durability of codes; Guest et al., 2006) ($N = 20$). The interviews were held at FIU and were typically attended by two or three authors. The first author led and/or was present at nearly all interviews, and the undergraduate research assistants participated in many of the interviews.

Table 1 presents the demographic information of our participants in the order in which they were interviewed. Not all participants who contributed to this study came from Spanish-speaking cultures or backgrounds, but many of them came from Spanish-speaking homes and/or described an ethnic and cultural link to a variety of South American and Caribbean countries where the primary language is Spanish, as is representative of the Miami community.

TABLE 1 Demographic details of interview participants

Name	Major	Gender	Race/Ethnicity	Immigration generation	Immigration country
Mary	Biology[a]	F	Latine[b] & Indian	Second	Cuba & India
Carla	Biology	F	Latine	Second	Guatemala & Peru
Sandra	Physics	F	Latine	First	Colombia
Nicki	Physics	F	Latine	Second	Cuba
Saul	Computer Science	M	Latine	Second	Cuba
Naomi	Biology	F	Indian	Second	India
Selena	Computer Science	F	Latine	First	Cuba
Chloe	Biology[a]	F	Latine	Second	Cuba
Jake	Engineering[a]	M	South African	International student	South Africa
Kelsey	Engineering	F	White	N/A	N/A
Victoria	Biology[a]	F	Italian	Third	Italy
Alex	Chemistry[a]	M	Latine	First	Cuba
Allie	International Business[a]	F	Latine	Second	Mexico
Marcos	Computer Science	M	Latine	First	Cuba
Mandi	Liberal studies[a]	F	Latine	First	Honduras
Jacq	Engineering	Nonbinary	Mestiza	Second	Nicaragua
Mia	Biology[a]	F	Black	Third	Trinidad
Daniel	Computer Science	M	Latine	International student	Brazil
John	Engineering	M	Latine	Second	Cuba
Saffi	Biology[a]	F	Latine	N/A[c]	N/A

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.

[a]On the premed track.

[b]Here, we 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., Brazilians). While no term is perfect, unlike the terms "Latinx" and "Latin@," the origins of the term "Latine" are rooted in South American social movements and its use is more congruent with a Spanish-language pronunciation.

[c]Is second-generation from Puerto Rico and not considered an immigrant to the United States.

7.3 | Limitations

We acknowledge that development of identity during childhood is based on a multitude of factors, which include historical and social contexts. Thus, the common era during which these students grew up (the early 2000s) suggests that the findings of our study may differ for children who are developing today. For instance, children today are more exposed to technology and attend schools that are even more dedicated to encouraging STEM careers, as evidenced by evolving national STEM standards and funding for technology in schools than was the case for our interview subjects. Even the term "STEM" is more ubiquitous and broadly understood now than it was 20 years ago. We are currently interviewing children aged 7 through 12 in part to understand the durability of the themes identified in the analysis presented in this paper. Additionally, though in this paper we discuss the experiences of students attending an HSI, we acknowledge the immense diversity that exists across these institutions. Understanding this, we make clear the unique characteristics of our institution and city so that readers can review our work and its implications considering this information and its transferability to their site (Lincoln & Guba, 1985). Nonetheless, the research provided here does give a sense of the types of experiences that persist in the memories of college-aged students as instrumental in the authorship of their STEM identity, which can provide guidance to researchers and programme developers interested in the ways individuals fashion themselves within STEM.

8 | EXPLICATION OF DATA

Our analysis began after our pilot interviews and continued simultaneously with data collection. This approach allowed us to explore developing hypotheses by pursuing interview subjects and interview topics that would test these hypotheses, as well as periodically critique and revise our methodological decisions and emerging interpretations (Lincoln & Guba, 1985; Miles et al., 2018; Moustakas, 1994; van Manen, 2014). These steps are detailed in the sections below.

8.1 | Coding of interview data

Understanding that experiences and related preconceptions influence every step of the research process (Lincoln & Guba, 1985), our first decision was to clarify within our research team the information we wanted to extract from the interviews to understand our phenomena from the perspectives of our study population. Reflecting on our research purpose, guiding framework, and experiences shared by our initial research participants, we agreed that the purpose of our coding would be to label utterances that related to conversations about science, the social context in which those experiences took place, and indicators relevant to STEM identity (i.e., recognition, performance competence, and interest). For instance, we recognized that a section of the transcript where a participant describes watching a nature documentary with her brother was a science conversation worth noting because it is a potentially important interaction. A participant's recount of feeling discouraged by receiving poor marks on a chemistry test could connect to identity as a performance competence experience, which we would want to code even if there was not an identifiable conversation associated with the event, as this event would historically contextualize the participant's STEM identity development.

After deciding on how to identify text relevant to our research purpose, the first, third, and fourth authors individually developed codes through open coding of the transcripts (Corbin & Strauss, 1990). Then, we met as a team to agree on the naming and articulation of shared codes and negotiate unique codes. The second author served as a peer reviewer in these conversations, acting as a sounding board for discussions on how to resolve inconsistencies or posing questions that challenged the authors to justify their thinking. After tentatively agreeing on a set of codes, we reviewed them to ensure they would reflect information revealed in the interviews about

content, context, and structure of conversations, as well as the identity elements of performance competence, recognition, and interest. For instance, we noted that a code for "initiation of conversation" could inform various details, including the context in which a conversation began, who was responsible for starting the conversation, and the content of the conversation. A code for acknowledging an individual's performance in STEM was assigned when a participant recalled their parents praising them for getting a good grade.

As we re-coded and discussed coding decisions using the first two interviews, one challenge that emerged was a tendency to miss opportunities to apply codes to the text. To address this issue, we developed an ordered sequence of coding to assist us in thinking systematically. According to this process, once we identified a significant segment of text (described above), we first coded using codes developed from our guiding notions of identity and conversation elements. Then, we reconsidered each coded segment to assign applicable codes across three additional categories: persons involved in the conversation (e.g., mother), the setting (e.g., formal learning institution), and the topic (e.g., physics). For instance, a description of a conversation initiated by a child asking questions about the stars with parents at dinner would be assigned a code of "Asking questions" and "responding to interest" from the grounded codes and "Immediate family," "Home," and "Physical science" from the person, setting, and topic codes, respectively. Coding occurred collaboratively for the first five interviews at which point we calculated an intercoder reliability of 95% or better for each coded transcript. Subsequent coding occurred individually with periodic check-ins by the first author for protocol compliance. As we continued interviews, we revisited our codebook, using team meetings to propose new codes, revisions to existing codes, and explication of code criteria. Figure 1 depicts a summary of our coding process.

