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Latino/a/x Engineering Undergraduate Students' Experiences with Racialized Ideologies: The Case of One Hispanic Serving Institution (HSI) and Three Emerging HSIs

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ABSTRACT

In this paper, we draw on Anzaldúa's *conocimiento* framework to examine 22 Latino/a/x undergraduate students' trajectories to and through engineering education at four university campuses. Findings show that these students have encountered an array of racial stereotypes about Latinos/as/xs, grappled with the lack of representation of Latino/a/x students and faculty in their departments, and been subject to racial microaggressions. Our findings have implications for engineering education regarding the creation of policies and practices that set a welcoming culture for Latino/a/x students and challenge oppressing practices in engineering.

KEYWORDS

Latino/a/x; engineering education; racialized ideologies; HSIs

Introduction

More than 30 years ago, a call was made to critically change the culture of engineering practice and education (Godfrey & Parker, 2010; Mejia et al., 2022; Pawley, 2009). In response to this call, more attention has been paid to the current culture of disengagement in engineering (Cech, 2013a). This culture frames environmental and social justice concerns as tangential to the profession, even though the National Academy of Engineering (NAE) has referenced the field's responsibility to address social issues, and the Accreditation Board for Engineering and Technology (ABET) requires that engineering programs help students develop a sense of social and ethical responsibility (Pawley, 2009). According to Cech (2013a), engineering's culture of disengagement is based on three pillars: an ideology of depoliticization, technical/social dualisms, and a meritocratic ideology. These three pillars uphold the belief that engineers, as well as the engineering field, are apolitical and detached from current pressing social issues (Mejia et al., 2020; Riley, 2005). These pillars also sustain the belief that individuals' success in engineering are the result of individual merit (Cech, 2013b; Foor et al., 2007).

As a result of the field's resistance to address social justice issues, engineering continues to be dominated by the ways of thinking and doing of those from the mainstream culture (i.e., white males) (Foor et al., 2007) while simultaneously adhering to oppressing ideologies. In fact, ideologies of depoliticization and meritocracy have detrimentally impacted the extent to which the field has critically engaged its participation in perpetuating injustices toward racial minorities (Cech, 2013a). The above is compounded by U.S. universities' failure to recruit racial minorities and their tendency to stay behind in innovating pedagogies and curriculum (Mejia et al., 2020), as well as not creating networks of support and mentorship (Camacho & Lord, 2013). For instance, Latino/a/x students continue to encounter barriers to persistence in engineering education, such as undue

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financial burdens (Becerra, 2010; Cech, 2013b) and compromised academic preparation (Garcia et al., 2020). These students also struggle to develop a sense of identity and belonging in engineering (Camacho & Lord, 2011; Espino et al., 2022), which brings about a hovering sense of social isolation (Carter, 2006; Kinzie et al., 2022). Although these factors profoundly shape educational equity for Latinos/as/xs, research has not provided sufficiently nuanced and disaggregated accounts of Latino/a/x engineering students' experiences, including discussions of the racialized stereotypes and racial microaggressions that they confront in engineering education.

We believe that providing such accounts is critical because the experiences of people of color have historically been omitted from academic discourses, thus continuously reproducing social inequalities and academic hierarchies (Delgado Bernal, 2002; Mejia et al., 2022). With the above in mind, we drew on Gloria Anzaldúa's *Conocimiento Framework* (Anzaldúa, 2003) to analyze 22 Latino/a/x engineering students' lived experiences throughout their engineering education trajectories at four university campuses. This analysis, which is part of a larger study, was guided by the question: *how do Latino/a/x engineering students describe their journeys to and through engineering as racial minorities?* Our analysis indicates that these racially marginalized students have encountered negative perceptions as Latinos/as/xs, endured the vulnerability that comes with the little representation of Latinos/as/xs, and experienced racial microaggressions. Our findings have implications for engineering education, in terms of recruitment of these minoritized groups and the creation of policies and practices that create a welcoming culture for them to challenge oppressing practices in engineering.

Theoretical framework

Based on the understanding that Latino's/a's/x's own experiences can be used to theorize the educational experiences of Latino/a/x engineering students, we counter research practices that have historically silenced Latino/a/x voices in engineering. To accomplish this, we employ Anzaldúa's seven-stage theory of *conocimiento* as a lens (Anzaldúa, 1987, 2003), which documents the interactions between marginalized individuals and broader colonized contexts, and resulting in ideological and identity tensions. By locating areas of conflict, we can identify instances of emerging agencies that are often overlooked or obscured by traditions of silence rooted in inequitable research ontologies and epistemologies.

Conocimiento involves seven recurrent and iterative stages that can be triggered at any time, which lead to a continuous process of consciousness raising (Anzaldúa, 2003). Conocimiento documents the ways *El Arrebato* (ruptures) throws individuals into *Nepantla*, a liminal space of contradictions and oppositions (Anzaldúa, 2003). In order to resolve these contradictions, individuals must be willing to enter the *Coatlicue* state by confronting the root causes of their sense of dissonance, giving way to a higher consciousness of the inner self. A shift into *El Compromiso* occurs through the attainment of a higher consciousness which empowers individuals to undergo a process of rebirth made possible by the death of a former identities and epistemologies (Anzaldúa, 2003). With new perspectives, individuals enter the *Coyolxauhqui* stage where they restructure their realities and create new visions of themselves and the world (Mejia et al., 2022). Due to the cyclical nature of Anzaldua's Seven Stages of Conocimiento, individuals can go through a *Clash of Realities*, as their new sense of self is challenged by existing power structures that dictate societal perceptions of their intersecting identities. Individuals whose identities and new conceptions prevail move onto the last stage, *Transformation and Spiritual Activism*, where the renewed sense of awareness is put into action to empower and transform (Anzaldúa, 2003).

