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Becoming La Ingeniera: Examining the Engineering Identity Development of Undergraduate Latina Students

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Keywords

Latina, engineering, identity, qualitative research, postsecondary education, phenomenology

Disciplines

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Comments

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Becoming *la ingeniera*: Examining the engineering identity development of undergraduate Latinas.

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Abstract

Latina students are enrolling in postsecondary education in high numbers, yet their enrollment in engineering fields remains low. Part of the challenge Latina students face is a struggle to develop a strong professional identity as an engineer. Using a phenomenological approach, this study examined the experiences of undergraduate Latina engineering students. Researchers used a four-step process to understand the meaning-making process of identity formation. Latina engineering students developed professional identities through interactions with family members, engagement with identity-based organizations, and in relation to their other identities. Implications include the need to enhance family involvement, provide organizational support, and consider intersecting identities.

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The field of engineering has historically played an important part in innovation, growth, and prosperity in the United States. However, only 4.4 percent of undergraduate degrees in this country are awarded in engineering, compared to European (13%) or Asian countries (23%) (National Academy of Engineering, 2014). The U.S. engineering workforce also lacks diversity, a valuable contributor to development and innovation (National Academy of Engineering, 2014). The United States cannot continue being a world leader in engineering without valuing, engaging, and enhancing outcomes for students from diverse backgrounds (Mack & McDermott, 2014; Mack, Taylor, Cantor, & McDermott, 2014). Therefore, creating and sustaining a pathway for diverse engineering students in higher education must become an important feature of strengthening the U.S. engineering workforce (National Academy of Engineering, 2014).

Disparities in the attainment of engineering degrees among Latina/o/x students has been an area of concern (Camacho & Lord, 2011; Revelo & Baber, 2015; Rincón, 2018) especially as the number of Latina/o/x students in higher education continues to grow (*Excelencia in Education*, 2018). In particular, we focus on these disparities particularly among Latina students who enter higher education at greater rates than before yet have disproportionately lower completion rates and engineering career representation than their peers (*Excelencia in Education*, 2015). Of all Latina graduates with degrees in science, technology, engineering, and mathematics (STEM) disciplines, 57% earned degrees in biological and biomedical sciences, while only 18% earned degrees in engineering or engineering technologies (National Center for Educational Statistics, 2013). From the outset, Latino students are 3.1 times more likely to declare majors in engineering fields and 2.1 times more likely to receive degrees in these fields (Rincón & Lane, 2017). Currently, only 2% of all employed engineers in the United States are Latina women (National Science Foundation, National Center for Science and Engineering Statistics, 2017).

Many factors may contribute to Latina students underrepresentation in engineering programs. For example, prior research has shown that Latina college students have difficulty envisioning themselves as engineers and feeling validated in the engineering community (Camacho & Lord, 2013; Carlone & Johnson, 2007). An inability to identify as an engineer and feel a part of the engineering community severely limits one's potential to persist in an engineering program and transition into industry (Camacho & Lord, 2013).

Engineering identity development, as an analytic lens, has the capacity to examine marginalization and disengagement from and within the engineering community (Carlone & Johnson, 2007). Furthermore, identity development can be used to explore how engineering contexts influence the core identity of Latina undergraduates in these fields and the type of individuals they become as professionals (Cobb, 2004). Therefore, it is imperative that scholars consider the engineering identity development of Latina college students in order to enhance their engineering experiences and encourage an environment that nurtures engineering identity development.

However, examining engineering identity development alone, without considering intersectionality and how this identity interacts with students' other identities (e.g., gender, socioeconomic status, language heritage), may not provide the nuance needed to fully understand the experiences of Latina engineering students. Intersectionality calls for a consideration of how individuals and groups experience spaces differently as a result of their multiple, intersecting identities and how they may be systematically marginalized in nuanced ways (Crenshaw, 1991). By focusing on one identity at a time, scholars neglect other types of identities students bring with them to college and how the interplay of identities impact experience. Through an intersectional lens, scholars can more fully understand how multiple, intersecting identities

influence the engineering identity experiences of Latina students, especially how the racialized and gendered experiences of Latina students come to bear on their engineering identity development.