8.2 | Development of themes

In developing our themes, we drew from the recommendations for analyzing phenomenological data described in van Manen (2014) and Moustakas (1994). This approach included iterative testing of themes throughout a fluid development process with frequent feedback from population members and expert researchers in STEM identity and informal learning to check the confirmability of developing interpretations (Lincoln & Guba, 1985) and to assist in the authors' own self-reflection on their "unquestioned assumptions" about the phenomenon based on their "natural attitude" (Hein & Austin, 2001, p. 6). Our theme development process is outlined in Figure 2.

To begin theme development, the first and second authors independently reviewed the first seven transcripts, including those from the two pilot interviews with the third and fourth authors, and code lists derived from coding these transcripts. They met to share their interpretations from this data and critique one another's ideas, for

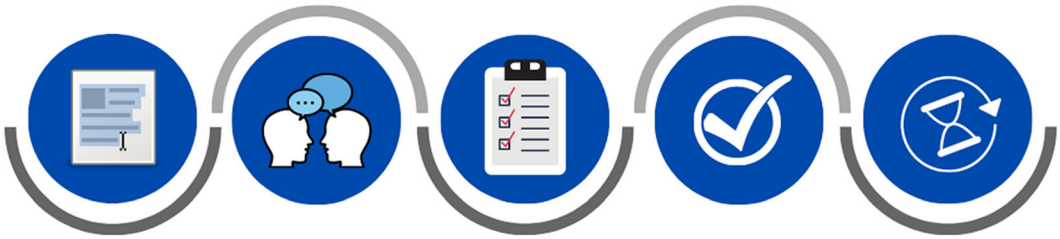

FIGURE 1 Our coding process developed over a series of events in collaboration with members of our study population (i.e., the third and fourth authors)

FIGURE 2 Our theme development occurred iteratively as data collection continued and with consultation with members of our research population and an external advisory board

instance through calling attention to negative cases in the data or posing questions as to how a personal relationship to the phenomenon could influence one's way of seeing the data. From these conversations, they negotiated a list of tentative themes.

Drawing from van Manen's (2014) suggestion of the hermeneutic, or data-interpreting interview, the first two authors constructed a research support team of six undergraduate STEM majors to review the deidentified transcript excerpts and code lists and offer their interpretations of significance they noticed in the data. This team consisted of the third, fourth, and fifth authors and three additional members of the research population, one of whom had been interviewed. The team was constructed in this way to allow participation in meaning-making from members of the population in a form of collaboration with participants and peer debriefing from those external to the study—two approaches to supporting trustworthiness in qualitative data (Creswell & Miller, 2000; Lincoln & Guba, 1985), as well as methodological and epistemic justice (Kayumova et al., 2018). The first and second authors were present for the meeting to provide guidance in reading transcripts and code lists and to ask questions to facilitate the students' reflection but refrained from offering any interpretations of their own.

After this meeting, the first and second authors worked to iteratively develop themes, first using the ideas that emerged from the group meeting to refine and revise their initial ideas, then rereading transcripts and code lists to assess the validity of revised interpretations. This reflection included modifying, adding, or removing ideas as data collection and coding analysis progressed, which was particularly important as more data—some collected through interviews with participants selected to participate as possible negative cases—diversified the experiences observed and allowed consideration of the nuances of the themes experienced by individuals according to race, ethnicity, and gender—aligning with our intersectional framing and phenomenological approach. Periodically the first and second authors consulted the external expert researcher panel and the third, fourth, and fifth authors to further test the durability of their developing ideas (Lincoln & Guba, 1985). As our team began to feel confident with our themes, we more purposefully reflected on our ideas considering guiding literature and frameworks (Moustakas, 1994), which suggested further ways of examining the data to articulate the nuance of the phenomenon we were observing, for instance drawing on our framework of intersectionality to question how the phenomenon was expressed based on child or parent gender.

9 | FINDINGS AND INTERPRETATIONS

We organize our findings into three major themes, summarized in Table 2.

9.1 | Theme I: Household norms that communicate the value of STEM

We wanted to understand the household contexts in which science conversations took place (Research Question 1 and 2), including identity-supportive assets drawn from outside of the nuclear household (Research Question 4). Many of our participants' narratives reflected a sense that STEM-related topics were appreciated by their families, as evidenced by the verbal exchanges they recalled occurring when they expressed STEM interests or pursuits. This

TABLE 2 Themes drawn from recollections of childhood parent–child STEM (science, technology, engineering, and mathematics)-related interactions

Theme	Subtheme	Description
Household norms that communicate the value of STEM	Family values and culture support STEM interests and recognition	Parents draw from their cultural resources, regardless of their academic preparation in STEM or STEM interests, to cultivate a home context where children are positively recognized for their STEM identity expressions.
	Family values and culture encourage STEM aspirations	Families communicate that STEM degrees are valuable, often linking the value to their family immigration histories and recognizing their children's STEM expertise when unfamiliar with U.S. norms around STEM.
Creating spaces for children's STEM-related expressions and identities	The structure of everyday STEM talk and STEM identities in practice	Parent–child conversations are structured to support child STEM identity construction in ways that recognize and celebrate the child's competence.
	Parents as buffers against negative experiences: Comparing school and home contexts	When children are denied positive recognition of their STEM expressions, interests, and abilities in school, home contexts sustain STEM identity in both implicit and explicit ways.
Conversation structures associated with children's perceptions of parents	Differences in the characteristics of conversations with mothers and fathers	Children's STEM-related interactions differ between mothers and fathers align with gender-based stereotypes that exist within broader STEM Discourses regardless of parents' professional and/or academic engagement with STEM.
	Immigration influence on STEM-related interactions as a factor of parental professions	Mothers' immigration experiences shape the way their children perceive them in relation to STEM and children's engagement in STEM-related conversations in ways that align with broader marginalizing STEM Discourses around gender.

valuation of STEM came across in the families' day-to-day activities and habitus (Archer et al, 2012), like shared interest in watching STEM-related television programmes (*Animal Planet* was often mentioned) and in the ways parents spoke about career pathways participants should consider.