Conocimiento's emphasis on the agency of Latino/a/x individuals in re-writing their own narrative makes it a helpful analytical tool to examine Latino/a/x engineers' experiences as they move through institutional cultures that have sought to erase their embodied epistemologies and identities (Mejia et al., 2022). For the purpose of this paper, we focus on Latino/a/x engineering students' accounts of *arrebatos* they faced in connection to their identities as racial minorities. Centering on these *arrebatos* enabled us to identify the institutional barriers hindering these students' ability to see themselves as

being part of engineering and finding a space for themselves within the discipline. In the context of the present study, *arrebatos* took the form of confrontations with negative race-based perceptions toward Latinos/as/xs and their suitability to the world of engineering, the lack of representation of Latino/a/x students and faculty, and experiences with racial discrimination within campus and across engineering spaces.

Literature review: Latino/a/x education in the United States

Although there is limited research on the history of engineering education for Latinos/as/xs in the United States, understanding the history of Latinos/as/xs in education is important for the framing of the issues discussed in this paper. This historical perspective helps understand the issues that have led to the current disproportionate underrepresentation, racialization, and marginalization of Latinos/as/xs in engineering education and practice. Historically, Latino/a/x education in the U.S. has been framed as an instrument of oppression where *de facto* practices such as curriculum differentiation, school segregation, language suppression and cultural exclusion became *de jure* (San Miguel, 2022; Valencia, 2005, 2010a, 2010b). According to San Miguel (2022), Latina/o/x communities have been excluded from any type of participation in the governance and decision-making of public education; thus, exacerbating the educational opportunities for Latinos/as/xs while stripping them away from their culture and language.

Valencia (2010b) provides a detailed description of how educational oppression and school failure for Chicano/a/x and Latino/a/x students has historically been marked by institutional processes that have led to detrimental outcomes. For instance, the *Rodriguez v. San Antonio Independent School District* landmark ruling impacted school financing by establishing school funding practices largely based on "racial and class profile of the school districts" (Valencia, 2010b, p. 11). These historical financial inequities can even be traced back to the early 1930s and 1960s when school segregation led to the educational neglect of Latino/a/x students (San Miguel & Valencia, 1998; Valencia, 2010b). Despite the resistance of the Latino/a/x, Mexican and Mexican American communities, for example, by the creation of *Escuelitas* and other acts of resistance (San Miguel, 2022), states like Texas and California continue to see the number of disenfranchised Latinos/as/xs increase, even though these two states have the largest Latino/a/x population in the country (Campaign for College Opportunity, 2018; Martinez, 2017; Valencia, 2010b). In defiance of the Civil Rights Act of 1964 and subsequent attempts to maintain inequality in schools, discriminatory education funding practices adversely impacted and continue to impact Latino/a/x students today. Texas, for example, "has the longest and most pronounced history of inferior education in regard to Chicano students" (Valencia, 2010a, p. 23).

This inferior education for Latinos/as/xs has also been attributed to the use of deficit ideologies to explain achievement gaps between white and nonwhite students (Rosa & Flores, 2017). Deficit thinking involves the practice of blaming academic "failure" on the cultural views or practices of the communities that racialized students come from (e.g., Mexicans do not like to study, speaking Spanish hinders their academic success, etc.). Within the educational realm, deficit thinking has created long established labels to describe people with different backgrounds in terms of deficiencies (Cabrera, 2019; Menchaca, 1997; Valencia, 1997, 2010a; Valencia & Solórzano, 1997; Valenzuela, 2010). These include labels such as limited English proficiency (LEP) students, disabled students, inner-city students, or remedial students, which have always placed youths associated with these labels as inferior, deficient, and somewhat in need of remediation or "fixing." This deficit perspective permeates the way we create curriculum, teach courses, and prepare exams, resulting in a predictable (because it is sought that way) pattern that these groups are not as good as the others who do not have those "limitations" (Flores & Rosa, 2015). Deficit thinking creates an expectation of low achievement because of perceived inadequate language proficiency, motivation, or lack of familial support. Although the deficit thinking model lacks empirical validations, it continues to maintain a powerful influence in educational practice still today (Rosa & Flores, 2017; Valencia, 1997).

Similarly, engineering education has made slow progress regarding racial parity and educational equality (Camacho & Lord, 2013; Revelo & Baber, 2018). In fact, deficit thinking is also reflected in engineering education, which continues to be dominated by the mainstream white culture (Foor et al., 2007; Mejia et al., 2022). On the one hand, universities have failed to recruit Latino/a/x students into engineering (Camacho & Lord, 2013). On the other, those Latino/a/x students who enter the world of engineering confront exclusionary racial climates (Camacho & Lord, 2011; Mejia et al., 2020) and racial stereotypes that construe them as unsuited for the profession (Cech & Waidzunas, 2011). Latino/a/x students also confront racial microaggressions and racial discrimination that result in reduced self-esteem and racial isolation (True-Funk et al., 2021), as well as a decreased sense of belonging (Camacho & Lord, 2011). Racial microaggressions are hidden and obvious oppressive acts perpetrated against racialized and minoritized group members that function as a means for asserting and maintaining social dominance. Correspondingly, racial stereotypes are generalized concepts about a community based on their race. According to Solorzano and Yosso (2002), racial microaggressions and racial stereotypes are inextricably related as one reinforces the other. In this way, the negative attitudes that inform racial stereotypes take shape as racial microaggressions, and engineering is not the exception to these acts.