This phenomenological study examined how Latina undergraduates made meaning of their college experiences and developed engineering identities. Its purpose was to explore how students' formal and informal engineering experiences informed their engineering identity development and how other intersectional identities influenced that development during their college. The following two research questions guided this study:

1. How do Latina undergraduate students in engineering develop their engineering identities during college?
2. How do other intersectional identities influence the development of an engineering identity during college?

Background & Literature

This section reviews the relevant research pertaining to engineering identity development of Latina students in higher education environments. It provides a basis for understanding how Latina engineering students enter into and persist within engineering environments, particularly as individuals who hold historically marginalized gender and racial/ethnic identities. Furthermore, it connects previous scholarship to concepts of role identity theory and intersectionality in order to frame how engineering identities are shaped within higher education.

Identity Development and the Exclusionary Nature of Engineering Environments

Engineering identity refers to how engineering students are incorporated into the larger professional community and how they negotiate their role within that community (Tonso, 2006). Developing an identity may facilitate professional community engagement and goal development

(Burke & Stets, 2009). To become a part of this professional community, students must recognize themselves as engineering-minded individuals and gain a sense of recognition by others of their engineering identity. This identity development process is important because students feel more secure when others, who share a similar identity, validate their self-perceptions of being an engineer (Burke & Stets, 2000; Stets & Burke, 2000).

Engineering identity development allows researchers to analyze student self-perceptions and has been found to be a significant indicator of educational and career persistence (Tonso, 2006, 2007). This process influences student academic and personal development and persistence in engineering disciplines (Matusovich, Streveler, & Miller, 2010; Stevens, O'Connor, Garrison, Jocus, & Amos, 2008). Engineering identity allows students to build and maintain a sense of belonging and community within this context (Tonso, 2006b). In addition, research has shown that college engineering students who identify as engineers are more likely to persist within engineering than students who do not (Pierrakos, Beam, Constantz, Johri, & Anderson, 2009).

Due to the historically exclusionary nature of engineering and persistent gender and racial/ethnic inequities that exist, women and underrepresented minorities may face challenges to developing an engineering identity (Carlone & Johnson, 2007). Engineering environments are seen as masculine, competitive, and objective, qualities often more associated with and beneficial to men (Banda, 2013; Stonyer, 2009). This negative climate, which may extend outside the classroom, may lead to stereotype threat, which may threaten students' performance or confidence in themselves. Steele (2011) posits that when faced with a particular stereotype (e.g., female students do not perform as well in math as their male counterparts), awareness of the stereotype can create internal pressure on the people it targets (for fear of reifying the stereotype) that causes them to do worse than they would otherwise. Marginalized students may

sometimes feel exhausted as they experience interactions that minimize their professional identities and force them to justify their place in the engineering community to outsiders as well as themselves (Ahlqvist, London, & Rosenthal, 2013; Rodriguez, Cunningham, & Jordan, 2017).

Women and underrepresented minority students who perceive a higher level of compatibility between their gender and/or racial/ethnic identities and their engineering identities have a stronger sense of belonging, more confidence, and greater motivation (Ahlqvist, London, & Rosenthal, 2013; Ross & Godwin, 2016; Stevens, O'Connor, Garrison, Hocuns, & Amos, 2008).

However, past scholarship has primarily focused on the ways in which either gender or racial/ethnic inequities influence the engineering identity experiences of women or underrepresented minority students, respectively. Although both types of inequities are equally important, they should not be conflated. As growing research has shown (Carlone & Johnson, 2007; Museus & Griffin, 2011), women of color experience higher education environments differently than their White female or Latino male peers who may have privileged identities, particularly in the engineering setting. Therefore, scholars must continue to disaggregate experiences in order to understand how women of color, who experience these contexts with both marginalized gender and racial/ethnic identities, develop and sustain engineering identities.