9.1.1 | Family values and culture support STEM interests and recognition

Parents who have careers in STEM may be especially poised to construct a home context where science is omnipresent in family conversations (Gonsalves et al., 2021). Consistent with this conjecture, Alex explicitly connected his family's cultural values around STEM with conversations about his parents' careers:

> I think [my interest in STEM] is more tied into maybe my family background. Because my dad is a veterinarian, so he's all about science, and my mom's a pharmacist, so I think generally that ties in. They don't push me to specifically go [the] science route…[it's more] like when they come home my dad always says, "Oh, my patient today"…He always talks about dogs; my mom is always talking about medicines and stuff like that. So, I think I'm generally within the comfort zones of science, and I liked it.

In addition to supporting STEM interests using knowledge and resources immediately associated with their profession, participants whose parents worked in STEM fields also recalled their parents taking advantage of social networks to further their STEM interests. Alex recalled being connected with an uncle, an emergency medical technician (EMT), when he decided he wanted to study human medicine. Jake's father was a podiatrist and encouraged Jake to pursue the profession, but when Jake expressed an interest in bioengineering, his father introduced him to a prosthetist with whom he had studied podiatry. Jake recalled that he and his father "just drove up to his place, a couple of hours away. We drove there, I saw what [the prosthetist] was doing, and everything, and I just fell in love with it."

While this capacity to support STEM interests in households with STEM professionals has been noted (e.g., Archer et al., 2012; Gonsalves et al., 2021; Sjaastad, 2012), even when our participants did not consider their parents to have STEM careers they similarly reflected on the valorization of STEM in their homes. When asked what she did to explore her interest in medicine, Saffi recalled that she would find YouTube videos about surgery and share them with her mother, whom Saffi did not describe as a STEM worker. In response, Saffi's mother shared videos she received from a neuroscientist friend in her home territory of Puerto Rico. By connecting participants with STEM-affiliated family and friends, participants received affirmation in favor of their specific STEM career interests—an interest intimately tied to participants' STEM identity. Simultaneously, participants implicitly understood their parents' affirmation as communicating the sense that STEM careers are "thinkable" for individuals "like them" (Archer et al., 2012), whereas popular portrayals of STEM professionals would not have represented the ethnic identities of most of our participants.

While Alex, Jake, and Saffi felt that their parents shared their interests in STEM, this sentiment was not shared by all our participants. Yet, their stories still suggested their interests were noticed and celebrated in their homes. Mia reflected that her mother did not share her fascination with natural science, yet still, she recalled conversations in which her mother engaged with her in science activities, which led Mia to believe her mother supported her interests:

> If I was like, "Oh, Mom, I want to dissect this animal," [even though] my mom is afraid of bugs and afraid of animals, she'd be like, "Ok, let me get you a kit,"—a fake kit for kids—and she'll break it down. We'll watch videos together.

In this interaction, it is important to note that Mia's mother went beyond just providing the kit to Mia. She also participated—they would "watch videos together"—which, in addition to encouraging Mia's in-the-moment interest also modeled—through participation in and encouragement of her STEM pursuits—that Black women could engage with STEM. Many participants similarly talked about their parents providing science kits and books so that they could pursue these interests with siblings or friends, which created a context for them to be recognized by their peers as someone who "does STEM," engendering opportunities for positive recognition events (R. Hughes et al., 2021).

9.1.2 | Family values and culture encourage STEM aspirations

As many of our participants were from families who had migrated to the United States, they often recalled their family's discussion of their educational and career aspirations as being explicitly tied to their family's experience as immigrants and their parents' desire for participants to earn a rewarding job that provided "stability." Mandi reflected that while she was in Honduras she was not a "good" student, but her attitude towards her studies changed when she immigrated and recognized her family's sacrifices for her education:

> When I came here everything changed because it was just me, my mom, and my brother. So, it was kind of like we came to a different country to get a better education. So, I was not just going to do the same; so, I started getting better…it was emphasized in our lives because, you know, that's what we came here for. Like, we left everything just for that.

Selena similarly shared that she was told by her parents to appreciate the opportunities available to her in the United States. When asked how her parents communicated this, she said, "literally by saying that, like, 'You have opportunities that I didn't have. I wish I had come here when I was young, so take advantage. Don't just waste it'."

In the context of encouraging careers that provided stability and financial security, STEM careers were often characterized within narrow cultural boundaries of what STEM subject areas and careers were considered of value. When asked about why he decided to switch from a traditionally non-STEM major into a computer science degree programme, Daniel shared that his decision was entirely a consequence of his researching careers that had reliable job prospects—a value he linked to the instability of life in Brazil and his parents' perception of the financial unreliability of his initial degree choice in music. Similarly, many of our interviewees' recollections suggested their parents had narrow perceptions of which STEM careers would lead to financial stability; these were often careers in medicine. Across several cases where participants pursuing STEM careers related to medicine changed their majors to pursue other STEM careers, they described conversations with their parents where they felt compelled to justify their career change by arguing in favor of the switch as providing similar financial opportunities and stability that the parents associated with medical careers. This observation aligns with research indicating family valuation of careers in medicine over careers as a "scientist" among British immigrant 11- to 14-year-olds (Wong, 2015).

Despite the narrow depiction of viable career pathways, participants' narratives reflected a family context where STEM was not only considered a possible path but also a necessary one to avoid hardships. Moreover, participants described their parents as willing to consider their children's understanding of STEM career choices despite the parents' sense of discomfort or unfamiliarity with the proposed career pathway. This was especially true for participants whose families had only recently immigrated, such as Mandi's and Selena's, or, in the case of Daniel, whose parents still lived outside of the United States. While this might reflect the parents' openness to hear their children's opinions, it could also reflect their positioning and recognition of children as "experts" in the content and context of STEM. This supposition is supported by the success all our participants described in convincing and reassuring their parents.