Methodology

Research context and participants

The data discussed in this article were gathered while carrying out a longitudinal research study across four research sites: three *emerging* Hispanic-Serving Institutions (HSIs) and one HSIs. Three of these universities are research-oriented, state campuses while the fourth university is a private, teaching-based campus with no Ph.D. engineering programs. Each of the four institutions possesses a student population representative of differences along the lines of race, gender, ethnicity, socioeconomic status, transnational experiences, and bilingual proficiency to varying extents. However, inconsistent with the diversity present in the larger student body, enrollment numbers indicated that representation of students from historically minoritized communities was smaller within engineering programs irrespective of the university's HSI designation. The goal of the larger study was to collect Latino/a/x engineering students' accounts of their experiences at these four campuses, to identify and examine systemic barriers they have encountered, and the ways they have responded to these challenges. The project aimed to validate the sensibilities, experiences, and embodied knowledge of Latinos/as/xs (Delgado Bernal, 1998) as they move through their engineering journeys.

In total, 22 Latino/a/x engineering students took part of this study, all of whom were invited to participate by means of announcements in the form of posters, bulletins, and digital notices circulated online in cooperation with various Latino/a/x, Native American, and Hispanic student organizations. It is important to note that in this paper we use the term Latino/a/x to encompass all participants; however, they were asked to self-identify and their descriptions are provided in Table 1 below and when we cite their opinions and reflections. Without exceptions, participants stated that their interest in joining the study arose from a desire to share their experiences as minoritized students and contribute to the possibility of a more equitable education for future Latino/a/x students. At the beginning of the study, all participants were classified as sophomores or juniors in their corresponding engineering programs.

Twenty out of 22 participants self-identified as first-generation college going. Furthermore, 19 self-identified as being of Mexican heritage. In addition, Santi and Eva self-identified as Honduran American, Lena self-identified as Peruvian American, and Rafaela disclosed that she is of mixed heritage (Black, white, and Hispanic). Furthermore, one of the participants was a veteran and two had previous professions outside of the engineering discipline before enrolling in their respective engineering programs. All participants, apart from one, characterized their socioeconomic backgrounds as low-income. As such, most opined that the economic conditions within their

Table 1. Participants' demographic information.

Pseudonym	Ethnic Identification	Generation	Engineering Major
Alberto	Hispanic/Latino	First Gen	Mechanical
Lara	Mexican American	First Gen	Environmental
Carlos	Mexican	First Gen	Electrical
Luis	Mexican	First Gen	Chemical
Nana	Mexican American	First Gen	General
Gerardo	Mexican American	First Gen	Mechanical
Eva	Honduran American	First Gen	Biomedical
Jacinto	Mexican American	Second Gen	Electrical
Jessica	Latina	First Gen	Mechanical
Elena	Latina	First Gen	Biomedical
Leo	Mexican American	First Gen	Mechanical
Mauricio	Hispanic	First Gen	Biomedical
Luz	Hispanic	First Gen	Biomedical
Sole	Mexican	First Gen	Chemical
Larissa	Mexican	First Gen	Computer
Rafaela	Hispanic, Black, & White	Third Gen	Civil
Lena	Hispanic	First Gen	Structural
Nuria	Mexican/Latina	First Gen	Computer
Lucía	Mexican American	First Gen	Mechanical
Lety	Mexican	First Gen	Civil
Santi	Honduran American	First Gen	Materials

communities affected the quality of the education they received in K-12. The impact of the various opportunity gaps that ensued continue to surface as participants press ahead in their respective engineering programs. Table 1 summarizes participants' ethnic identification, college generation status, and engineering field.

Data collection and analysis

The broader study drew from one-on-one *pláticas*, focus groups, and document analysis. For the purposes of this paper, we focus on the data collected from the one-on-one *pláticas*. The process of data collection began with Author #1, who arranged for individualized *pláticas* via Zoom video conferencing with each participant to build rapport, *confianza*, share personal stories about lived realities, and provide emotional support among other things (Delgado Bernal, 1998; Delgado Bernal et al., 2012; 2017). As a data collection method, *pláticas* offer a robust means for developing mutual trust between the two parties. The creation of a bond of mutual trust between the researcher and participants was vital to ensure that they felt comfortable discussing their experiences as Latino/a/x engineering students and developed a strong sense of confidence that their anonymity and privacy were safe. Author #1, an engineer himself, shared with the participants the discrimination he faced during his own journey through engineering. During these *pláticas*, Author #1 also disclosed and shared with the participants his background, personal experiences, and vulnerabilities as a first-generation, Mexican American, engineer as a way to reciprocate the trust between researcher and participant, and to acknowledge the positionality of the researcher as instrument (Secules et al., 2021). Over a period of two years, the pláticas became a space for participants to unpack experiences of marginalization and discriminations that would otherwise go unnoticed and unaddressed by the institutions and their engineering programs. One various occasions, Author #1 validated the participants' experiences by confirming that the discrimination they felt was not imaginary but rather systemic. Often, Author #1 acted not only as a researcher but also provided emotional support to the participants.

