Unraveling Intersecting Hispanic and Latiné Engineering Student Identities to Understand Sense of Belonging at a Hispanic Serving Institution

Melissa Lepe, University of California, Irvine

Melissa Lepe is a Ph.D. student at the University of California-Irvine. Her research interests include aircraft sustainability, aeroacoustics, and engineering education. Through her work at the UCI Aircraft Systems Laboratory and the STREAM Laboratory, she has worked on merging her interests in aviation and education to promote inclusivity, equity, and diversity in the aerospace field.

Spencer Currie, University of California, Irvine
Kevin Jay Kaufman-Ortiz, Purdue University/Cornell University

Kevin Jay Kaufman Ortiz holds a B.S. and M.S. in Industrial Engineering from the University of Puerto Rico Mayagüez Campus and Purdue University respectively. He is also a licensed mathematics teacher by the Department of Education in Puerto Rico. Kevin is currently a Ph.D. candidate in the School of Engineering Education at Purdue University. His interests center around national identity, engineering culture, acculturation, and inclusion of colonial migrants from the U.S. territories who are looking to pursue engineering careers in the contiguous United States.

Charlie Díaz, University of Pittsburgh

Charlie Diaz is a PhD student studying Higher Education at the University of Pittsburgh. He is a recipient of the K. Leroy Irvis Fellowship. His research interests include minoritized student experiences in Higher Ed, student activism, and the development of inclusive policy and practice in Higher Ed.

Gerard Dorvè-Lewis, University of Pittsburgh

Gerard Dorvè-Lewis (he/him) is a higher education PhD student and scholar at the University of Pittsburgh. His broad research interests include emerging adulthood, diversity, equity, and inclusion in higher education, first-generation college students, Black students, higher education policy, and student success. Prior to beginning his doctoral journey, he worked full-time in student affairs at the University of Florida where he also earned his bachelor's and master's degrees in Family, Youth, and Community Sciences.

Dr. Linda DeAngelo, University of Pittsburgh

Linda DeAngelo is Associate Professor of Higher Education, and Director of Graduate Studies and secondary faculty in the Gender, Sexuality, and Women's Studies Program at the University of Pittsburgh. Dr. DeAngelo studies social stratification, investigating how social inequities are produced, maintained, and interrupted. Currently her scholarship focuses on access to and engagement in faculty mentorship, the pathway into and through graduate education, and gender and race in engineering.

Prof. Natascha Trellinger Buswell, University of California, Irvine

Natascha Trellinger Buswell is an associate professor of teaching in the department of mechanical and aerospace engineering at the University of California, Irvine. She earned her B.S. in aerospace engineering at Syracuse University and her Ph.D. in engineering education at Purdue University. She is particularly interested in inclusive teaching conceptions and methods and graduate level engineering education.

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Melissa Lepe*, Spencer Currie*, Kevin Kaufman Ortiz, Charlie Diaz, Gerard Dorvè-Lewis, Linda DeAngelo, Natascha Buswell

Abstract

The climate in engineering is often thought of as "chilly" for students that are underrepresented in this space. This is further exacerbated by the lack of engineering in K-12 curricula, systemic barriers to entry, and engineering's fast-like nature. Studying the support of Hispanic Serving Institutions (HSI) within students' engineering identity is crucial in understanding how these engineering spaces contribute to students' perceived competency and sense of belonging. HSIs, as defined by Title V of the Higher Education Act, comprise a full-time student body that is at least 25% Hispanic. Despite positive intentions of bolstering diversity on college campuses, the HSI distinction fails to ensure that qualifying universities enact effective methods to support the Hispanic-identifying portion of their student body. In this study, Hispanic and Latiné student experiences in engineering are studied at the University of California-Irvine, an R1 HSI. First year students in various engineering disciplines were interviewed as part of an overarching project titled the UBelong Collaborative project. Follow-up interviews are still being conducted with these students to investigate their perceived sense of belonging throughout their undergraduate experience. This paper will focus on analyzing a subset of the first set of interviews, which were conducted at the start of students' introductory programming course. A qualitative analysis is conducted on nine students who self-identified as Hispanic and/or Latiné and their interviews are analyzed via a thematic analysis. Through this study, students introspect on the identities they deem most important as an engineer. The following are used to gain an understanding of how they draw comparisons with their engineering peers through language, rating of skill sets, and interactions. The intersectionality of their identities is explored by analyzing their engineering successes as well as the biases and barriers they encounter or perceive. Our findings indicate the most influential factors in students' sense of belonging are peer interactions, peer demographics, faculty interactions and identity-based student organizations. Differences among genders also emerged, such that women and non-binary students were more likely than their men peers to identify disparities within engineering, especially among interactions with peers and differences in perceived stereotyping. Latiné students who are not men are more likely to experience the "double bind in higher education", referencing the added challenges that come with navigating multiple underrepresented identities while pursuing engineering. Finally, results indicate mixed perspectives among Hispanic and Latiné students and their perceived support from HSIs. Although belonging to a culturally inclusive community enhances one's college experience, the university itself could certainly implement better ways to support its Hispanic population.

Introduction

In order for the United States to maintain technological growth, it is imperative that gaps in the engineering workforce are filled to meet the needs of all individuals. Due to employment growth and some professionals leaving the engineering profession each year, the United States Bureau of

*The following authors share first authorship.

Labor Statistics estimates that 195,000 engineering and architecture job openings are projected annually [1]. The American Society of Engineering Education (ASEE) reported that in 2023, a little over 134,00 engineering bachelor degrees were awarded with 17.2% of those degrees awarded to minority students [2]. Among the various ethnic groups reported (African American or Black, Hispanic, White, Asian American, American Indian/Alaskan Native, Native Hawaiian/ Other Pacific Islander), Hispanics have seen the largest growth in bachelor degrees awarded from 2010 to 2021, showing a 7.0% to 13.1% increase respectively [2].

The United States engineering field has historically been characterized by a demographic of white men, resulting in an exclusionary environment for students of underrepresented groups and backgrounds [3], [4], [5]. With few K-12 programs offering engineering courses and projects, engineering is characterized as a borderland discipline that faces barriers to entry and retention challenges as a result of its "chilly" engineering environment, especially amongst Latiné engineering students [4].