9.2 | Theme II: Creating spaces for children's STEM-Related expressions and identities

To address Research Questions 1 and 3, we sought to identify how home science conversations were constructed and how they related to participants' STEM identity expressions. In part of our exploration of Research Question 4, we also wanted to see how these conversations compared to and were influenced by their experiences with teachers. We examined our interviews to identify events in which participants described expressing interests, performing tasks, or receiving recognition in STEM, suggesting influences on their STEM identity development (Hazari et al., 2010). We viewed these events as part of an incremental development process in which participants practiced identity-related behaviors, received recognition feedback on those behaviors, and used that feedback to fashion (or unfashion) their STEM identities in a largely unconscious cycle (Gee, 2000). In presenting this theme, we focus on the home and school contexts as two areas where self-perception in STEM appeared to be most salient in our participants' narratives.

9.2.1 | The structure of everyday STEM talk and STEM identities in practice

When participants described expressing an interest in STEM, we asked them to tell us more about how their parents responded. We viewed these expressions as "bids for recognition" through which individuals "can be recognized, supported, or rejected by others in an ongoing process of identity negotiation specific to the situation and context" (Pattison et al., 2018, p. 982). In instances where our participants' description of interaction could be understood as a bid for recognition, we noted that they were not only displaying their interest in STEM to their families but also garnering information from their parents' response that conveyed their parents' perception of their involvement in STEM, and, by extension, their STEM personhood.

Although participants recalled one-on-one STEM conversations both initiated by them and by either of their parents, the anecdotes interviewees shared suggested that they were the primary drivers of those conversations, steering their parents in directions that reflected the interviewee's existing STEM interests and expressions. This tendency was especially evident for recreational (i.e., for fun, to pursue curiosity) STEM-related conversations that were not linked to formal school activities, which resonates with Dabney et al.'s (2013) findings suggesting that doctoral students' science interests were related to home more so than school experiences. In some cases, the conversations unfolded as participants asked their parents to tell them more about a topic they perceived the parent knowing about. Sandra spoke extensively about conversations with her father, an engineer, on science topics that were driven by her curiosity. She excitedly recalled opportunities such as watching fireworks or witnessing a thunderstorm where she would ask a series of questions of her father to "feed that curiosity." These conversational structures (i.e., child initiating conversation through personally relevant queries followed by a meaningful parental response that gave answers to the questions) were described by participants whose parents worked in STEM fields but not exclusively. Allie also described conversations with her father, who worked in business, unfolding this way.

More often, however, participants whose parents were not STEM professionals followed up by asking their children questions that encouraged the child to continue expressing and engaging with their interests. Mia recalled that when she talked to her mother about STEM topics she was interested in, her mother would "be very proactive in the conversation," commenting "'Oh, I didn't know that,' and she's like, 'Well, did you figure this out?' or, 'Why did you read this?,' and I'd be like, 'I read this because da da da,' and 'Did you know…?'. It was always a real conversation." Mia sensed that her mother was engaging her in a "real conversation," which made her feel like the "expert" from whom her mother was learning. Saffi described a similar dynamic with her mother: "In Biology [class] I learned something about cancer, and I'd be like, 'Mom, do you know what cancer is? It's like when this happens.' And she's like, 'Wow, I didn't know!'" Saffi's mother's exclamatory response communicated a belief that the information Saffi shared was not widely known, thus imparting to Saffi that this knowledge identified her as especially well-informed. Though these two conversations started for different reasons—Mia asking her mother for more

information and Saffi sharing something she knew about a topic—in both instances children remembered their parents encouraging them to continue talking or learning about the topic while recognizing the child's competence.

9.2.2 | Parents as buffers against negative experiences: Comparing school and home contexts

While some participants discussed interest and sense of recognition in STEM being fostered in school settings, they often described their formal schooling (i.e., K–12) as a place where their interests were not encouraged and where their STEM identities were not recognized. Although difficult to hear, this was not surprising given the breadth of evidence highlighting the exclusionary school practices that disproportionately affect individuals who identify as women, Black, Latine, differently abled, and/or other marginalized groups in K–12 environments (de Araujo et al., 2018; Neal-Jackson, 2018). Consequently, their narratives reflected a siloing of their STEM identity expressions to the home. Although we reject deficit-based framings of teachers' behaviors, particularly considering the systemic structures that often inhibit their success, we present these findings from the perspective of the interviewees, purposefully avoiding (and discouraging) direct critiques of the educators.

John described being disengaged with the boredom of school but would enthusiastically look up information about dinosaurs at home. When asked what he did with what he learned, he recalled that he would "brag about it to my dad." Selena talked about doing science experiments with her mother and friends, but she didn't consider this "science," it was "just something fun that we did." When asked if she recalled doing anything in school that she would have considered interesting, Selena responded, "No, not, science-wise." While Sandra described having had enjoyable STEM-related experiences in school, she reflected that she would refrain from asking questions in class, preferring to go home and talk to her father, with whom she felt more comfortable directing questions and from whom she expected to get the detailed answers she craved. In general, participants described classroom Discourses of STEM as fact-based and curriculum-driven, restricted to content that did not resonate with their personal interests. Thus, the home context provided an environment where participants could explore their interests and author their STEM identities by pursuing interests along lines that were personally meaningful.

Some of our participants' recounted teacher-related interactions that reflected negative emotional valence in relation to science (Wang et al., 2018) that highlight the role parents may have played in sustaining participants' sense of self in STEM. Carla recalled being overlooked by her fifth-grade teacher for placement in an advanced science programme, though she remembered a classmate whom she perceived "never did any work in class" receiving the distinction. She attributed this lack of recognition to her preference to not speak out in class—a tendency that has been noted to marginalize girls in STEM (Brickhouse et al., 2000; Parson & Ozaki, 2018). Though before that point she had "always liked science" and had been excited by the prospect of taking a more rigorous course in middle school, following that experience "there was a gap where I just didn't like science anymore," which persisted until she took STEM courses in college. However, Carla also enthusiastically described engaging in science-related interactions with her family across her grade school years, such as watching *Discovery Channel* with her brother and talking to her father about her aspirations to be a doctor. Despite her negative school experiences, she elected to enter college as a Biology major, which enabled the context in which she began to feel more like a STEM person. Similarly, Nicki's teachers in elementary and middle school would not answer her science-related questions, telling her she was "too slow." Yet, Nicki talked about the joy she found visiting zoos and aquariums with her family where she excitedly read signs and attended talks, as well as doing experiments with her neighbors using science kits her parents bought for her. In high school, Nicki met teachers who recognized and enabled her science-related interests and expressions, encouraging her to take more advanced science courses, in which she excelled, ultimately contributing to her decision to major in physics.

