

Board 90: Latinx Persistence In and Beyond the Degree: Intersections of Gender and Ethnicity (Research)

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Latinx Persistence in and Beyond the Degree: Intersections of Gender and Ethnicity

Hispanic-serving institutions [HSIs], which enroll almost half of Hispanic students attending college [1], HSIs represent less than 6% of postsecondary institutions in the U.S. If STEM educators are to successfully broaden participation of Hispanics in STEM, it is imperative to understand the role these institutions play and their potential to broaden participation of Hispanics (hereafter referred to as Latinx) in STEM. Equally important is understanding the challenges, barriers, or hurdles Latinx students face in seeking STEM degrees at HSIs, particularly in engineering and computer science.

To that end, an interdisciplinary research team is currently conducting a study on (1) persistence of Latinx engineering and computer science (hereafter referred to as engineering) undergraduates and (2) factors contributing to their successful trajectories beyond graduation. In particular, the focus is on the intersecting factors of gender, socio-economic status [SES], national origin, and language, and its impact on Latinx persistence in engineering. In our study, persistence is defined as both completion of an engineering undergraduate program and staying in the field for one year following graduation.

Few studies examine persistence beyond graduation, and, because almost half of engineering degree holders do not enter engineering occupations [2], we studied participants during a critical juncture in their trajectory — the last year of their studies and the first year of their professional lives — to better understand this phenomenon. Thus, the research is expected to contribute to the extant knowledge base on Latinx’ positionality in engineering capstone courses as they form teams, seek professional positions in the workplace, and/or make decisions to continue on to graduate school during their last year of undergraduate studies.

Further, understanding persistence of Latinx is particularly imperative given that they are the nation’s largest minority group and among its fastest growing populations [3]. As such, this research project will contribute to the national conversation on broadening participation of Latinx. The site of this research investigation is “Border University” (BU), which serves a largely Mexican-origin population in a region of Texas with one of the lowest median incomes [4]. In particular, we focus on the senior capstone course where students work in teams to solve a problem. Our study uses an identity lens to understand Latinx persistence in engineering.

Theoretical Framework and Literature Review

We draw from a sociocultural theory of identity [5] - [7] to understand how Latinx engineering students see their trajectory through engineering studies and how they decide on next steps, whether it be entering the engineering workforce or pursuing graduate school. Briefly, this perspective argues that identities are situated in social and cultural worlds that are populated by social types that members of those worlds recognize as meaningful, i.e., their actions and their use of cultural artifacts such as words, images or texts [8].

Literature over the past decade indicates that developing a sense of identity is a core issue in the study of teaching and learning, generally, and in science education, specifically [9] - [13]. That is, we learn values, language, knowledge and skills situated in everyday practice with others and with artifacts, and what we learn creates a sense of self and identity—who we are for ourselves and in relation to others [14]. As cultural beings, we inherently make sense of our world in unconscious and tacit ways through our interactions with our environment as we engage in authentic and situated activity with other people. In this framework, identities are constructed in social practice and they are in continuous flux, or dynamic, depending on any particular situation, such as whether an individual is in a welcoming environment or in an environment where individuals sense themselves as outsiders.

Persistence is a manifestation of motivation [15]. Most studies of persistence examine graduation rates [16], reporting significant differences in persistence across racial/ ethnic groups. For instance the fact that “Black and Latino undergraduates were significantly less likely to persist in STEM majors than were their White and Asian American counterparts” [17, pp. 556] is often quoted. Similarly, some researchers have reported that “women persist in engineering at approximately the same rates as men, even when disaggregated by race” [18, pp. 182]. These seemingly contradictory statistics would appear to call for a more nuanced understanding of the concept of persistence, namely with an intersectional perspective.

Intersectional Perspectives. In recent years, scholars have turned to intersectional perspectives to examine the simultaneity of gender with race/ ethnicity and SES with the understanding that these factors or constructs are not separate but mutually constitutive [19], [20]. Scholars [18] have recently proposed that to not examine the simultaneity of gender with other constructs from analyses tends to render some women invisible. Women who experience discrimination in different ways “are often positioned in the space where racism or xenophobia, class and gender meet” [21, pp. 17]. Rather than being positioned either as a woman or a person of color, an intersectional framework posits that women of color live “in the interstices of complex subordinate positions on dimensions of race, gender and class” [22, pp. 248]. In contrast, non-intersectional understandings are associated with efforts to address retention and recruitment of women that “disproportionately benefit White women, and programs intended to serve minorities mainly benefit minority males” [23, pp. 176].