A key effort focused on boosting Latiné recruitment in universities is the classification of qualifying institutions as Hispanic Serving Institutions (HSIs) per Title V of the 1965 Higher Education Act. American universities qualifying for the HSI title comprise those whose undergraduate student body is at least 25% Hispanic [6]. Contrary to other race or ethnicity-based distinctions awarded to universities, such as the Historically Black College or University (HBCU) distinction, the HSI distinction fails to require or promote any sort of actual support for their Latiné students beyond surface-level demographic requirements in their enrollment [7]. This could potentially lead to the unintended consequence of universities merely admitting Latiné students to use the HSI distinction as an "advertisement" and as a means to acquire additional funding. While the HSI distinction may be based on an enrollment threshold, scholars argue institutions must actively provide support for Latiné students. This can be accomplished by ensuring there exists a campus culture where students can celebrate their culture and bond with other students of similar identities and life experiences, which, in turn, has been shown to foster a greater sense of belonging [8], [9], [10]. With an HSI title and recognition, institutions hold the responsibility to serve the communities it represents.

Sense of Belonging in Engineering

There exists a broad body of literature developed over the past thirty years that examines sense of belonging felt by Latiné and non-Latiné college students in the United States at both HSIs and non-HSIs. One of the first works in this area by Hurtado and Carter in 1997 utilized quantitative analyses to demonstrate that positive peer interaction is a significant predictor of Latiné students' sense of belonging [11]. Additionally, participation in religious or social-community organizations was found to have the highest contributions towards Latiné students' sense of belonging. Participation in other organizations such as fraternities/sororities and student government had a lesser but still notable impact on student sense of belonging [11]. When studying the relationship between ethnic-based organizations and sense of belonging, Hurtado and Carter found that there was no statistical difference in student belonging for students who were members of such organizations compared to those who were not. However, they acknowledged that students who reported racial-ethnic tensions on campus and were members of an ethnic-based organization had relatively higher levels of sense of belonging than students who

were not members. At the time of this study, it was hypothesized that Latiné students faced group cohesion in ethnic-based organizations while also remaining marginalized. While making a first step into understanding minority student sense of belonging, the authors acknowledge that the issue was complex and the relationships between campus climate and cultural identity groups warranted further study [11]. Today, a wider body of research has shown that identity-based (specifically race or ethnicity-based) organizations support minority students' sense of belonging in STEM [5], [12], [13], [14].

In addition to identity-based organizations, a more recent body of literature has expanded on the environmental factors associated with sense of belonging. Hoffman et al. noted that belonging is moderated by empathetic faculty understanding, perceived peer support, perceived isolation, perceived faculty support and comfort, and perceived classroom comfort [15]. More recent analyses from Polmear et al. [12] and Buckley et al. [16], among others, confirm and build upon Hurtado and Carter's [11] predictors of belonging by adding predictors such as major satisfaction, faculty diversity, and demographic similarity to the belonging frameworks they developed. These predictors are utilized to guide our analyses and frameworks.

Sense of Belonging at a HSI

Students' sense of belonging at HSIs within the United States has also been studied in [17], [18], [19], [20]. The examination of students' sense of belonging at HSIs is valuable, demonstrating that students of individual racial and ethnic groups manifest belonging in unique ways [21]. Overall, studies focusing on HSIs reach similar conclusions to those mentioned previously—predictors of belonging include institutional demographic characteristics, faculty perceptions and interactions, and peer interactions. Maestas et al. [19] quantitatively investigated Latiné students' sense of belonging at the University of New Mexico (UNM), an HSI with 35% of overall student enrollment comprising Latiné students (at the time of publication in 2007). Not only does UNM maintain a large Latiné student population, but with only 45% of their student body (at the time of publication in 2007) being White, the institution's demographics constitute a "minority-majority" in which all racial or ethnic minority groups (African-American, Latiné, Asian, Indigenous people, etc.) collectively make up a larger portion of the student body than non-minority students (i.e. White students). Maestas et al. [9] make the important assertion that connectedness to a university is positively influenced by students' interactions with an array of racially and ethnically diverse peers, pointing to the conclusion that HSIs are uniquely poised to produce a greater sense of belonging in their student body due to their increased levels of student diversity. However, the extent to which students' sense of belonging could be improved if HSIs go beyond the basic demographic-based requirement of earning the HSI distinction still warrants further study and is a major focus of this paper.

Barriers Faced by Latiné Engineering Students

Despite rising Latiné enrollment in college and efforts to improve Latiné students' sense of belonging at both HSIs and non-HSIs nationwide, the culture of many engineering programs and the engineering field itself leaves a significant number of Latiné students feeling disconnected from the campus climate and their major. Esquinca, Mein, and Mucino describe how the "hypercompetitiveness" of engineering is a barrier for the development of Latiné students' sense

of belonging in their engineering major at a HSI [18]. This is compounded by systemic educational inequities faced by the Latiné population as they progress through their K-12 education [4]. Furthermore, students in Esquinca et al.'s study felt as though negative pedagogical practices (e.g., instructors making courses extremely difficult to weed out students [22]) also inhibit students' sense of belonging [18]. Our analysis demonstrates that the corollary to this statement appears valid as well: more inclusive and accessible teaching practices help students' sense of belonging grow. Finally, Latinas and non-binary Latiné students experience the "double bind" of not only dealing with the intensity of their major, but negative stereotypes from men peers as well [3]. The heightened sense of isolation felt by Latina and non-binary Latiné students at both HSIs and non-HSIs is well-known and has been reported by various researchers [4], [18], [23], [24].