In both cases, participants experienced a deidentification with academic STEM because of minimal or negative recognition from teachers during their primary school years. While we cannot say that any one event contributed to

their lack of authentic engagement with school STEM, participants leaned heavily on these specific recollections to explain their disengagement. Yet, the nature of our sampling as consisting of mostly STEM majors limited us to "success stories," that is, those who persisted and enrolled in a college STEM programme. For our participants, their sustained connection to STEM between deconstructive events and subsequent re-engagement with academic STEM in college appeared mostly or entirely attributable to the opportunities they had for science-related interactions with or facilitated by their parents. Relatedly, we found several instances in which parents responded to their children's diminished sense of performance competence in school STEM. Saul described struggling with a calculus course that he felt threatened his sense of self in STEM because of his perception that his peers were more "naturally" competent. He recalled his mother responding by encouraging him to work with his teacher for help and praising him for his abilities despite the challenges. These occasions demonstrated parents' capacity to act as "buffers" of negative experiences that antagonized our participants' identification with academic STEM.

Parents typically played these buffering roles in ways that embodied and leveraged cultural characteristics often associated with low science capital and/or marginalization (Archer et al., 2012, 2015), creating an environment where these characteristics were normalized and framed as strengths. Saul contextualized his mother's support in relation to the incident described above and similar ones (e.g., uncertainty about applying for financial aid in college) as motivated by the value his mother placed on him obtaining a college degree—a value he associated with her experiences as an immigrant. According to Saul, these experiences motivated her to connect him to the resources that would support his success while recognizing her inability to provide them herself. Mia's recollections provide a more explicit example of how caregivers normalized traits associated with marginalization in STEM as strengths, speaking specifically about her mother's role in helping her overcome discriminatory gender- and race-based evaluations:

> Mia: I was told women don't need to know STEM. I was in a STEM club in high school, and I was told [by another woman] pretty girls don't [need to] know science…it was either someone who looked like me and saying that's not possible and I'm like, "How?" It'll be a woman saying you can't do this because you're a woman…And it's always when I was trying to learn; it was always when I wanted to learn or just be proactive in STEM; it was always those stereotypes about women or stereotypes about being Black.
>
> Interviewer: That could have really hurt you.
>
> Mia: Yes.
>
> Interviewer: I wonder why it didn't.
>
> Mia: I have extreme confidence. My grandparents were activists in the communities, and my mom did not end up doing the same path as my grandparents, but my mom was like, "You always have to show them. You can show them better than you can tell them," and that was her motto: "You can show them better than you can tell them."

9.3 | Theme III: Conversation structures associated with children's perceptions of parents

In addressing Research Questions 1 and 2, we wanted to understand how conversations differed based on participants' perception of their parents and how the differences in these characteristics suggested notions of

what qualifies someone as a STEM person. Participants' positioning of their parents as (not) STEM people related to parental gender and profession in ways that shaped the content, context, and structure of STEM-related conversations. We noted this in the narratives of participants who grew up in both single- and two-parent homes.

9.3.1 | Differences in the characteristics of conversations with mothers and fathers

In nearly every case where participants had opportunities to engage in STEM-related interactions with either of their parents, one parent was positioned as more expert in STEM—often the individual who had more formal STEM credentials. Participants typically turned to that person in favor of alternatives when they had questions or wanted to talk about STEM topics. In cases where parents held seemingly equivalent STEM credentials or where neither were perceived to have STEM credentials, participants' narratives suggested they saw their fathers as having more STEM expertise than their mothers. This was often noted through descriptions of their fathers as more well-read or knowledgeable, which was also often equated with having natural aptitudes in STEM, aligning with research on persistent and marginalizing stereotypes of a STEM person as naturally gifted (Archer et al., 2020; Parson & Ozaki, 2018).

Allie did not describe either of her parents as having STEM-related credentials, but she felt like she could turn to her father, who worked in real estate, to talk about science because "he knows everything about everything," repeating three times "he's a very knowledgeable guy." When asked if she ever had these conversations with her mother, she responded, "No, no…I love my mom, don't get me wrong, but I've never seen her like she knows everything…She's stronger on the emotional side." Both of Kelsey's parents worked for an information technology consulting company they co-owned and held similar degrees in computer science, but she "never really talked to her [mother] about how the world works" because she "didn't think [her mother] had the same background as [her father]." Kelsey justified this differentiation by alluding to her father's personal interest in astronomy, but she never mentioned having conversations related to astronomy when we asked about the content of STEM conversations with her parents; rather, the examples she gave were largely related to mechanical physics.

Many participants conveyed an association between their perceptions of their mothers as lacking STEM expertise or interest and the absence of conversations about STEM topics of interest (e.g., choosing to initiate STEM conversations with their fathers instead). Instead of talking to their mothers about STEM interests, then, they described their mothers as proactive in conversations about school and careers. Carla recalled:

> [I remember] doing the science fair projects with my mom. She would always help me—not so much on the actual science of it. She could 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.

These observations are consistent with feminist research on STEM Discourses that create a false dichotomy between caregiving roles and STEM (e.g., Harding, 1986; G. Hughes, 2001). Mothers were considered reliable resources for help with school-related STEM activities that did not require them to understand STEM content. This positioning of the mother was evident even in cases where the mother held a STEM degree or profession but the father did not. In a few cases, participants described their fathers as predominantly absent during some of their more formative years but they reconnected later in life. Their recollections suggest participants turned toward their mothers to satisfy their "for fun" STEM-related inquiries, but descriptions of conversations after the father returned suggested that those questions were mostly redirected towards fathers.

9.3.2 | Immigration influence on STEM-related interactions as a factor of parental professions

Studies of the experiences of immigrants have faced criticism for their deficit view of the capital migrants "lose" as a result of their relocation in that they fail to account for (a) the within and between-group variance in the resources migrants draw from, (b) their active involvement in developing "new forms of capital in the country of residence" that often leverage "migration-specific cultural capital," and (c) their ability to create new "mechanisms of validation for their [existing] cultural capital" (Erel, 2010, p. 649). We highlight this to frame our participants' deficit-based perceptions of changes in their parents' STEM-related capital in relation to their parents' immigration experiences. In every case we observed, these negative perceptions were applied to mothers who were described as having completely abandoned STEM professions, which participants used to justify a downgrade of their status as a "STEM person." None of our participants' fathers were described as losing a STEM career due to immigration.