Participants individually took part in as many as six *pláticas*, the duration of which varied from 40 to 90 minutes per session. Each *plática* was transcribed verbatim and coded via inductive, axial, and deductive coding methods (Saldaña, 2015) with NVivo 12. The process by which Author #2 and Author #3 carried out the coding process began with the implementation of an inductive coding stage

with Author #1. To start, we read through participants' *pláticas* and identified reoccurring themes which produced approximately 60 lines of inquiry. We then sequestered the themes and applied a method of axial coding using Gloria Anzaldúa's theoretical framework of *Conocimiento* as our guide for the identification of wider themes. Our use of axial coding resulted in the development of a comprehensive coding scheme that mapped participants' shifts and moves across the seven stages of conocimiento throughout their engineering trajectories. We then used this encompassing coding scheme to re-code all pláticas data (74 interviews, for approximately 57 hours of *pláticas*). In the process of working with data, new questions emerged in connection to the participants' experiences, which were later asked during follow-up *pláticas. Pláticas* included questions about their childhood and adolescent experiences, familial values, support systems, and their student experiences within the K-16 educational pathway.

Researcher positionality

The first author self-identities as a Mexican American, first-generation, *transfronterizo* and bilingual engineer and educator. His schooling experiences in the United States, particularly in the U.S.-Mexico borderlands in the Southwest, inform his research agenda exploring historical and social justice aspects of engineering education for Latinos/as/xs. The narratives presented in this paper are representative of the first author's experiences in the borderlands – experiences that are necessary to communicate in engineering education to assert our legitimacy and identity in engineering spaces. Similar to the participants in this study, the first author lived through the stigma of being an *atravesado* (a transgressor) (Conchas & Acevedo, 2020; Mejia et al., 2022) in engineering. It is this closeness to the world of engineering and the Mexican American community in the borderlands that allowed the first author to develop trustworthiness with the participants.

The second author self-identifies as a working-class, Latino, bilingual (Spanish and English), first-generation scholar who works at the nexus of critical applied linguist and anthropology of education. As a young adult and English teacher, he frequently had others frame his bilingualism in racializing ways, not only in Costa Rica but also in the United States, where he eventually moved to pursue his doctoral education. As a result of these marginalizing experiences, his research now centers on examining U.S.-based Latino/a/x, bilingual teacher candidates' negotiations of identity at the nexus of language, ethnicity, and race, especially within multilingual/multicultural settings such as Texas. His personal and professional background provided him with an important level of insider knowledge about Latinos/as/xs' experiences of marginalization and oppression within and beyond U.S. institutions.

The third author is a queer, working-class, Xicana whose scholastic passions center on interrogating systems of power as they relate to Queer, Transexual, Black, Indigenous, and People of Color (QTBIPOC) student experience. Her experiences within a Texas K-12 public school pipeline as one of many racialized students from historically Mexican American, low-income communities inform her ability to recognize, interpret, and theorize oppressive power structures within academia.

As scholars, we acknowledge our own racialized identities and concur on the importance of integrating *teorías mestizas* (Anzaldúa, 1990) in engineering education to "rewrite history using race, class, gender and ethnicity as categories of analysis, theories that cross borders" (p. xxv). Our goal is to problematize how racialization happens in engineering spaces, particularly in spaces that are supposed to create identity-supporting and culturally-affirming spaces for Latinos/as/xs (i.e., HSIs and emerging HSIs). We also acknowledge that academic research is still part of a Westernized epistemology that determines the construction of truth and reason. Through this research, our intent is to challenge the construction of the "other" by presenting the *voces* of the participants that willingly invited us into their spaces as they also see the need to change the dominant narrative in engineering education.

Findings

In this section, we discuss three recurring overarching topics Latino/a engineering students constantly brought to our attention: (1) their encounters with circulating stereotypes of Latinos/as/xs; (2) the impact of the notorious lack of representation of Latinos/as/xs in their engineering departments; and (3) their experiences with racial discrimination in engineering spaces.

Circulating racial stereotypes of Latinos/as/xs

Data showed that Latino/a/x engineering students have been exposed to an array of stereotypes within and beyond engineering spaces. Some of these stereotypes frame Latinos/as/xs as engaging mostly in menial work (e.g., landscaping), as largely absent from engineering/academic spaces, or as consciously choosing "easier kinds of engineering." Other stereotypes encountered by the participants questioned altogether the character and intellectual abilities of Latinos/as/xs who occupy engineering spaces, as we discuss here.

Gerardo – a Mexican American, first generation, mechanical engineering student – broached the subject of the stereotypes that exist about Latinos/as/xs and menial labor. As Gerardo recounted, his father is a small business owner who operates a landscape company. Over the holidays and during his summer breaks, Gerardo helps his father complete landscaping jobs back home, which he believes helps him burn off stress from the semester and gives him time to catch up on life with his father. He described the frequency with which customers evade, delay, or haggle the cost of their bill for landscaping services rendered, which he associated with a deep-seated practice of undervaluing Latino/a/x blue-collar labor. Specifically, Gerardo reported that certain assumptions about race and class in connection to Latinos/as/xs have emerged through his interactions with his father's clients. To further illustrate, he narrated an incident in which his father's white client was shocked to learn that landscaping was not Gerardo's primary or only occupation but that he is rather a full-time engineering student:

> [I]t's happened where my dad will have conversations with them [white affluent clients]. "Oh, is that your boy? Is this all he does?" And my dad would be like, "Oh, he's actually studying for mechanical engineering" And they'll be surprised, "Oh, really?"