Research Goals

To build upon the foundation of research demonstrating Latiné engineering students' lack of belonging at HSIs, we aim to examine the extent to which HSIs intentionally work to support the Latiné portion of their engineering student body. In order to gain a deeper understanding of Latiné students' experiences and ideas regarding belonging, we conducted a qualitative study that allowed detailed student accounts to surface. Previous studies have used quantitative measures that do not allow students to express and elaborate fully on specific experiences in higher education [25], [26], [27], [28]. These large-scale analyses are undoubtedly essential in developing a clearer understanding of how universities cultivate belonging in their student body, but they can occasionally lack the nuance and subtleties present in student responses that would otherwise emerge through a qualitative analysis. Furthermore, given the vast heterogeneity of the Latiné engineering population, a qualitative study allows for various viewpoints to be expressed without being aggregated through quantitative analysis.

In this study, we highlight the narratives of nine first-year Latiné engineering students at the University of California-Irvine (a Southern Californian HSI) in order to focus on these subtleties and better understand what this HSI does for its Latiné engineering population's sense of belonging and what could be improved. In hopes of advancing toward a promising solution that elevates Latiné engineering students' sense of belonging, we suggest changes be made at the institution- and department-level. A thematic analysis of semi-structured interview transcripts is conducted in order to achieve this goal. By identifying key changes that could be implemented at this HSI and its school of engineering (consisting of six engineering departments), the institution and school of engineering will be better positioned to support Latiné students' sense of belonging. While this study focuses on students from the University of California-Irvine, the resources and emerging themes discussed can be used to inform other engineering programs across the country.

Note on Terminology

Engineering education researchers continually use different terms to refer to Latin Americans for a variety of valid reasons. When studying this population, tensions between the English, Spanish, and Portuguese languages and histories clash when trying to encompass the population under one umbrella term. The best term to use is that with which participants identify [29]. In the case of

this study, one of our participants identifies as non-binary, making *Latiné* the most appropriate term. Individuals in the LGBTQ+ community deal and cope with unique hostilities in their journeys to becoming engineers [30]. Some scholars are using the term Latin* to encompass all variations of the term but by using *Latiné*, we explicitly recognize that the experiences of non-binary and sexual minority individuals can be different than non-LGBTQ+ individuals in engineering. Although Latin* is a useful all-encompassing term, it does not explicitly push back on recognizing non-binary individuals within the Spanish language. Therefore, throughout the paper, we refer to the interviewees collectively as *Latiné* to maintain gender neutrality.

In addition, we have utilized language that differentiates between interviewees' biological sex (male, female) and their self-reported gender (man, woman, nonbinary). Given that this work attempts to gather insights related to students' self-reported gender identity and not their biological sex, we use terms like "men peers" and "women classmates" throughout this work. However, interviewees may use biological terms including male and female when referring to gender. To maintain integrity with the interviewees' candid responses, we have not altered their language and discuss their responses in the appropriate contexts.

Methods and Approach

To understand the experiences of Latiné engineering students, we examined the transcripts of nine semi-structured interviews. Student participation in this study was voluntary and was limited to students in an introductory engineering programming course at the University of California-Irvine, an R1 HSI. Interviewing students during this course ensured that the participants were relatively new to their engineering major as either transfer students or new college students. The interviews lasted between 30 minutes to one hour depending on the length of student responses. These interviews are part of a larger collection of work, UBelong Collaborative, that analyzes the potential of a novel ecological belonging intervention to improve all engineering students' sense of belonging.

Students who received the UBelong intervention are represented with a "1" in the Cohort column of Table 1, and students in the control group (i.e. who did not receive the UBelong intervention) are indicated with a "0". Interviewee cohorts in the overarching ecological study were not considered during sampling for this paper. Although UBelong Collaborative surveyed and interviewed students from various racial and ethnic backgrounds, this paper will focus on a subset of student interviews who self-identified as Latiné. In the larger scope of the UBelong Collaborative's research goals, students will be interviewed at various "check in" points in their undergraduate engineering trajectory; however, this paper will solely focus on student's first interviews.

Table 1 lists interviewee demographics, referencing each with a pseudonym that has been chosen to maintain anonymity. The demographic data includes self-reported and confirmed (at the time of interview) race/ethnicity, major, domestic status, gender, sexual orientation, and cohort for all nine interview participants. It is important to note that one interviewee, Manuel, self-reported their gender identity as nonbinary. Hence this interviewee will be discussed using gender-neutral terms, including *Latiné* (singular).

Table 1: Interviewee demographics and backgrounds

Interviewee Pseudonym	Race/Ethnicity	Major	Domestic Status	Gender	Sexual Orientation	Cohort
Dolores	Mexican American/Chicano or Mexican	Material Science Eng.	Domestic	W	Bisexual	1
Manuel	East Asian (Japanese), Central American (Salvadorean)	Aero-space Eng.	Domestic	NB	Prefer not to respond	1
Nina	South American (Brazilian)	Aero-space Eng.	International	W	Heterosexual	0
Vincent	Mexican American/Chicano or Mexican	Chem-ical Eng.	Domestic	M	Heterosexual	1
Maria	Mexican American/Chicano or Mexican	Aero-space Eng.	Domestic	W	Bisexual	0
Isabella	Mexican American/Chicano or Mexican	Environ mental Eng.	Domestic	W	Heterosexual	1
Regina	Mexican American/Chicano or Mexican	Mech-anical Eng.	Domestic	W	Heterosexual	1
Luka	Mexican American/Chicano or Mexican, White	Bio-medical Eng.	Domestic	M	Heterosexual	0
Carlos	African American/Black, Puerto Rican, White	Aero-space Eng.	Domestic	M	Heterosexual	1

The analysis focuses on excerpts from these interviews in which Latiné engineering students narrate their personal experiences prior to and during their college experience. The interviewees' testimonies are used to understand the extent to which the HSI and the school of engineering support Latiné engineering students and, in turn, foster their sense of belonging within their engineering major. The interview protocol prompts interviewees to describe the ways that the HSI does or does not support them and how support could be improved. Additionally, students are asked to comment on common identity-based engineering stereotypes and discuss how their

own identities may influence their engineering journey and experiences. Sample interview questions are listed in Table 2. These open-ended questions enabled Latiné students to candidly comment on their own positive or negative experiences.