Professional Skill Development in Teamwork— Gender Factors. Teamwork is an essential professional skill in engineering [24], and one that is increasingly important in engineering education [25]. In addition, teamwork is a major part of the job, with engineering graduates reporting that 60 to 80% of time is spent on teamwork [26] or even that it is an *essential* competency [27]. Unfortunately, it is also perceived as an area of under-preparation by recent graduates [26].

Women’s experiences in engineering design teams has been the subject of a number of studies, with several studies noting that women’s experiences in teams could potentially “recreate sexist environments already found in the university environment for undergraduate women if they are not properly managed” [28, pp. 82]. Negative experiences in teams (not being

accepted, heard, or respected by her peers) could have significant long-term impacts, i.e., it could be the difference between staying or abandoning engineering after graduation.

During teamwork activities, students negotiate their identities, status, and authenticity. [29] showed that gender is a factor that can potentially impact women's learning experiences in teamwork. One study [30] found that in presentations men were assigned (or chose) to present technical content more than women even in teams where they were the minority. Engineering students' self-presentations are linked to gendered notions of expertise, such as expressed in gendered perceptions of ability [31]. A landmark study [32-33] analyzed the identity work that occurred in engineering project teams, finding that prevailing typologies at the research site impinged on how students positioned each other in study teams. Students drew on these categorizations in their work with each other so that a student who had been pegged as a particular type of engineer had credibility and status not enjoyed by others. Some of the female students studied did not enjoy the status or recognition of being an authentic engineer.

Although studies of gender and teamwork have been instrumental in understanding the experience of women in engineering, the studies presented in the previous section were not conducted at HSIs. Increasingly, scholars have recognized the particular experiences of "the double bind," which is defined as the experiences of women of color or underrepresented minority women, including African Americans, Latinas, and Native Americans in STEM, who are "consistently underrepresented at advanced education and career in most fields relative to White women and men of any color" [23, pp. 173]. A small, but growing, body of literature explores the identity work of women of color in "the double bind." Some researchers have focused on women of color in the workplace [34], in the professoriate [35], in undergraduate studies [36] - [41], and in the transition between college and the workplace [42].

Language as a marker of identity. Spanish/ English bilingualism is "a major component of the US Latino linguistic experience" [46, pp. 380]. Sixty years of research in the sociolinguistic tradition show how social groups use language to mark in-group belonging. For instance, bilinguals have been shown to reserve one of their languages for some domains (education, legal) and the other for other domains (family, friendship). Use of Spanish then can telegraph, for bilinguals, membership in the familiar domain. In-group membership is indexed by language use and shared beliefs [45].

Beliefs about language, language ideologies, have an effect on how people use language. For instance, separating languages into domains is an ideological stance that disparages code switching or mixing. Language use itself [43] can signal ideologies for bilinguals and can also serve to categorize individuals [44]. Language ideologies that accept and value multilingualism and code mixing are known as heteroglossic language ideologies.

The relationship between identity and ethnicity has been analyzed in a large body of literature [48] - [57]. Not all Latinx people are bilingual and many today reject the ideology that they must speak Spanish to be recognized as Latinx. The population in the city in which this study is set, on the U.S.-Mexico border, is more than 80% Mexican origin, and the use of

Spanish can become a shorthand for shared understanding between Mexican Americans and Mexican nationals who may not share a nationality but share a shared cultural heritage and may share ideological stances of belonging as well as a way to signal in-group belonging [47].

Methodology

This is a study of the relationship between identity and persistence among Latinx students. We used ethnographic methods to study interactions in senior capstone design course to understand engineering identities. The overarching research question that guides this study is: How do undergraduate Latina/o students who are enrolled in a senior capstone engineering course understand their identities in the context of completing their studies and their transition to the workforce and/or graduate studies?

BU, a Minority-Serving Institution with over 80% Latinx population, was the ideal setting for a study of Latinx persistence. More than 60% of BU graduates are the first in their families to earn a bachelor's degree, and one-third report a family income of \$20,000 or less. This study focused on undergraduate Latinx students enrolled in senior capstone courses in two majors: Mechanical Engineering and Computer Science (ME and CS). These two majors were selected because of their historically low participation of women compared to other majors at our university. Of the 3,442 students enrolled in undergraduate engineering at BU in 2016, 20.9% were female and 79.9% were Latinx.