Gerado was not the only engineering student grappling with stereotypes about Latinos/as/xs. For instance, Carlos – a Mexican, first-generation, electrical engineering student – shared his experience while apartment hunting during his internship in an affluent area in California. As he narrated, the Vietnamese landlord with whom he was speaking inquired about why he was looking to rent a room. When Carlos disclosed that he was a college student at the nearby university, she said: *"that's so rare that Latinos go to school and go to college."* The majority of the participants described similar experiences encountering low expectations set for Latinos/as/xs, to the extent of becoming internalized. For example, Nuria – a Mexican, first generation, computer science student – explicated how this low-bar expectation emerged in her own home. She remarked, "*[it was] not very expected of me [by my mother] to want to do computer science."* In fact, her mother wanted Nuria to follow in her footsteps and become an elementary school teacher. Although Nuria received a lot of emotional support from her mother, she has often detected a hint of doubt in her mother's words of encouragement, *"if it ever gets too hard, just know that we don't expect you to be in college or anything."*

In addition to the stereotype that Latinos/as/xs do not go to college or do not major in engineering, some participants themselves seemed to have internalized the stereotype that Latino/a/x students naturally gravitate toward one type of engineering, which was frequently described as the easy path or the path of least resistance in engineering. Alberto – a Latino, first generation, mechanical engineering student – observed that there is an underrepresentation of Latinos/as/xs in mechanical engineering. He rationalized the gap in his program as

a matter of choice, where civil engineering is a more popular field among Latino/a/x students because *"it seems easier"* and because *"they [Latinos/as/xs] came from the industry of construction."* Alberto's assumption may stem from a hyper-representation of Latino/a/x laborers in the construction industry, and the predominance of white engineers in mainstream media, as was pointed out by Leo – a Mexican American, first generation, mechanical engineering student. Leo, as many other participants, indicated that Latino/a/x parents typically worked in blue-collar spaces, including construction. When he was asked to visualize what an engineer looks like, Leo stated that he envisions a *"white person"* in *"khakis and this collared shirt"* but not usually a *"Hispanic person."* When asked to explain his interpretation, Leo attributed it to his exposure to popular cultural representations of white men as inventors and professionals but Latinos/as/xs as blue-collar workers.

While having a *plática* about the clothing of engineers and what that meant in terms of being recognized in the world of engineering, Leo mentioned that probably wearing clothes used in a formal Mexican American space—like wearing a *vaquero* suit and a *sombrero* to a *quinceañera*—to an engineering workplace would not be acceptable. During the conversation, Leo explained that Mexican American clothing would probably not be accepted in engineering, regardless of how formal it was. Further probing Leo's stereotypes of the *white male engineer*, he was asked if he could see himself wearing a *sombrero* [Mexican *vaquero* hat] in engineering spaces just like his father does when he attends formal events. Leo hypothesized that he would not initially wear a *vaquero* hat because it would be considered odd and informal. Other participants also referred to how uncommon Mexican traditional attire is in higher education spaces. For example, Carlos pointed out his girlfriend's *"Latino graduation,"* which he described as *"cool," "different," "more familiar,"* and *"like a little fiesta."* As a matter of fact, attending her graduation ceremony opened Carlos's eyes to the existence of different types of ceremonies held for different minoritized communities, noting that his graduation followed an upper-class, Eurocentric style, he described as *"a lot more formal and a lot more professional."* These descriptions suggest the ways in which even clothing – although an essential part of cultural identity – could reinforce a negative stereotype (i.e., informality) in engineering spaces.

Participants also reported encountering stereotypes of Latinos/as/xs in terms of inherent attributes never suspected of white individuals. According to Elena – a Latina, first generation, biomedical engineering student – interactions with non-Latino/a/x classmates can go one of two ways: *"they think you're very dumb, or they think they can make you do all the work [. . .] because they know, like, we're trying to prove ourselves so we can do our work and everything."* The negative stereotype of Latinos/as/xs as *"dumb"* seems to affect students' perceptions of themselves and their interactions with faculty/mentors. For instance, Santi – a Honduran American, first generation, materials engineering student – confessed he is constantly worried that his mentor might see his work *"as dumb as crap,"* which he believes could reinforce an existing assumption that *"all Latinos are stupid and [that] we can't do this"*.

Participants also reported they have developed a sense that they need to prove themselves from their interactions with engineering professors who may ascribe to similar assumptions on race. A case in point was Carlos's account of an exchange with an engineering professor, which whom he attempted to develop rapport. In his attempt to establish some kind of relationship, Carlos asked his professor about his interests in industry-related materials and technologies, which he did not take well. Carlos perceived the immediate rejection and scrutiny from the professor: *"he took a step back, he looked at me up and down, and said, like, 'these are weird questions'"*. The professor's reaction surprised Carlos because he noticed that the professor was comfortably answering the same questions for other students who appeared be other cultural and ethnic backgrounds. According to Carlos, the adverse interaction caused him to suddenly become hyperaware that his professor took visual note of his tattoo and his informal attire that resembled streetwear complete with *"Jordan shoes, mid-rise socks, and just a plain white shirt"*.

Lack of representation of Latinos/as/xs in engineering

In their discussions of racial biases and discrimination they have confronted in engineering, the participants did not only reference negative stereotypes of Latinos/as/xs circulating in higher education and society more broadly. In fact, in discussing their experiences, participants also gave prominence to the evident underrepresentation of Latinos/as/xs in engineering even at these HSIs and emerging HSIs. More importantly, participants also reflected upon the ways said underrepresentation impacted their experiences and trajectories.

As Santi put it, *"I've always been the only Latino in all my classes [.] even in the lab, I don't see any Latinos. Again, it's a lot of Asian researchers, Asian Americans, white people, but I don't see other Latinos."* All participants noted the absence of not only Latino/a/x students but Latino/a/x faculty as well. For example, Lara – a Mexican American, first generation, environmental engineering student – expounded that she has never seen Latino/a/x faculty in engineering, except for a teaching assistant she had for one of her classes. She also stated that in her experience, she has seen more Latino/a/x faculty in the education department. Participants stated that this visible lack of representation of Latino/a/x students and faculty in their programs had detrimentally impacted their experiences in engineering.