Latina Students in Engineering Environments

Prior scholarship has shown Latina/o/x students in engineering, particularly Latinas, may face obstacles to the development of an engineering identity and must utilize various forms of capital to resist marginalization (Aguirre-Covarrubias, Arellano, & Espinoza, 2015; Camacho & Lord, 2013; Villa, Wandermurmen, Hampton, & Esquinca, 2016). Latina students sometimes feel as though their gender and racial/ethnic identities do not fit within the engineering culture and attempted to gain value and acceptance through assimilation (Camacho & Lord, 2013). Even

though Latina/o/x students express interests in STEM careers, they encounter difficulty developing and sustaining STEM identities (Sorge, Newsom, & Hagerty, 2000). Hazari, Sadler, and Sonnert (2013) found that Latina students were the most disempowered in their STEM identities among all racial/ethnic subgroups and as a result faced the greatest challenges in developing a sustained identity. Latina students may encounter instances of sexism and racism in their engineering identity journeys and strongly rely on both self-recognition and recognition from peers, faculty, and family to sustain their sense of identity (Carlone & Johnson, 2007; Rodriguez, Cunningham, & Jordan, 2017). Research has shown that to counteract these challenges, Latina engineering students need authentic peer connections, mentors, and role models who can offer support, mentorship, and connections to career opportunities as well as demonstrate that they can claim their gender and racial/ethnic identities simultaneously (Camacho & Lord, 2011; Foor & Walden, 2009; Rodriguez, Cunningham, & Jordan, 2017).

Previous research has highlighted how support groups, university initiatives, and student organizations are meaningful for Latina engineering students in forming and maintaining engineering identities (Villa et al., 2016). Educators are pivotal in assisting families in learning about and become more involved in the academic and career decisions of their daughters (Decuir-Gunby, Grant, & Gregory, 2013). University-sponsored initiatives, such as mentoring by faculty members of color, allow students of color in engineering the chance to interact with faculty and staff as well as see mentors who hold similar identities (Decuir-Gunby, Grant, & Gregory, 2013). Latina engineering student organizations provide opportunities to meet other college-going Latina students and find support on shared issues (Banda & Flowers, 2016). Including cultural identity in Latina/o/x engineering student organizations sends a message of inclusivity as students aspire to become engineers (Banda & Flowers, 2016). These positive

experiences were echoed in another study more broadly focused on Latina and Latino students who reported that Latina/o/x engineering student organizations encouraged them to find role models and become role models to current and prospective engineering students (Alonso Revelo, 2015).

Furthermore, support from family members, especially relatives involved in engineering fields, has been shown to be a key factor in Latina engineering students' success (Camacho & Lord, 2011; Decuir-Gunby, Grant, & Gregory, 2013; Villa et al., 2016; Wilson-Lopez, Mejia, Hasbún, & Kasun, 2016). Latina/o/x families play an important role in supporting prospective engineering students and building the relationship between community and classroom (Camacho & Lord, 2011). Latina/o/x students often benefited from engineering funds of knowledge deriving from family members who helped shape their interest, engagement, and ethical reasoning in engineering (Wilson-Lopez, Mejia, Hasbún, & Kasun, 2016). Latina engineering students, in particular, drew upon familial capital to overcome insecurities, feelings of intimidation, having to prove themselves to competitive male peers, taking challenging courses, and having difficult advisers in order to persist in engineering (Aguirre-Covarrubias, Arellano, & Espinoza, 2015; Villa et al., 2016). However, Latina/o/x families may also impose cultural and gender-based expectations on their children, including *marianismo*, which portrays Latina women as family-oriented, submissive, and dependent and which contrasts with *machismo*, which views Latino men as dominant and independent (Raffaelli & Ontai, 2004). Such expectations may complicate how Latina engineering students interact with their families during college.