Saul recounted that his mother gave up a career as an engineer in Cuba to work at a furniture store when his family moved to the United States. He contrasted his mother's experience with that of a friend's mother—also an engineer who migrated to the United States. Saul recalled that his friend's mother was able to transfer her expertise because she "took some sort of competency test," interpreting this as an indication that his mother's inability to practice engineering might be due to "lack of knowledge." When describing his interactions with the two women, it was clear that Saul approached STEM-related talk with them differently. Despite the indication that Saul's mother expressed interest in STEM-related conversations, Saul perceived her motivation to talk to him about STEM to lie primarily in her general support of his education and future rather than her affiliation with STEM or an affinity toward STEM-related topics. He talked to her about his aspirations rather than conversing with her to explore a shared interest in STEM, commenting that when he talked to her about what he learned in school he would explain it "in layman's terms." The interactions he described with his friend's mother positioned her as a STEM expert, such as in conversations where she told him about her decision to pursue engineering.

Marcos, a computer science major, related that his mother worked in computer science before immigrating, but he consistently turned to his father, a math professor, to discuss "intriguing" STEM topics, instead crediting his mother for career guidance:

> Marcos: If I ever had some question about math that I was intrigued about, then I would go to [my father]…but actively, it's been my mom that has shaped [my decision to pursue computer science] the most.
>
> Interviewer: Now that you're in computer science, do you talk to your mom about computer science at all?
>
> Marcos: Since she's just working now, she doesn't, like, actively study it or anything…Everything that she basically learned has been from a while back, so I don't really talk to her about it, and I don't think she remembers too many things about it.

Though Marcos acknowledged the significant role his mother played in steering him to computer science from a career-choice perspective, he perceived his mother as lacking knowledge and ability to talk to him about modern topics in computer science, even though at one point he remarked that he believed the programmes she developed in Cuba are "still used today."

Participants often appeared to notice their mothers' frustrations with obstacles in their capacity to connect with their children through STEM-related conversations. Marcos reflected:

> She didn't feel very good about, like, "Oh, he's never seen me do my specialty and how I was when I was younger. Right now, all he can see is what his dad does." That was obviously her passion, so when she came [to the U.S.] she didn't like the fact that she basically gave that up to find work, but part of the frustration also comes from that I never got to appreciate what she does because I never got to see it.

Here, and elsewhere in his interview, Marcos recognized his mother's computer science interests, pursuits, and "passion" but speaks of them as relics of his mother's past. Others recognized their mothers' frustrations in ways that were not always directly framed in relation to career changes but rather to challenges in engaging with participants in STEM subjects in which the mothers had excelled. Two participants described this when they recalled their mothers helping them with their mathematics homework—subjects that the participants stated their mothers enjoyed. Chloe described her mother, who had worked as a dentist but was at the time of the interview employed as a dental hygienist, as someone who enjoyed mathematics and wanted to interact with Chloe while she was studying the subject. However, Chloe recalled her mother encountering challenges during these conversations because of misalignment between seemingly divergent pedagogical approaches. Chloe recalled, "She would just be like, 'I learned the quadratic formula, but you guys do it so differently'…I feel like it would bother her a little bit because she's like, 'I know this, but what are they doing?'" Selena shared a very similar description of some of her math-related interactions with her mother who had worked as an accountant in Cuba. For mathematics particularly, many of our participants described their households as places where mathematics was enjoyed and valued, some noting that it was easier for their parents to engage with them in mathematics because the subject presented less of a barrier in cases where their English language ability was emerging, but narratives such as Chloe's and Selena's suggest that expectations for solving problems in a particular way stymied interaction.

10 | DISCUSSION AND IMPLICATIONS

As significant persons in their children's worlds, parents shape their children's self-perception in STEM and related aspirations regardless of their own STEM affiliations (Sjaastad, 2012). Thus, it is important to consider the role of parents when challenging assumptions about who holds membership in STEM and who can serve as positive influences on a child's STEM identity construction. For our participants, talking about science with their parents appeared to reinforce their STEM personhood regardless of the amount of "science capital" parents held, though the content, context, and structure of those conversations differed.

Our interviews provide evidence that parents of now-college-STEM majors engaged in furthering STEM-related conversations that arose when parents brought up a topic related to work, asked about progress in STEM courses at school, and/or children's curiosity in a STEM topic led them to talk to a parent. Regardless of how conversations came up or the STEM experience of the parent, parents engaged in ways that affirmed children's STEM interests, confidence in their understandings of STEM topics, and self-recognition as actors within STEM—critical components of identity formation (Hazari et al., 2010)—by encouraging the child's continued expression of interest or learning, sharing knowledge, and/or providing the child with additional social or material resources. In nearly all the experiences conveyed, participants and parents had recognizable roles in STEM-related conversations: participants expressed a need or desire to understand and explore participant-generated STEM topics and parents acknowledged and encouraged these pursuits even in cases where they were themselves unfamiliar with the topic. Our participants described these conversations with their parents as normalized, supplying the positive formative feedback that encouraged continued expression of interest, which in turn led to more conversations that allowed the child to practice their identity as a STEM person through everyday science talk. In this way, participants practiced using the Discourses that characterize the STEM community—including using STEM-related terminology and demonstrating knowledge-based expertise—in a personally nurturing context.

The persisting existence of these conversations across participants' lifetime should not be glossed over. It is in the ways individuals use language (and semiotics more broadly) in specific contexts that they form and reform their sense of self in relation to those contexts: "Worlds are figured through language and images as well, and these means of objectification make possible…deliberate efforts of persons and groups to direct their own behavior" (Holland et al., 1998, p. 281). In other words, without contexts in which young people can use language to agentically position themselves within STEM, positive identification with STEM is stunted (e.g., Brown et al., 2005; Brown, 2006; Riedinger & McGinnis, 2017). All our participants' narratives conveyed the existence of nonschool spaces where parent–child conversations took place that permitted and nurtured STEM-related interests, positive recognition, and confidence.