For some participants, not seeing Latino/a/x students and faculty has created a hovering pressure to continually demonstrate to non-Latino/a/x peers, mentors and other faculty that they deserve the space they occupy within their engineering program. For instance, Santi explained that the lack of Latino/a/x student representation in his program made him feel tokenized and obligated to *"really do a good job,"* to show that *"he is the real deal"* and not *"just an insignificant worker."* Participants even referenced the ways this pressure to have to show that they have what it takes to become engineers has impacted their willingness to seek help from peers and professors within and beyond the classroom. For example, Larissa – a Mexican, first generation, computer science student – expressed a reluctance to ask questions in class because she is grappling with the feeling that she must exceed her classmates' expectations of her: *"I would feel like people would see [me], 'oh, of course she needs help.'"* In the face of the little representation of Latinos/as/xs in engineering programs, when one Latino/a/x student fails, Carlos feels as though their entire community fails: *"You know, I feel like I'm not speaking for myself, but I'm speaking for the community."*

For other participants, this lack of diversity has isolating effects. Specifically, Larissa expressed that for a Latina engineering student in a *"white dominated field [. . .] it can be lonely."* She explained that in the absence of representation of Latinos/as/xs in her engineering department, she has built her own support system by relying on friends she has made throughout her engineering trajectory. Relatedly, Lara noted that the scarcity of Latinos/as/xs in her engineering department creates a cultural and linguistic disconnect, where: *"You don't tend to practice a lot of like your culture or your Spanish. So that's like the hard part."* Lara has tried to find other Latinos/as/xs, but she realized that they are scattered on campus, making it difficult to connect to them. Aware of the ways this disconnect can ware away her culture and language, Lara makes it her personal mission to exclusively speak with her siblings in Spanish whenever she visits with family, demonstrating the ways these Latino/a/x engineering students counter the institutional failure to provide a culturally and linguistically sustaining campus life.

Other participants stated that entering white-dominated institutional spaces from the position of a token can be an intimidating experience that could lead to culture shock. For instance, Leo reported that he felt out of sorts upon meeting his classmates face-to-face after a long period of attending online lectures during the COVID-19 pandemic. He attributed this sense of confusion to having discovered that he was the only nonwhite or non-Asian engineering student in the class, which made him question his belonging in the space altogether: *"being the only one Latino or one of the two Latinos there, I'm like, 'Oh, I don't know what I'm doing at times.'"* In similar fashion, Santi expounded that his tokenized position as the only Latino among white and Asian researchers in his laboratory was

intimidating, to the extent that he began to question *"if [he was] able to do engineering"*. Hence, tokenization has blindsided many Latino/a/x engineering students in this study, leading them to doubt whether they truly belong in their programs and the field of engineering at large.

The more these participants discussed their experiences as racial minorities in their departments, the more they engaged in thinking about a different reality. In fact, some students engaged in imagining the benefits of ensuring ethnic parity and equity in their engineering education. For instance, Carlos – who described his engineering program as predominantly white and Asian – explained that having more representation of Latinos/as/xs would create a much-needed sense of *"community or family"* because *"just feeling comfortable in your own environment is really important to your learning."* For Carlos, feeling *"comfortable"* with his peers and professors in his engineering department was key and largely connected to finding people with whom he could connect culturally and ethnoracially. He described the importance of accessing a sense of family/community:

> At school when I meet an engineer that's in the same field as me and comes from the same background, it really creates a connection that we can start off with. It's almost like a foot in the door type of thing to meeting someone when you share that background or like, "hey," like, "oh, your grandma makes beans too".

Carlos' imaginings of ethnic parity point to prospective institutional support that could positively enrich Latinx students' engineering educational experiences and ensure their persistence until graduation. Other participants even brought attention to a paradox where engineering and innovation go hand in hand, but the field has failed to keep pace with the hyper-diversity found in the modern world. Specifically, Jacinto – a Mexican American, second generation, electrical engineering student – characterized his engineering program as *"male and white dominated"* and expressed concern because the absence of Latino/a/x engineering students felt as though *"there's a lot missing in the engineering world"*, which he believes *"comes from diversity."* From his perspective, the predominance of white males in engineering fails to reflect how *"the world is getting more diverse."*

Experiences with racial discrimination in engineering spaces

In addition to the circulating stereotypes of Latinos/as/xs and the little representation of the Latinos/as/xs in engineering, participants also reported experiencing racial discrimination in their daily interactions with non-Latino/a/x mentors, peers, and faculty. These instances of racial discrimination were not only symptomatic of a lack of ethnoracial representation but served to further perpetuate negative stereotypes of Latino/a/x students and existing power structures.

For Elena, racial discrimination in the classroom is not an uncommon occurrence. For example, she narrated that she sometimes overhears conversations among her non-Latino/a/x peers which involve making disparaging remarks and spreading stereotypes about Latinos, namely Mexicans, *"I hear their stories and I hear like [. . .] 'oh, those, those Mexicans [. . .] they will be car mechanics,' and those classic stereotypes of the plumbers and the mechanics kind of thing."* Elena has also encountered further instances of racial hostility directed toward Latinos/as/xs. In one of her pláticas, Elena described several interactions with a peer she characterized as an unabashed *"white supremacist."* According to her, this white student would sit next to her in class and openly speak derogatively about immigrants, Latinos, trans people, and LGBTQ+ individuals. Adding to Elena's cause for alarm was the student's remarks about his love of firearms and *"shooting at stuff."* Elena expressed that she associated racist, pro-gun people with belligerence and violence, which caused her to fear for her safety to the extent that she did not want to openly oppose his views or physically remove herself from the interactions. Adding to the dismay, the student additionally remarked that he had a dating preference for Latinas, which made her feel even more uncomfortable and objectified.