Table 2. Sample Interview Protocol Questions

Do you see your experience in class so far as potentially different from others because of your own gender, racial, or ethnic identity or the intersection of those identities? In what ways?
Have you ever been told that based on your gender, racial, or ethnicity identities or the intersections of those identities that there would be barriers for you as an engineer?
What does the school of engineering at [HSI] do to create a sense of belonging for you and students who have identities similar to you? What could they do to help you feel more connected? What about at the University overall?

After the completion of the interviews, the nine audio recordings were transcribed and anonymized. The co-first authors developed a preliminary codebook containing codes that were generated deductively and inductively. Deductive codes were selected based on their prevalence in the literature. Examples of the deductive codes used in this analysis are peer interaction, instructor interaction, and faculty diversity. After examining the interview transcripts in the early phases of coding, the inductive codes were generated based on the content of the transcripts. These include recognition by exterior champions and sense of culture. Interviews were coded by co-first authors until an interrater reliability of at least 80% was achieved, a common benchmark utilized in qualitative analysis [31]. During this process, the codebook was iterated upon and finalized. Table 3 lists the final codes utilized during the thematic analysis.

Table 3: Codebook used in thematic analysis of interview transcripts

Codes (identifier)	Description
Identity-based Extracurricular Activities Endorsed by Institution or School of Engineering	Clubs (e.g., Society of Hispanic Professional Engineers), Cultural Events (e.g., Festivals)
Faculty Diversity	Identity-based diversity among engineering faculty members
Recognition by Institution or School of Engineering by External “Champions”	Staff, faculty, or other representatives outside of Latiné community expressing support
Lack of Identity-based Extracurricular Events Endorsed by Institution or School of Engineering	Lack of clubs, events, etc.
Lack of Faculty Diversity	Lack of identity-based diversity among faculty
Lack of Recognition by “Champions”	Lack of support
Peer Demographics	Identity-based similarities or differences among peers within or outside of engineering.
Peer Interactions	Curricular or extracurricular interactions with peers

	within or outside of engineering Interactions may be connected to racial or gender identities.
Instructor Interaction	Interaction with engineering instructors (professors, teaching assistants)
Engagement with Coursework and Major Satisfaction	Enthusiasm and excitement regarding engineering coursework
Familial Relationships and Sense of Culture	Familial and cultural influences in engineering career
Differences in Belonging Between Latinos and Latinas	Latinas expressing an additional barrier in belonging compared to their men Latino peers as a result of gender
Differences in Belonging Between Latiné Students with Varying Degrees of Latiné Heritage	Interviewees express how their sense of belonging is connected or not connected to their Latiné Heritage.

Results

The iterative coding process revealed multiple important themes discussed by the student interviewees that shed light on their sense of belonging at an R1 HSI, their views on the institution's support in their sense of belonging, and how the institution could enhance its support of the Latiné engineering population. These were used to formulate the themes used in the thematic analysis in Table 4.

Table 4: Themes Used in Thematic Analysis

Themes	Corresponding Codes
Peer-based factors that affect belonging	● Peer demographics ● Peer interaction
Faculty-based factors that affect belonging	● Instructor interaction
Intentional action from HSI or School of Engineering that promotes belonging	● Identity-based extracurricular activities endorsed by institution/School of Engineering ● Diverse faculty ● Recognition by institution /School of Engineering outside of Latiné-specific events
Individual-based factors that affect belonging	● Engagement with coursework/major satisfaction ● Familial relationships and sense of culture
Differences among the Latiné community	● Differences between Latino/Latina/Latiné individuals ● Differences among Latiné community regarding physical attributes, familial background/status

In addition to the thematic analysis, the frequency with which the interviewee mentioned or discussed each code was analyzed quantitatively to highlight trends among participants. The total aggregated code frequencies are found in Figure 1.

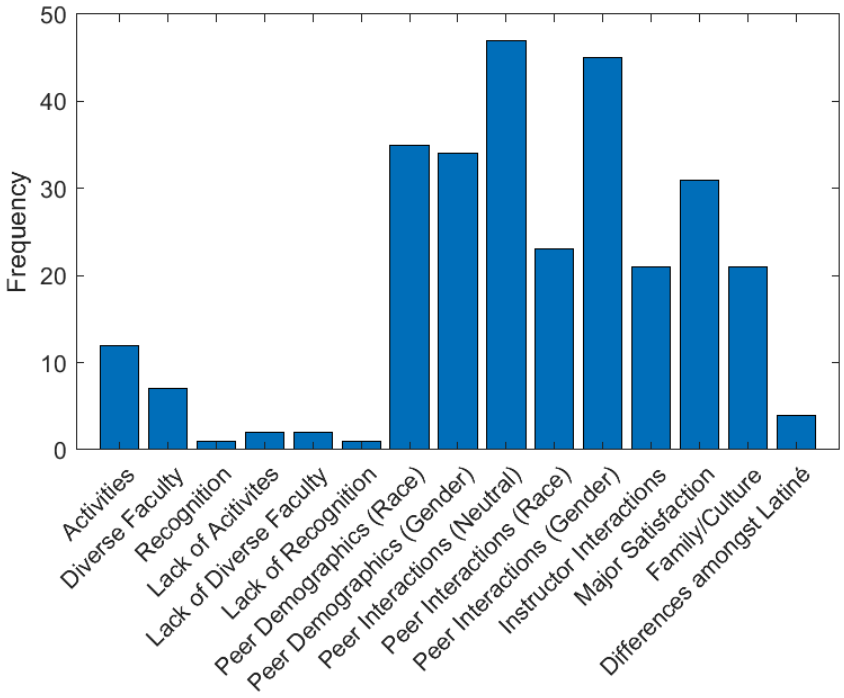

Figure 1: Code frequency across all interviews

To further understand nuances in the data among the participants, code frequencies were disaggregated by treatment (those who received the UBelong intervention) and control (those who did not receive the UBelong intervention). This disaggregation was performed to assess if the UBelong intervention led to any variation among the interviewees' responses as shown in Figure 2.