Summary

The impact of stereotype threat and other negative experiences may be more acute for Latina students who experience additional intersectional identity challenges within the culture of engineering. Because Latina students move through educational contexts as both women and racial/ethnic minority students, who are both underrepresented in this context, they may face complex identity development experiences (Carlone & Johnson, 2007; Rodriguez, Cunningham, & Jordan, 2017). Despite shifting higher education demographics and growing interest in engineering identity as an analytic lens, a gap in the literature exists regarding Latina students and engineering identity development. Although extensive literature exists regarding women and underrepresented racial/ethnic minorities in engineering, limited research has focused on Latina students separately from larger discussions on Latina/o/x or minoritized students in engineering, women in engineering, or even women of color in engineering (e.g. Camacho & Lord, 2013; Martin, Simmons, & Yu, 2013). In order to address the gap in our collective knowledge, this phenomenological research study focused specifically on how Latina college students developed their engineering identities during their college experience. It also explored how other intersectional identities influenced the engineering identity development process.

Conceptual Framework

This study drew upon interrelated concepts from role identity theory (Stryker & Burke, 2000) and intersectionality (Collins, 2008; Crenshaw, 1991) to understand the engineering identity experiences and development of Latina undergraduates in engineering. Prior research has shown that identifying as an engineer is particularly important for a student's retention, development, and sense of engineering community (Tonso, 2006a; Tonso, 2006b). Framed by social identity theory and symbolic interactionism, role identity theory addresses meanings individuals attach to the context of their social and cultural roles and recognizes that some identities, such as

engineering identity, become more or less salient, depending on circumstances (Stryker & Burke, 2000). When taking on a particular identity, individuals act according to that identity and align their actions with others in the community to achieve desired outcomes (Burke & Stets, 2009).

One's meaning making and understanding of the role that one plays influences the development of an engineering identity in several ways. Stryker and Burke's (2000) conceptual framing emphasizes that role identity theory explores how individuals define themselves within social structures, how internal dynamics determine actions, and how identities are established and revealed in interpersonal interactions. Across psychology, sociology, science education, and engineering education, three interrelated conceptual factors (recognition, interest, and performance/competence) have been shown to influence the way in which identity develops (Stryker & Burke, 2000). First, external recognition (students' perception of how others view them) influences how students view themselves. Although early recognition from parents and teachers has been deemed important to early engineering identity development, recognition from faculty and engineering peers is also seen a key during college (Mannon & Schreuders, 2010). Second, subject-matter interest, often discussed in terms of students' preferences or affinity for a subject, influences how students will understand and take on the role of an engineer (Lent, Brown, & Hackett, 1994). Third, performance (or competence) refers to the ways in which students understand the knowledge and skills of their discipline and see themselves participating in the discipline. These concepts play an important role in the self-efficacy beliefs of a student and influence engineering persistence (Marra, Rodgers, Shen, & Bogue, 2009).

For the purposes of this paper, role identity theory was utilized to understand the meanings Latina students attached to their engineering experiences and the ways in which various intersecting identities became more or less salient depending on context. Theoretical concepts of

role identity theory (i.e. external recognition, subject matter interest, and performance / competence) guided the interview protocols in data collection and the analysis of participants' interactions with others and their beliefs about their roles within the engineering community.

This study was also informed by scholarship on intersectionality (Collins, 2008; Crenshaw, 1991; Museus & Griffin, 2011). The term "intersectionality" refers to the way in which multiple, intersecting identities (i.e. race/ethnicity, gender, class) create patterns of systemic inequities both at the individual and group level (Crenshaw, 1991). This concept grew out of Critical Race Theory and shares a similar goal of examining how power and oppression are imbued in social systems (Museus & Griffin, 2011). Where intersectionality differs from Critical Race Theory is in its understanding that people carry within them multiple identities and lines of difference that constantly interact and impact their everyday lives (Crenshaw, 1991; Museus & Griffin, 2011). A racialized experience, then, cannot be separated from one's gender, class, sexuality, and other types of identities. In this study, students' experiences as engineering students were informed by their race/ethnicity, gender, socioeconomic status, and other identities that shaped their past and present lives and how they experienced engineering environments. Utilizing concepts of intersectionality and role identity theory enabled the researchers to understand the complex nature of engineering identity development for Latina college students, in which multiple identities, and, therefore, multiple, distinct forms of marginalization, shaped their experiences.