Although Archer et al. (2012) and Gonsalves et al. (2021) suggested that talk events that support science identity were often exclusive to families where adults held STEM careers, we found that not to be the case in our study. While we did notice that conversations differed qualitatively in households where parents had formal STEM training, parents broadly applied strategies that successfully encouraged our participants' STEM pursuits. Our findings resonate with research such as that of Pattison and Dierking (2019) who documented that girls from as young as four develop sophisticated science-related interests in light of their interactions with their maternal caregivers despite living in low-income circumstances. Relatedly, all our participants vividly recalled expressing an early interest in STEM topics, and most recalled talking to their parents about those topics as early as first or second grade. However, we recognize the importance our participants expressed in resources such as books and videos to ignite conversations that allowed them to practice their STEM identities. We acknowledge that these resources may be more difficult for some families to find or to use due to limited community access to institutions that provide them (Neuman & Celano, 2001) or limited availability of options in languages other than English (e.g., Lambson, 2002; Paganelli & Houston, 2013). Several of our participants were able to access Spanish-language resources through their parents' connections with friends outside of the United States, but this accessibility should not be assumed. Efforts should be made to work with communities to develop and place these resources in the areas where they can be accessed, trusted, and where families already feel welcomed and acknowledged. Teachers may facilitate these valuable parent–child interactions by curating resources, for instance by providing engaging reading materials and encouraging children to report back on what they discussed with their parents.

Our participants' membership in groups marginalized in STEM contexts, as well as their families' immigration histories, appeared to shape the content, context, and structures of family conversations and, therefore, the ways participants practiced identity-forming Discourses. While this framing of marginalization and immigration status in relation to STEM identity treats those as two separate factors, we do so for the sake of presenting distinct ideas. However, we understand that a person's experiences are linked to the various ways they identify and are identified in inextricable and multiplicative ways (Crenshaw, 1990) such that one could not attribute an individual's experience to a single factor. For example, Nicki and Carla experienced challenges to their STEM identity from teachers through school evaluations. Understanding this phenomenon of intersectionality, we would not compartmentalize their experiences as either a factor of their position as women or as second-generation Latinas, but rather as a function of these and other ways they identify and are identified by others. Similarly, Mia's recollections of how others positioned her in STEM were associated with her gender and race not separately but as a distinct, intersectional identity. The stories she shared suggested that her mother worked to counteract negative stereotypes associated with how she understood Mia would be perceived as a Black STEM woman—as a complete, intersectional being rather than a collection of disparate identities. In this way, we see the role of parents in providing identity-formative recognition as especially meaningful and unique. We argue that parents are uniquely situated to recognize and respond to their child as a product of many identities, which may be much more difficult for schools, camps, or other formal or informal spaces to address without the knowledge of the multifaceted histories and heritages of children.

Indeed, while most of our participants did not discuss discrimination directly, our findings suggest that the home, and particularly the parent–child relationship, can serve as a driver and ever-present antidote for STEM

identity construction despite lack of access or contrary messaging that young people may encounter. Saffi's mother connected her with a STEM professional (a neuroscientist) who shared her ethnic identity, providing representational affirmation and another social context to practice Discourses that she would have likely not encountered in school or media. Despite unfavorable school science evaluations, Chloe, Selena, and many other female participants found parental contexts that overtly valued and highlighted Latina's math competency. Participants described feeling recognized as STEM persons in ways affirming that someone "like them" has the "authority" to engage with STEM—an important exercise given the assumptions of exclusivity of membership in STEM contexts (e.g., Calabrese Barton & Yang, 2000; Leslie et al., 2015).

On the contrary, we also found evidence of obstacles encountered (or constructed) by participants as factors of both theirs and their parents' marginalization and immigration status. Participants positioned their migrant mothers who no longer pursued STEM professions as lacking STEM interest, symbolic clout, and knowledge, despite being able to articulate the economic and systemic reasons their mothers may have given up their pursuits. Participants leaned on these ways of positioning their maternal caregivers as reasons for not engaging in conversations with them about specific STEM topics. Using an intersectionality lens, we see these identity-shaping experiences as a factor of both mother's identification with marginalized groups in STEM (e.g., women) and their immigration status. Participants positioned their mothers as primary caregivers largely in gendered ways (e.g., "stronger on the emotional side," and "help me to make sure that I'm not getting hurt") often seen as incompatible with the passionless objectivity of STEM (Harding, 1986) and their status as immigrants who had been denied of pre-existing academic and professional credentials further diminished participants' perceptions of their STEM personhood. The intersection of these factors explains the unique ways that these mothers engaged with their children and were prevented from having certain types of STEM-related conversations. Considering the STEM expertise held by mothers and research reinforcing the value of female role models in STEM to girls' STEM identity formation (e.g., Stout et al., 2011), our findings draw attention to the untapped potential of migrant mothers' histories in their children's STEM identity construction.

Despite failing to engage in topic-specific conversations with their maternal caregivers, almost all participants for whom this was the case identified other social resources (e.g., teachers, other relatives, family friends) for engaging in STEM identity-related Discourses. Participants often credited their mothers for having proactively connected them to some of those resources. Thus, it is important to consider when interpreting these findings not only the value inherent in identity construction through parent–child interactions but also to imagine ways that these experiences may be leveraged to dismantle discriminatory Discourses of STEM membership. For instance, mother's frequent role in locating resources and strategizing problem-solving reflects scientific inquiry skills that are not noticeable in participants' interactions with fathers who are predominantly described as communicating trivia-type information about STEM topics. Given their own status as STEM authorities who have the power to define performances that are valued in STEM (R. Hughes et al., 2021), teachers may facilitate this recognition by emphasizing the scientific skills employed in these types of problem-solving situations or by encouraging children to investigate the ways that their parents do science in everyday contexts.

While we recognize the value of parent–child conversations particularly in cases where parents had little or no academic preparation in the United States or where participants identified with marginalized communities, we recognize the tragedy of social reproduction implied in some of our framings of STEM identity as children become further encultured into adopting elitist, Western stereotypes of STEM personhood (G. Hughes, 2001; Hussenius, 2014). For example, our participants considered their fathers' possession of a large body of factual knowledge as a characteristic of what makes someone a STEM person despite having recollections of their mothers' capacity to identify, acquire, negotiate, and/or leverage STEM-related resources such as educational opportunities and adult STEM role models—in this way reproducing in the home narrow and discriminatory Discourses of belonging in STEM. Here is another clear opportunity for teachers to dismantle these stereotypes by establishing in the classroom what is valued in STEM—particularly given that children, like Selena, are likely to associate science with the classroom (Allen & Eisenhart, 2017).