While the overall success of the ecological UBelong intervention has previously been established [32], it was important to consider how it could have skewed participant's sense of belonging. Overall, it does not appear that membership to either the control or treatment group significantly affected the frequency with which codes were discussed. However, the group that received the ecological treatment had slightly higher frequency across the majority of codes with the exception of faculty diversity and peer interactions. The most notable difference between the control and treatment groups emerged when discussing peer interactions.

In addition to the ecological intervention, differences among gender were considered. The code frequency was disaggregated by gender with men constituting one group and women and non-binary people constituting the other. We acknowledge the problematic nature of including the one self-identified non-binary participant with the women participants when disaggregating. This decision was not intended to be exclusionary or endorse binary thinking. The intention was to look at the majority gender (i.e. men) as opposed to those that are traditionally disempowered or nontraditional in engineering. Given that the number of interviewees in each group was not

equal in our study, the disaggregated code frequencies were normalized by the number of interviewees in each group as shown in Figure 3.

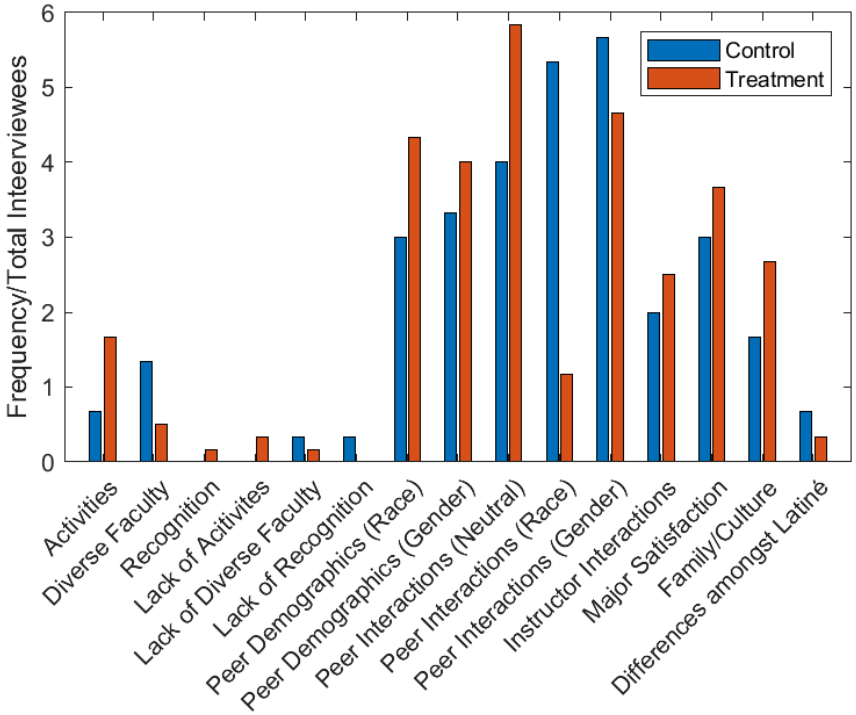

Figure 2: Code frequency by control groups normalized by number of interviewees

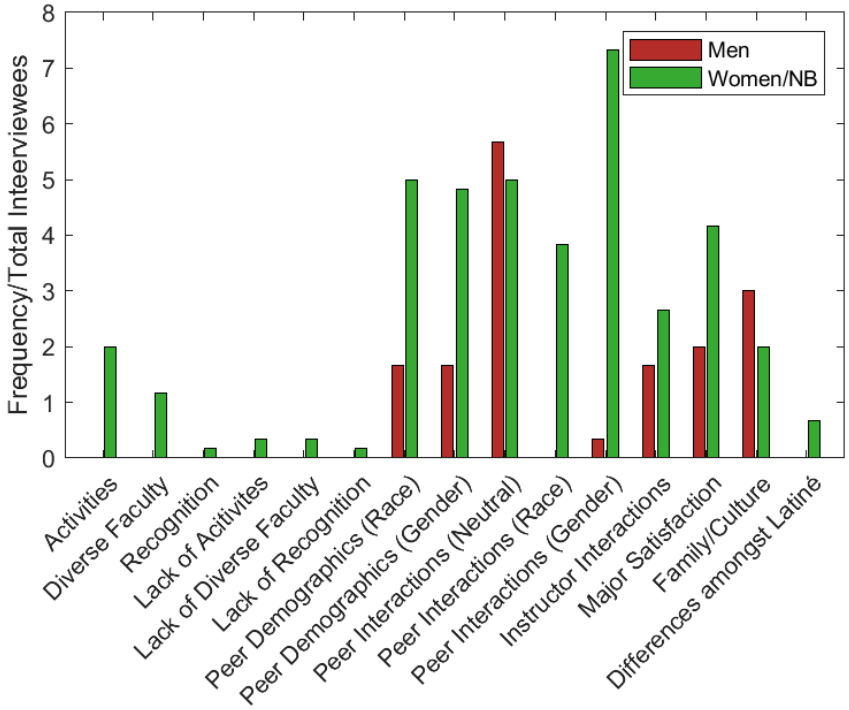

Figure 3: Code frequency by gender normalized by the number of interviewees

It is not surprising to learn that women and non-binary students comment more than men on gender-related topics, such as gendered peer demographics or gendered peer interactions. As mentioned previously, women and non-binary engineering students experience the double bind of engineering education such that their intersectional identity places them in multiple marginalized groups [3]. What is perhaps more surprising, though, is that women and non-binary interviewees appear to discuss almost all codes with greater frequency than the men interviewees. As members of multiple marginalized groups, one could potentially argue that women and non-binary engineering students devote more time and effort seeking support or are more critical of gender and racial-ethnic tensions on campus.

Men, however, did match the frequency with which codes on general peer interactions were discussed. Given that Latino engineering students avoid the double bind as men, their interview responses likely focused more on general peer interaction and less on racial-ethnic and gender-based issues. Nevertheless, this certainly does not indicate that Latinos avoid all hardships and barriers that their women and non-binary counterparts face—as we have discussed, Latinos still face many struggles in their engineering majors.