Participant selection. All students enrolled in the senior capstone courses for these two majors, ME and CS, were invited to participate in two questionnaires as part of this study. We used purposive sampling to select focal participants. Focal participants were selected based on the following criteria: ethnicity; nationality; gender; and status as first-generation college students. For each of these categories, we sought a distribution mirroring that of BU engineering. Because information about the above categories was only known to the instructor of record, we relied on that faculty member to suggest teams that would fit the desired description. The instructor solicited demographic and scheduling preferences as part of normal instruction. One team was observed during Fall 2017 semester and the other during the Spring 2018 semester.

Data Sources. Data was gathered from questionnaires, in-depth interviews, and participant observation. We used method of deep interviewing, which allows the researcher "to understand the details of people's experience from their point of view" [58, pp. 130]. Seidman's method allowed us to understand the ways individuals interact with social and cultural forces, such as those that are prevalent in organizations where people work and study. We also engaged in participant observation and video-taping of senior capstone courses in both focal majors (i.e., mechanical engineering and computer science). The purpose of participant observation is to capture everyday interactions of our focal participants in real time during teamwork-focused learning situations in the classroom. Long-term immersion and participant-observation in the field enabled us to produce "thick descriptions" [59] of focal participants in order to better understand their identity development within the context of teams. Participant observation also provides a mechanism for triangulating our other data sources, as a way of confirming or

contradicting what participants share in their in-depth interviews. Finally, participant observation helps us gain an understanding of the cultural norms and practices within the senior capstone experience which may facilitate or inhibit Latina/o students' success in engineering.

Data analysis. Although data collection for this study is in progress, we have begun initial coding and focus coding. The research team analyzed interviews and fieldnotes through the inductive process of thematic analysis, using grounded theory analysis procedures. This paper is the product of the first round of focused coding, and it includes all data for the first-year cohorts. Data collection and analysis will continue for latter cohorts.

Findings

In this paper we focus on two ME teams who worked on their senior design projects during the 2017-2019 academic year. Observations and interviews for these ME teams were conducted by the first author. As Table 1 below summarizes, the teams were comparable in a number of respects, sharing the same major and similar team composition (Latinx, at least two women, a mix of US and Mexican K-12 schooling), career aspirations and team objective. One team called itself the High-Achieving Engineers Team (HAE) and the other team called itself the Popular Kids (PK), both pseudonyms. As we show in this paper, the teams had contrasting ideologies toward language and toward gender.

Table 1: Pseudonyms, K-12 education and major

Pseudonym	Team	K-12 schooling	Major	Gender	Language Use (Observed)
Elisa	HAE	Mexico and US	ME	F	Mostly Spanish
Francisco	HAE	Mexico	ME	M	Mostly Spanish
Samantha	HAE	US	ME	F	Spanish and English
Alfonso	HAE	US	ME	M	Spanish and English
Oscar	PK	US	ME	M	English
Adam	PK	US	ME	M	English
Alex	PK	US	ME	M	English
Genesis	PK	Mexico and US	ME	F	Mostly English
Alicia	PK	Mexico	ME	F	Mostly Spanish

Team HAE was formed at the beginning of the Fall 2017 semester by the instructor. Although some of them knew each other from previous classes, it was the first time they had all worked together. Similarly, the professor solicited information in Spring 2018 to form Team PK. However, toward the end of the semester, by interviewing members, the first author found out had influenced the instructor's team building system so that a team of friends could work together in the senior design project. They provided scheduling information so that the

previously-formed team would be able to continue to work together during their last semester. With the exception of Alicia, they had all worked together in previous projects.

Language Use in Teamwork

The teams had significant contrasts regarding their use and ideologies about language, which is significant because ideologies affected team members' sense of belonging in the teams and, consequently, their identity work. Both teams met regularly to work on their capstone projects. These meetings took place during students' own time and in a place of their choosing. Although the topic was academic, the tone of the conversations was often friendly. Even when discussing technical topics, participants engaged with each other in a playful manner. They would sometimes share snacks or meals while they worked. Participants created friendship bonds even to the extent that they occasionally met during their free time, such as going out for drinks. They also communicated via online platforms to set up meetings and to continue discussion of topics related to the project. In addition, they also used online platforms to share entertaining memes or jokes.