Additionally, several participants shared experiences in which they had to convince their parents of the value of careers outside of medicine—for instance in physics or computer science—using promises of success embedded in U.S.-based Discourses around these fields. While their parents eventually adopted these values and supported their children's pursuits, this requisite change in perspective could become problematic in relation to social equity if STEM fields are promoted in ways that require families to either drop or change their cultural values. While this is not to suggest that educators should not promote these careers to children from cultures where they are not valued, it advises the need to consider the broader ethical implications associated with encouraging children in STEM pursuits in consideration of the cultural violence that often exists in the STEM postsecondary classroom and workforce (e.g., Godwin & Potvin, 2017).

It is also important to note that our participants could all be considered STEM success stories as defined by university-based and national Discourses around STEM in that they pursued STEM postsecondary education. This excludes the kinds of individuals who might pursue STEM fields through vocational training or apprenticeships. This also excludes students who may have faced more violent or persistent challenges to the intersection of their racial, ethnic, and other identities where their developing STEM identities would not have fared as well. Even in cases where participants found their families supportive of their STEM pursuits, it is worth keeping in mind that school experiences both hindered and facilitated their pursuits. In these cases, most negative experiences occurred in primary or middle school and positive experiences in either high school or college. It is unclear whether Carla and Nicki, for example, would have reignited their passion for STEM had they not encountered supportive educators later in their educational trajectories.

Finally, we found that interviewing individuals about the details of the conversations they recalled provided a wealth of information about their experiences that related to the construction of their interests, their sense of performance competence, and their feelings of recognition as a STEM person. These interviews not only elicited details of conversations but also led to the expression of family values, cultures, and norms that contributed to our participants' understandings of themselves as STEM persons. Other researchers studying identity negotiation—in STEM or otherwise—may consider this approach as part of their data collection, particularly when considering social construction of identity. We also realize that the participation of population members in interviews and analysis assisted tremendously in the sense we were able to make from the data. While perhaps not possible or appropriate in all circumstances, we advise that researchers reflect on how to involve participants in the research process when conducting identity-related studies. Indeed, this participation is a valuable contributor to quality in qualitative research that is not often pursued (Cian, 2021).

11 | CONCLUSIONS

Broadening participation in STEM is often cited as a goal of STEM programmes, yet it is not always clear what is hoped to be achieved by creating more inclusive STEM communities. Identity-related aspirations for STEM programmes could dangerously tread into the realm of molding minoritized individuals into stereotyped versions of STEM professionals, necessarily leading to a jettisoning of their own culture and values. Relatedly, many individuals at a young age decide that STEM is not for individuals “like them”—that is, those with their ethnic, racial, gender, or socioeconomic identity—a consequence of dominant STEM community Discourses. This lack of identification with STEM not only threatens the diversity of the STEM profession, which is necessary for drawing awareness to STEM issues overlooked by the masculine, Euro-centric cultures that dominate the field, but also deprive children of the experience of enjoyment, discovery, and curiosity that are inextricable from STEM inquiry and fundamental to healthy development. Thus, it is necessary to approach STEM identity development from a place of cultural inclusivity and respect which acknowledges the powerful relationships that exist within the home. However, many parents may be made to feel that their backgrounds are inadequate for engaging in STEM conversations with their

children. Our research suggests that this perception of parents' inadequacy, which is likely brought about by parents' own disidentification with STEM based on the dominant messaging of exclusion, is unfounded.

Given that our participants came from diverse homes with diverse schooling and immigration experiences, it is not surprising that the kinds of interactions participants recollected having with their parents around STEM-related topics varied. However, this variety only strengthens the argument that STEM identity recognition may occur in many contexts that are meaningful for the child. Given that "becoming a science person is dependent on the complex mixture of political, social, cultural, and personal relationships which are influenced by the demographics, the politics, and the overlapping of different power structures within a specific landscape" (Avraamidou, 2019), our findings highlight the value of leveraging children's home lives. Indeed, this cultural intersection is likely why parental recognition manages to be so impactful—parents are in a unique position in that they are more closely associated with the child's own cultural experiences than any other individual, and, given that language can encode cultural experiences (Wells, 1994), STEM-related conversations between parents and children serve as a powerful force in their identity development.

We emphasize that our findings do not present novel ideas of how parents can engage with their children—our data demonstrate that parents readily participate in these types of interactions without any guidance from researchers. Instead, we aim for our findings to draw the awareness of researchers and practitioners to the capacity that parents already possess but may have been socioculturally trained to undervalue, hindering parents' ability to engage with their children's STEM pursuits. The types of conversations related by our participants were raised organically, through the natural rhythm of interaction that occurred within those homes. Efforts to support children's STEM identity by forcing changes in the ways parents talk to their children are likely to produce disappointing results because of the difficulty in making recommendations that consider the idiosyncrasies of family life based on a slew of household conditions and histories. What our research emphasizes is the value of these interactions, regardless of the sociocultural forces acting upon the family, and the need for its appreciation in supporting child identification with STEM. It must be considered how outreach to parents may need to be differentiated using grassroots approaches that consider the unique challenges and positioning caregivers bear within their household. For instance, in considering this differentiated outreach, it is important not to consider some resources as "for mothers" and others as "for fathers," thus reproducing gendered expectations of STEM membership. Instead, these results demonstrate that parents may have different ways of connecting their children with STEM and the spectrum of these approaches should be considered. Further, though one implication of our research is that programmes aimed at supporting child STEM identity should include activities that promote child–parent interactions, there is the caveat that these programmes must also reflect on how they can support parents' self-efficacy in drawing upon the strengths they possess but may have been trained to not see as relevant to their child's STEM pursuits.

ACKNOWLEDGMENTS

We would like to thank the members of the *Talking Science* team at FIU who supported this study. We would also like to acknowledge the various reviewers whose diligent and constructive feedback helped to shape the final version of this manuscript. This study was supported by National Science Foundation CAREER Award No. AISL-1846167.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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SUPPORTING INFORMATION

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How to cite this article: Cian, H., Dou, R., Castro, S., Palma-D'souza, E., & Martinez, A. (2021). Facilitating marginalized youths' identification with STEM through everyday science talk: The critical role of parental caregivers. *Science Education*, 1–31. https://doi.org/10.1002/sce.21688