Discussion

The following discussion section is intended to analyze in more detail the most prevalent themes that emerged from coding the interviews and is informed by the frequency of codes discussed in the results section. After analyzing code frequencies and accounting for differences in treatment and gender, we found that interviewees' sense of belonging was most influenced by their peers, faculty, and the actions - both taken and not taken - by the institution and the school of engineering. Individual-based factors and cultural factors are no less important to Latiné students' sense of belonging, but the scope of this analysis centers on themes that could be improved by direct action taken by the university. As previously stated, these themes were identified from the codes and summarized in Table 4.

Theme 1: Peer-based factors that affect belonging

The codes in Table 4 that fall into this theme include: peer demographics, peer interactions, instructor interactions, major satisfaction and engagement with coursework, familial relationships and sense of culture. The excerpts from the interviewees' responses that correspond to these codes deal with student experiences that naturally occur in the classroom and on campus. They are experiences a student would expect to encounter regardless of any intervention or support from the university or School of Engineering, whether at an HSI or not.

1.1 Demographic Factors: Gender

Almost every interviewee mentioned a gender disparity in their engineering major, regardless of the interviewee's gender and major. Male-presenting interviewees acknowledged the disparity, but did not report any personal barriers that resulted from it. Manuel, a non-binary mechanical engineering major, speaks about the typical experience of a male-presenting engineering student:

"I think there's definitely part of being [perceived as] male that establishes this implicit comradery between other men, and that I can just feel comfortable walking into a room and it being majority male…. I don't have the feeling of walking into a room and being in the minority of a group. So I don't have the feeling of being like, wow, I'm one of 10 girls in the classroom or something, which doesn't seem really to be the case. The gender breakdown does seem to be dispersed, I guess."

As male-presenting students, Manuel and other interviewees recognize the gender disparity in their courses and acknowledge their privileged status of being, or appearing to be, in the gender majority. It should be noted that Manuel has self-described themself as male-presenting during other interviews in the overarching UBelong project. In this excerpt, Manuel comments that peer demographics positively affect one's sense of belonging through the "implicit comradery" shared between people of the same gender or gender presentation. Furthermore, they importantly note that women engineering students do not appear to share this level of implied friendship given the engineering field's skewed gender distribution [33], [34].

1.2 Demographic Factors: Race and Ethnicity

In addition, the significance of peer demographics in belonging extends beyond gender, with racial demographics also influencing how Latiné engineering students' develop a sense of belonging [16], [35]. Maria, a Mexican American woman, reports how she is affected by a lack of peers that share her ethnicity:

"I definitely think about race a lot, my own race because I really don't see any, there's a lack of Hispanic people here, let alone Mexican people. And if they are Hispanic it's more like on the white spectrum, you get me, because anyone could be Hispanic. It is hard to find indigenous Mexican people. And I definitely do feel like it's created an impact on me because I come from a place where it's all that or it's everyone and even my own specific ethnicity race [sic]. So it's kind of hard really adjusting to making friends here."

In her interview, Maria describes how a lack of peers sharing one's identity manifests into a suboptimal sense of belonging. In her case, she does not see many other students with an indigenous Mexican background and consequently has a challenge forming friendships. Coming from a community mostly composed of people sharing her identity, Maria demonstrates she is negatively affected by the bleak representation of others like herself within her major.

The corollary to this is also true in that sharing ethnic identities with one's peers positively contributes to belonging. Dolores, in response to being asked which of her identities she thinks about the most, states how finding peers of her same ethnicity is a positive experience:

"I think just being Mexican or Hispanic because I am in these Latin oriented clubs like SHPE [Society of Hispanic Professional Engineers], so it's nice to find people like the same descent or origin…."

Although this excerpt highlights the positive impact on belonging that stems from sharing one's ethnicity with their peers, it also underlines a crucial barrier faced by Latiné engineering students across the country: instead of being able to find peers of similar ethnicity in their courses, Latiné engineering students must seek out extracurricular methods to find one another. Dolores makes this clear in another excerpt from her interview:

"I think just that the lack of diversity. I think MSE [Material Science Engineering] by itself is already a really, really small cohort, and on top of that, I can almost guarantee I'm the only, if not one of three or four that are women and Latina in MSE."

Despite the positive decision to join others of her racial and ethnic identity through SHPE, Dolores is still very aware of the gender and racial and ethnic disparities present in her major.

1.3 Peer Interaction-Based Factors: Race and Ethnicity

Race and ethnicity are critical aspects of Latiné engineering students' identity. Interactions with one's peers that either honor or disparage one's race and ethnicity have powerful ramifications on Latiné engineering students' sense of belonging. Peer interactions greatly vary between Latiné engineering students, perhaps due to one's personal opinions or the off-chance encounters in which some students interact with peers that are more or less tolerant. By examining Latiné engineering students' reactions to peer interactions, we can begin to distinguish what supports and what hinders one's sense of belonging.

Negative race and ethnicity-focused peer interactions are damaging to Latiné engineering students' sense of belonging. These often come in the form of microaggressions. Regina, a Mexican American woman, noted in her interview that her peers have referred to her hometown as "gangster," "ghetto," and "hard". When elaborating on how these microaggressions affect how she interacts with her peers, she states that:

"It's not really difficult. It's more of like, okay, let's get past this now I get it. You want me to, don't expect me to play into that stereotype. I'm not going to indulge this. So I just tend to shut it down right there."

Regina asserts that she has gained the strength to look past these negative interactions and to prevent them from deeply affecting her. However, these comments are all too common among the Latiné engineering student body, and not all students have the fortitude to brush them off.

When Latiné engineering students do have the chance to interact with peers that share their race and ethnicity, students exhibit increased feelings of support. Due to the racial and ethnic disparity of Latiné students in engineering, these types of interactions often take place in racial and ethnic student organizations or professional societies. However, positive peer interactions are certainly not limited to interactions with those sharing one's racial or ethnic identity.