Some instances of racial discrimination were more direct and palatable. Santi recounted racial hostility toward him as the only Latino in his research laboratory. As he described, during his freshman year, he joined a laboratory, within which a white doctoral student served as his mentor.

However, rather than supporting him in developing research skills, this doctoral student disparaged him and questioned his skills and belonging in the laboratory altogether:

> The first time I ever joined a research lab on campus was a lab that was doing 3D printing of skin and tissue, which I thought was really cool. And the PhD student, or someone in the PhD program was kind of like my mentor. And he was very demeaning. A lot of times he would say my data is crap. One time I remember, he sat me down, pulled out a notepad and a pencil and he put it in front of me. He's like, "show me you can actually do this calculation" of like a mole or concentration! "Show me that you can actually do this because I don't think you can!" . . . Eventually after two months I quit the lab because it was just not good for me. And I did a lot of work on the project. I stayed up in the lab. I would stay up in the lab until 3:00 a.m. sometimes because I wanted to prove myself, I wanted to prove "no I am not dumb, I can do this. I am gonna do a good job and you will see, you'll see that I can actually do this, I am not what you think I am." But because of that first experience I feel a lot of pressure because people may think that I am the representation of all Latinos because there are not many of us.

Santi did not report this encounter to his Principal Investigator because he had no rapport with anyone other than the research assistant. This incident deeply impacted Santi's perceptions of attitudes toward Latinos/as/xs in his engineering department. In addition, even though the incident occurred early in his academic trajectory (freshman year), it left a lasting impression on his perceptions of his own skills: *"I was always scared of, like, coming into lab [. . .] I'm not cut out for this. Maybe I'm just not intelligent or something."* Although Santi has not experienced additional racial discrimination since then, he recently reported that he has never been able to connect to his laboratory mates nor has he received proper mentoring. From his perspective, the hostility directed toward him was a consequence of underrepresentation of Latinos/as/xs in engineering which led him to seek opportunities to work under the supervision of a Latino researcher at a different university for his graduate degree.

In other instances, participants found themselves the target of racial discrimination just before starting their first semester. For example, Lena – a Hispanic, first generation, structural engineering student – reported hostility directed toward her during the Summer Institute she completed prior to starting her engineering major. As part of the Institute, she was paired with a group of male students who openly ridiculed her gender, ethnicity, and accent. She recalled that the experience *"was challenging because it was my first year and I didn't feel like I had support in that sense. I had to really step out of my own self and defend myself because, 'who am I going to tell here?'"* Not having the coding experience to participate in the design portion of the project assigned during the Institute, she opted to draft the group's presentation. As a bilingual speaker, Lena switched between languages as she was working toward the finished product. The male students in her group read over her unfinished work and collectively engaged in disparaging her writing: *"And then they were like, 'Oh, like, have you even taken English?' Like, 'this doesn't sound right!' Like, 'did you even pass your AP classes?'"* She later reported the incident to her mentor, but to her surprise, the mentor only asked that the male students apologize to her. They excused their behavior as customary for "boys." However, Lena explained that the male students frequently made rude remarks, which contradicted her classmates' excuse.

For some participants, racial discrimination surfaced during their interactions with their professors. For instance, prior to coming to college, Nuria had four years of coding experience, which she thought would give her a head start in her first computer science class with Dr. Thompson (pseudonym). While Nuria in fact completed that first class successfully with high marks, she had to endure discrimination that rendered her presence and coding skills invisible. On one occasion, Dr. Thompson asked students to help him identify a coding error he had made on the board. Aware of the error, Nuria volunteered her answer, but it went unacknowledged though she recalled that she was sitting at the front of the class and locked eyes with Dr. Thompson moments before she spoke.

> I just started speaking and like, he looked at me and then he turned the other way, and he picked on like one of his other favorite students. And then he was like, 'Oh, Devin, like, yes, what's the error?' And then Devin [a white, male student] like said the exact same thing as I said. Yeah. And then Dr. Thompson was like, 'Oh great! Thank you!'

Not knowing if the professor was purposefully ignoring her, Nuria opted to sit in the front row to ensure she could be seen, but the situation remained unchanged. And therefore, from Nuria's

perspective, this was not an isolated incident but rather just an illustration of how Dr. Thompson frequently disregarded her in favor of her white peers. According to Nuria, Dr. Thompson had prior knowledge of her coding experience because she disclosed it to him in a preliminary course survey he designed, which made her more confident that she was simply being ignored.