Each team selected a main language for team interaction and socialization. Team HAE, which had been formed by the professor and whose members were bilingual, defaulted to use mostly Spanish to socialize with each other and to complete the senior design activities. Like the vast majority of BU students, HAE students knew both languages and used both of them for social and academic purposes. They made sense of this by saying that they used Spanish because there were a lot of Spanish speakers at the university and also because of their shared identity. For instance, Alfonso said that in his engineering classes, Spanish was the language of choice for students. "Most of the students here are of Hispanic descent, so they speak Spanish and then a lot of the students that I work in teams with- some of them are from [Mexico]." Elisa made the connection to cultural values saying, "Spanish is important because of the culture here [...] Because we are all Mexicans; this is our language. We joke around more in Spanish, but in engineering outside of school and outside of here in [BU], it is all in English."

In contrast, team PK, which had worked together for a number of semesters prior to their senior design project, evidently had a strong affinity towards each other based on a number of shared views, one of which was their preference for English. Indeed, their shared ideologies may have been a factor that led them to stick together. While most groups would use Spanish, this group preferred English. In observation of teamwork activities, the only use of Spanish in PK was done in a mocking tone [60], which was remarkable for engineering at BU. With a high concentration of Mexican students, most study sessions and group projects take place in Spanish, according to our participants and as confirmed by a number of studies conducted at Border University [61]. While both teams selected a language to communicate, each team had members for whom the choice could potentially be problematic, as discussed in the next section.

Heteroglossic Language Ideologies

Team HAE used both languages for academic and social purposes with no strict separation of languages into academic or social domains. When they were working together on writing reports, they wrote in English, and they also talked about the content of the writing in Spanish. Their fluid and dynamic use of both languages, including the use of technical terminology, corresponds to bilingual use known as translanguaging [50f]. This bilingual language use encompasses multiple voices and languages within conversation rather than a strict separation of languages, a heteroglossic ideology of language.

Using both languages fluidly was beneficial for team HAE in that they were able to use both languages for academic purposes, such as to write assignments. Translanguaging could expand the potential meanings and understanding available to the team, such as when a word's meaning was discussed in two languages. Another benefit was that students were free to use whichever language best suited them and potentially could create a welcoming teamwork environment. Although Spanish was the default language for social purposes, team members often switched back and forth between languages regardless of topic. For Samantha and Alfonso, who had been educated in the US, and had immigrant parents, this arrangement might have contributed to a sense of belonging and inclusion in the team.

In contrast, team PK separated both languages so that only one language was used notwithstanding the fact that most of the members reported being bilingual. Interactions that took place in only one of the languages (i.e., a monoglossic view of language), precluded the potential benefits mentioned above. Specifically, members who could potentially benefit from using both languages would use only one of their languages. For instance, Alicia and Genesis (both educated in Mexico) might have been able to reap both social and cognitive benefits if translanguaging practices were used in team PK.

Alicia was placed in team PK by the professor months after the rest of the team had already established a strong bond in previous semesters. In an interview, Alicia suggested that she immediately felt unwelcomed in the team. The first thing she noticed that signaled to her she was not welcome was the fact that they didn't speak Spanish, as she mentioned in an interview (translated here).

I mean, I obviously feel more comfortable speaking in Spanish. Could I speak English if I have to? I will do it, if I don't have a choice. But if I have the option of speaking Spanish, I will always take it. And in teams we always speak Spanish and up to now this is the only team where I have to speak English in all my teams at [BU].

Moreover, a monoglossic linguistic environment might have also contributed to an environment in which PK team members did not openly share their immigrant pasts. Namely, both Oscar and Genesis had experiences on the Mexican side of the border, which was not spoken about or acknowledged as part the observed PK team exchanges. Oscar's parents immigrated to the US from the Mexican side of the border and Genesis spent her childhood there. Alicia, who was open about her daily border crossing experiences, also faced jokes about Mexico and Alicia's hometown during teamwork activities. In sum, it seems that team PK's

monoglossic language ideologies and behavior may have reflected a larger trend in perspectives about Mexico and Mexicans in circulation in the US at the time (2017-2018).

Intersections of Gender and Ethnicity

As the findings above show, the choice of language may have signaled to participants a particular language ideology. However, ideologies about language intersected with ideologies about gender in ways that impacted individuals for whom both factors mattered. Namely, the two women in the group, Genesis and Alicia, who had both grown up and been educated in Mexico, faced many challenges in participating in the team.

In team PK, the de facto leader, Oscar, had a strong and dominant personality. A military veteran, Oscar signaled a particular kind of identity during teamwork activities. He often shared his experience with the team and bonded with the other men in the group by discussing topics such as sports, weightlifting, cars, guns and their girlfriends. The other men, in turn, responded with their own stories. Genesis sometimes responded to the discussion of relationships, but for the most part remained quiet when those topics were raised. Alicia never responded to those topics but tried to relate to them by sharing her interest in yoga and exercise.