1.4 Peer Interaction-Based Factors: Gender

Among the peer-interactions discussed, gender played a critical role in how peers interacted with and perceived their fellow students. The women interviewees noted more negative reactions than their men counterparts attributing this to differences in gender and or perceived gender. Amongst the interviewees, women Latiné students' reactions to interactions with men peers are varied. Nina, a Brazilian woman enrolled at this HSI as an international student, states:

"I feel like if I have a question and I'm going to ask a boy, one of my classmates about it, they're going to think that I have an interest in them. So that's why I prefer asking my TAs or the professor, I know we are in a group and we should help each other, but I dunno how to approach to them [sic] and really help each other without, they're thinking that I want to, something else. That's hard. I dunno, it seems weird, but that's how I feel."

Nina describes one of the many ways in which women Latiné engineering students can be made to feel like they do not belong in their major. In her case, she worries that simply asking her men classmates a question about course material will incorrectly communicate that she is romantically interested in them. As Nina goes on to mention, this ultimately results in apprehension when approaching her men classmates, even when in an assigned small-group setting. While she seeks help from teaching assistants and the professors, given the importance of positive peer interaction in forming a sense of belonging, it is likely that these uncomfortable interactions are prohibiting Nina from experiencing an ideal sense of belonging.
Certainly, Latiné engineering students' sentiments regarding peer interaction vary greatly from person to person given the unique experiences each student encounters at their university. Isabella, a Mexican American woman, summarizes her thoughts on gendered peer interactions in her interview:

"And it's often the girls who are soft spoken and the boys who are more out there and more noticed because they proclaim their work or things in general in that way more. And it's also a thing where I feel many women feel like they have to not speak up or be quiet and that's why that's definitely one thing I've noticed. But for the most part I feel, I feel there's not too much of a difference or too much prejudice or issues with that. More just of an inner thing sometimes that the different genders might face."

She attributes the cause of challenging interactions with men peers to inherent gender differences and she asserts that, "for the most part," she does not face much prejudice because of this. Compared to Nina and other interviewees in the study, Isabella speaks less critically of her interactions with men peers. The exact cause of this is unknown, though it may be due to a lack of negative experiences with men or her own internal thoughts regarding gender. What can still be gleaned from her testimony, though, is that Latiné women in engineering may struggle to feel a strong sense of belonging due to systemic gender barriers and internalized gendered expectations.

Theme 2: Faculty-based factors that affect sense of belonging

Previous research on factors influencing sense of belonging and engagement among university students points to faculty interaction as a significant predictor [36], [37], [38]. This includes Latiné engineering students as well. One could argue that faculty interaction is especially important for fostering belonging among Latiné engineering students, as many of the other factors we have previously described already dampen Latiné students' sense of belonging. Positive faculty interaction has the potential to bolster belonging in other ways such as promoting greater engagement with coursework, which in turn also increases sense of belonging [12]. Likewise, a negative faculty-student relationship can reduce Latiné engineering students' sense of belonging as they navigate a major already riddled with systemic barriers.

Interviewees mentioned both positive and negative interactions with their faculty members. The effects of positive interactions were heightened when the instructor shared parts of the Latiné students' identities. Luka, a Mexican American man, reported times he had negative experiences with professors who were gatekeeping course material and reacted sourly to student questions:

"I've only talked to maybe two of my actual professors in person and they're not the nicest people in the world. The looking down, they're like, oh, you should already have known this versus, I don't know what some people's skill level is. It's just you're there to help. I feel like teachers are there to help us, not just for them to give us problems, to challenge us because I feel like that's what the real world's for is to give us challenges and not help us. But I feel like they're here to help us for the real world. So I feel like they shouldn't be as confrontational or as mean to some students if they don't know the problems."

Continuous negative interactions can communicate to students- especially those in marginalized communities, such as Latiné students- that they do not belong at that school or in that major. These negative interactions may also reduce a student's interest in their major, further diminishing sense of belonging.

On the other hand, positive interactions that were described by the interviewees have the effect of strengthening Latiné engineering students' sense of belonging. Isabella describes how she views her faculty members as supportive, regardless of students' identities:

"I feel that faculty is overall very supportive. No matter what you may look like or where you come from… they give you the same attention as any other student and they help you and they care about you just as much as any other student… they genuinely want to see succeed no matter of your[sic] background or your race or your gender. And often even if you are a minority in the specific major you are in, then they might even encourage you even more just for that reason."

Isabella touches on a very important concept that illustrates how faculty-student interactions influence belonging. Through these interactions, the role of a professor has transformed from

someone teaching students the course material to someone who genuinely cares about their students and wants them to succeed. Professors following this example are bound to help Latiné engineering students develop a stronger sense of belonging. While it is impossible to generalize engineering faculty attitudes on these interviews alone, distinguishing between positive and negative faculty interactions highlights key improvements that could be implemented in the classroom to better support all engineering students.

Theme 3: Intentional action from HSI or School of Engineering that promotes belonging

We have discussed multiple factors that contribute or hinder Latiné engineering students' sense of belonging. The extent to which the HSI takes intentional action to support this population will be examined in the following section. The interviewees' responses regarding this support (or lack thereof) are crucial to identifying ways that universities across the United States, whether HSIs or not, can better support their Latiné engineering students.

The University of California-Irvine employs multiple measures in an attempt to support its Latiné engineering students. Methods of support that arose during interviews include: identity-based extracurricular activities endorsed by the institution or school of engineering, diversity of faculty and instructors (specifically those that share student identities), and recognition of the Latiné engineering student body by external champions.

3.1 Clubs and Other Extracurricular Activities

Interviewees reflected that the most notable form of support from the HSI and its school of engineering was its endorsement of identity-based extracurricular activities. This particular HSI's school of engineering endorses multiple identity-based engineering clubs and societies geared toward its Latiné engineering students, including the Society of Hispanic Professional Engineers (SHPE) and its Latina-specific chapter SHPEtinas, Latinos in Science and Engineering (MAES, formerly the Mexican American Engineering Society), and the Society of Women Engineers (SWE). Regina, a Mexican American woman, explains the benefit of these organizations in her interview:

"There's also a club for engineers. I don't know if you've heard the Society of Hispanic Professional Engineers and there's also Latinos in Engineering and Science. I am a part of those both [sic] clubs. So they do affect me in where I see more of people who have similar experiences or similar tastes like me. So it's nice to have a support, especially since when I first came here I had no support, I didn't know anyone, I was just on my own. So it was nice to see them."