Discussion

The results from this analysis demonstrate that Latino/a/x engineering students are often faced with situations that create barriers in their pathways to and through engineering, which can be described as forms of *arrebatos* (Anzaldúa, 1987). Latino/a/x constantly – and historically – experience stereotypes about who they are and who they are supposed to be, which is often exacerbated in engineering spaces. The argument that racialization is a Black/White issue is also demystified by the participants' accounts. Donato and Hanson (2012) have argued that differential education (Menchaca, 1997; San Miguel, 1999) for Mexican and Mexican Americans in the U.S. Southwest (where the institution of higher education for this study are located) emerged from a segregationist effort to maintain Mexicans and Mexican Americans away from schools. Americans continue to believe that school segregation is a Black/White issue without critically analyzing the history of segregation that Mexicans and Mexican Americans faced for being "legally" considered white but socially recognized as nonwhite (Donato & Hanson, 2012). Educators often invoked the power granted to them by administrators to adapt programs for Mexicans and Mexican Americans as they saw fit, which often meant implementing programming and curricular changes (in the name of pedagogical benefit) to justify differential education, tracking, and vocational education (Blanton, 2003; Gonzalez, 2013). It is this historical legacy that is illustrated in the participants' narratives that continues to be present in the education of Latino/a/x engineering students. Similar actions (derived from deficit ideologies) taken by faculty and administrators are described by the participants in this study, which often take the form of pushing students to take "easier" courses (Foor & Walden, 2009) or change majors under the premise that such route will benefit the student – without realizing that it also means encouraging differential education.

The participants' accounts also provide an insider's perspective to what racialization looks like in spaces that are meant to offer culturally-affirming environments, such as HSIs and emerging HSIs. We recognize that engineering is in and of itself a microcosm (Godfrey & Parker, 2010) within the institution; however, we argue that the racialized discourses participants described are both created and emulated as part of the whole institution. For instance, the participants mentioned the constant scrutiny they are faced with faculty and administrators as they try to navigate their own engineering pathway. Often, these encounters take the form of subtle and overt marginalization, including perceptions that Latinos/as/xs do not do engineering or do not go to college. There are also expectations about Latinos/as/xs to perform in ways that are normative to engineering, such as dressing, talking, behaving, and believing in specific ways (Faulkner, 2007; Foor et al., 2007; Godfrey & Parker, 2010; Pawley, 2009; 2012). In addition, participants mentioned how these racializations often emerge in the form of low expectations and the frequent questioning of the capabilities of Latinos/as/xs, reflecting the historical racialization of Latinos/as/xs as incapable of pursuing education, inadequate for schooling, lazy, and unable to adapt (Menchaca, 1997; San Miguel, 1999; San Miguel & Valencia, 1998; Valencia, 1997, 2010a).

This study also demonstrates that deficit ideologies are the primary source of *arrebatos* (Anzaldúa, 1987) in Latino/a/x engineering students' engineering trajectories. Deficit ideologies have contributed to this historical racialization where Latinos/as/xs are positioned only in relation to their ability to generate "outcomes" (San Miguel, 1999). Under the banner of Americanization, tracking, and vocational schooling (MacDonald, 2004; San Miguel, 1999), education in the U.S. Southwest became the means to maintain a capitalist structure under the disguise of modernization, and it continues to be embraced in engineering education programs. As indicated by participants' accounts, Americanization has become the vehicle through which engineering has endorsed assimilation for Latinos/as/xs in the name of modernization, especially because their culture, language, practices and

traditions are perceived as an obstacle to modernization (Gonzalez, 2013). Thus, as the participants indicate, there is an emphasis from engineering faculty, students and staff on ensuring that Latino/a/x students reject their own forms of knowing, doing, and being when entering engineering spaces while embracing a meritocratic ideology and negating systemic oppression.

Finally, participants' experiences also highlight the importance of culturally-affirming spaces, particularly at HSIs and emerging HSIs. The study shows that deficit ideologies manifest in engineering in different ways and that they can go unchallenged. This uncritical acceptance of schooling practices can have long-lasting impacts for the future generation of Latino/a/x engineers where their identity is questioned, their communities and households are positioned as inadequate, and their success is scrutinized. Ideologies of race and power are always intertwined (Flores & Rosa, 2015; Rosa & Flores, 2017), and they constitute the foundation of the hierarchical structures we (re)create in engineering education; that is, who belongs and who does not belong in engineering.

Final thoughts

Unfortunately, the deficit ideologies about Latinos/as/xs' motivation to go to and persist in school is prominent in US society (Valencia, 1997), which has also led to the internalization of raced stereotypes about Latinos/as/xs. Underrepresentation of Latinos/as/xs in engineering has maintained the status quo of whiteness and Eurocentrism as the institutional default for standards governing dress, decorum, and curriculum. Racialization of Latinos/as/xs in engineering education will continue as the policies and programming changes are made in the name of the pursuit of "benign pedagogical decisions" (Donato & Hanson, 2012, p. 206) without acknowledging the voices of those it is meant to support.

A historical perspective on the education of Latinos/as/xs is important if we want to dismantle the dominant narratives in engineering. We cannot continue to embrace the idea that Latinos'/as'/xs' cultures constitute destabilizing forces for the purpose of progress and development. Engineering programs at HSIs and emerging HSIs can begin to serve their students by stopping stripping away their language and seemingly "undesirable" cultures. Our pedagogical practices, curricular decisions, and programmatic adjustments need to carefully consider what they are meant to do. We must stop presenting what we do as something that is done for the "benefit" of the students while also doing it in a patronizing way. In the end, as engineering educators we were (and still are) part of a system that taught us to engage in practices for the benefit of others. It may be important to think more deeply and critically about how everything we know is also part of the same system of Americanization that has been institutionalized (and that is still been present today) through schooling. As Gonzalez (2013) argued, teachers learned about how to Americanize Mexican American students in the U.S. Southwest, and the classroom itself became a place for ensuring Americanization where children were asked to emulate "desirable behaviors" while calling out and ridiculing those that engaged in their own traditions, linguistic practices, and cultures. This is a call to engineering educators and researchers, as well as HSIs and emerging HSIs, to promote more culturally-affirming spaces and reject racialized ideologies about Latinos/as/xs while truly serving students.

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