For Alicia, belonging in engineering was fraught. She told us stories of how her legitimacy in engineering was often questioned by the mostly Latino male students in the engineering program. In response, Alicia often clung to a close female engineering friend during most of her studies.

I feel like all of them thought “Oh, Alicia is not going to make it” [...] I mean, they treated us like “well they are stupid” or I don’t know what. And if we got an 80 in an exam and they got a 60, then it would be “so who did you copy off of?” and I don’t know what. [...] I mean, they didn’t attribute it to things we did. They all think it’s because it was given to us or that we cheated because they can’t accept that a woman beat them, that we were smarter than them in something.

In her senior design project, her and Genesis’ engineering abilities were also questioned. During Group B’s concluding activities, Omar (with the support of the other two men) decided that Alicia and Genesis would be responsible for the least engineering-related tasks. They were asked to design a PowerPoint presentation and poster for the senior engineering design. The rest of the team would be in charge of design and testing the design. The women in team PK were assigned menial tasks despite the fact that they contributed to the design process. In one session, during the final stages of the design challenge, the men and the women of team PK, the women were asked to sit together to work on the design work while the men used software to interpret data and prepare the final design. Once the women finished graphic design work they sat quietly while the men discussed the software. Thus, the women in team PK, who were both bilingual, Mexican-origin Latinas, faced a particularly difficult situation.

One year after graduation, both Alicia and Genesis expressed serious doubts about continuing in engineering. Genesis recently reported that she has left the field of engineering and would pursue creative interests. Alicia has left the field of mechanical engineering and is pursuing a master's degree in environmental engineering. This is a change from her expressed plans at graduation, which were to abandon engineering and pursue a career in the field of fitness.

Discussion

The context of teamwork activities is a venue where participants signal the type of person they wish to be recognized as. Students negotiate their belonging and make bids to be recognized as particular types of engineers by acts such as mentioning or alluding to status signifiers including membership in professional organizations, grades, discussions of internships or personal connections [7] during teamwork sessions. Participants were keenly sensitive to the loaded meanings that bids for identity could take, as can be surmised by the names that groups used to name themselves or the conversations about grades, jobs, organizations and trips that took place on a regular basis during teamwork activities.

As we show in this paper, identity work is built, in part, on the use of language to signal solidarity and in-group membership. Both teams, PK and HAE, used language to achieve that purpose, with the latter signaling heteroglossic ideologies through the use of Spanish and English across domains, as well as translanguaging. For team HAE, composed of a mix of Mexican Americans, recent immigrants, and transnational students, it seemed that both English and Spanish, side-by-side, were needed. In contrast, team PK seemed to espouse monoglossic language ideologies.

This paper also shows how language ideologies intersect with gendered perceptions of ability and notions of expertise. Female members of PK faced what seemed like an emotionally draining situation in which they faced gendered perceptions of ability [30] that relegated them to do menial, non-engineering-related tasks. It is, therefore, not surprising that both of them have seriously considered leaving engineering altogether.

The paper also suggests, however, that alternatives exist within engineering studies at Border University. Team HAE, in which heteroglossic ideologies were prevalent, was led by Elisa, who contributed to creating an inclusive teamwork environment within team HAE. She also seemed to successfully navigate the world of engineering studies at BU. During her last semester, she reported having an internship, graduating with honors, and obtaining a job offer. One year after graduation, Elisa also reported high job satisfaction at her new job in a well-known, out-of-town engineering firm.

Conclusion

To understand the issue of Latinx persistence in engineering, we used a sociocultural perspective to understand how participants' belonging in engineering is mediated by the intersecting factors of ethnicity/ national origin and gender. While some scholarship on Latinx persistence exist, few studies consider the intersections of ethnicity and/or national origin with gender. As noted by recent scholarly efforts [23], it is crucial to understand the lives and experiences studies of women in "the double bind," i.e., impacted by both negative ideologies about gender and ethnicity/ national origin. In that spirit, our study seeks to contribute to that literature.

By contrasting two mechanical engineering teams' practices, we are able to understand some of the factors that might impinge on Latinx students' decisions to pursue engineering careers beyond graduation. This study is set at a crucial juncture in participants' lives—their last semester of college and the transition to the workforce and/or graduate school. We sought to understand Latinx' students', particularly women's, experiences and persistence during this critical juncture.

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