Regina notes how joining clubs like SHPE and MAES helped alleviate her struggles adapting and acclimating to college. As was seen earlier, interacting with and being surrounded by peers sharing one's identity positively contributes to one's sense of belonging [16]. By endorsing these identity-based campus organizations, this HSI is helping to support its Latiné engineering students.

3.2 Faculty Diversity

Instructor diversity is another area in which the institution or school of engineering is able to exercise some level of control. Interviewees' experience with diverse faculty is varied and dependent on department, courses taken, and academic term. As a result, some interviewees had more encounters with diverse faculty than others. However, insight on the effect of faculty diversity on the Latiné engineering student body is gained.

Previous work has demonstrated that compared to their non-Hispanic peers, Latiné students more resolutely seek out role models who speak Spanish, who are from their culture, or who understand their culture [39]. Similarly, when a student experiences a lack of diversity among faculty, it could inadvertently promote the message that students of a particular identity do not succeed in that field. Thus it is important for students to be able to relate to the identities of their professors. In her interview, Regina recounts that hearing her professors speak her native language, Spanish, inspires her and establishes a deeper connection between her and her professors:

> *"You see Professor [redacted] or Professor [redacted] who speaks Spanish and I see all of my professors don't speak Spanish. So when I heard them and I was like, oh my god, you and me we're besties right now. I understand what you're saying when you suddenly speak Spanish randomly. And I'm like, oh wow. So it was very, what's the word? Not nice. It's very wholesome to see those kinds of things happen, especially when you see a person of power, especially someone way above in their field, it's like, oh, I can do that too."*

Interviewees who had not taken a class with a professor who shared their identity (e.g., Latiné, woman) did not necessarily view it as negative or as a sign of suboptimal faculty diversity because they recognized that they were still new to the major and had been taught by only a small sample of engineering faculty.

Faculty diversity is not the only faculty-based factor influencing Latiné students' sense of belonging. It is also important for campus authority figures, including faculty, to recognize that certain groups of students face systemic barriers in STEM. Maria commented on this from the intersectional perspective of a Mexican American woman in engineering:

> *"I think every professor should acknowledge how or every person should acknowledge how women in STEM or just non-binary people in STEM do face a hostile environment and they should make it clear. That's a no-no here."*

Ignoring the existence of systemic barriers for certain groups in engineering campus environments is detrimental and should be avoided in engineering classrooms. Failing to validate the experiences and sentiments of students in these groups reinforces the notion that these barriers should not be discussed. By openly discussing these barriers, faculty communicate to students that these barriers need to be addressed, and students in marginalized groups can recognize that their professors care about their wellbeing.

Implications and Future Research Directions

Despite the insights gained from these nine Latiné engineering student interviews, several limitations are worth noting. Qualitative research studies like this one typically have a low sample size to be able to reach depth and richness during data analysis [40]. While we used qualitative methods to extract rich data about these individuals, we know the Latiné community is not a monolith and displays a significant amount of heterogeneity (e.g. family background and socioeconomic status).

Second, all nine interviews were conducted in California, a state in which the Hispanic and Latiné population is the majority demographic. Because of this, it is possible that our interviewees felt a stronger sense of belonging compared to Latiné students at HSIs in non-Hispanic majority states due to belonging affordances external to the university. It has been noted throughout the literature that geographic proximity to large Latiné communities positively contributes to Latiné student belonging at universities [41].

Finally, all interviewees were in the first year of their engineering major (at the time of this study), possibly leading to lower levels of belonging simply due to the process of acclimating to the university environment. Certainly, many systemic barriers exist in universities and especially in engineering that lead to Latiné student attrition, such as microaggressions and lack of support. This can cause Latiné students to feel suboptimal levels of belonging throughout their education. However, many factors contribute to sense of belonging throughout a student's educational pathway, making it difficult to isolate any specific number of variables in a single study.

There are multiple avenues through which future research could advance the study of Latiné engineering students' sense of belonging. Despite the insights gained from the present analysis, the extent to which a demographic-based HSI criterion guarantees support for Latiné engineering student bodies at these institutions warrants further investigation. Future work could identify HSIs displaying various degrees of Latiné support and collect qualitative and quantitative data from these student bodies in order to assess how students respond to varied levels of institutional support. This could potentially uncover a "critical" amount and/or type of support that could be incorporated into the HSI designation requirements. In recent years, peer-based and faculty-based mentorship initiatives at various HSIs have been founded to support Latiné engineering students [42], [43]. Qualitative studies with participants in these initiatives will likely uncover more insight into how the Latiné engineering community can be best supported by their institution.

Despite gradual improvement, Latiné engineering students have traditionally been and still are subjected to microaggressions and other systemic barriers in the classroom which diminish their sense of belonging [44], [45], [46]. As seen in our analysis and many other studies, Latiné students respond well when courses are taught by faculty members that share their ethnic identity [16]. Certainly, it is not realistic (nor ethical) to replace all non-Latiné faculty members, but what can be assessed is the pedagogical choices made by Latiné faculty members that appeal to Latiné students. By doing so, non-Latiné faculty members can be trained to develop courses employing these pedagogical choices in an effort to improve Latiné engineering students' sense of

belonging in every engineering course. It is not unrealistic to expect that doing so would increase all students' sense of belonging as well, not just Latiné students.

Conclusion

This qualitative study utilized a thematic analysis to determine how Latiné engineering students describe their sense of belonging at the University of California-Irvine, an R1 HSI in Southern California. The thematic analysis included coding the transcripts of nine interviews with Latiné engineering students that occurred while they were enrolled in an introductory programming course. Furthermore, the analysis revealed multiple ways in which the HSI and its School of Engineering work to support the Latiné engineering student population. The interviewees' responses provided valuable insight into the efficacy of these support methods and illuminated ways in which they could be improved. Collectively, the interviewees affirm the effectiveness of identity-based extracurricular activities and faculty diversity. However, enhanced faculty training would provide all instructors the tools needed to design engineering courses that accept and encourage the unique experiences of their Latiné engineering students.

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