Methodology

This phenomenological study examined the lived experiences of five Latina undergraduates majoring in engineering. Phenomenology allowed for the discovery of meanings, exploration of experiences, and provision of rich detail on meaning making and an individual's understanding of her role as an engineer (Moustakas, 1994; Van Manen, 2014). Phenomenology was an

appropriate methodology for this inquiry because it allowed for the exploration of experiences, discovery of hidden or complicated meanings, and exploration of the essence of a phenomenon (Husserl, 1931). We sought to identify the overarching “essence” of the phenomenon of engineering identity development by explaining its critical or defining elements.

To do this, we utilized anecdotes to serve as examples and accessible views into the lifeworld of individuals (Van Manen, 2014). These anecdotes provided concrete examples of situations and events which provided rich detail of the meaning making and essence of the phenomenon. Although these anecdotes will never be universal, they are examples that provide a nuanced understanding of how Latina students develop their engineering identities and invite researchers to investigate further nuances in the future.

Participants in this study met four criteria: (a) 18 years of age or older; (b) self-identified as a Latina student; (c) classified as a senior; and (e) enrolled as an engineering major. The study centered on the perspectives of Latina college seniors in engineering because their persistence through college yielded an enhanced understanding of the engineering identity development process since they were nearer to the end of their undergraduate studies than the beginning. Given the relatively small number of Latina students in engineering, snowball sampling was used to connect with prospective participants (Bernard, 2002).

The five participants in the study came from a variety of engineering majors: aerospace, architectural, biomedical, chemical, and mechanical. Most were involved in several identity-based organizations and sororities on campus (with one student not involved in any on-campus organizations). Four were of Mexican origin; one identified as Salvadoran. Three indicated a high socio-economic status (SES) level, while two indicated a mid-level SES, and one a lower SES. Only one participant identified as a first-generation college student; three of the five had at

least one parent with a bachelor's or master's degree. Both Spanish and English were indicated as primary languages used at home. Four of the five participants indicated advanced degree career aspirations. See Table 1. Student Profiles for more detailed information.

<< *Insert Table 1. Student Profiles here* >>

Data collection took place at a large, research-intensive, and Predominately White Institution located in the Southwest that is regarded as a leader in preparing engineers nationally. This institutional profile provided a unique set of circumstances in which to examine Latina students' engineering experiences and identity development. The institution's size, research intensity, and predominantly white demographics establish an educational setting that can be unfriendly to racially minoritized students in engineering. As a result, the institution has extensive engineering programming and initiatives targeted at enhancing the success of engineering students from diverse backgrounds, including efforts targeted at encouraging Latina students' and female students' success. At the time of data collection, Latina students made up approximately three percent of the overall undergraduate engineering population.

Data Collection & Analysis

Using a phenomenological analysis approach, researchers engaged in a multi-step data collection and analysis process, including bracketing, phenomenological reduction, and composing textural and composite structural descriptions (Husserl, 1931; Moustakas 1994). Reflexive journaling and memoing throughout the data collection and analysis provided an opportunity for the researchers to understand their prior experiences with and assumptions about engineering identity and explore ways to make themselves more open to the research process.

Data Collection. Prior to data collection, the researchers utilized research journal and memoing activities to reflect on their own beliefs and attempt to suspend assumptions about

engineering identity and the various social and cultural roles that students take on (bracketing). This process allowed them to focus on the research questions and see engineering identity as it was described by the participants, rather than how it was envisioned by the researchers.

Students participated in two one-on-one interviews, 60-90 minutes in length, which were audio-recorded and transcribed. In accordance with the phenomenological approach, the researchers created a series of questions aimed at elucidating a comprehensive understanding of the student's engineering experience (Moustakas, 1994). Interview protocols used elements of the conceptual frameworks of role identity theory and intersectionality to explore the meanings students attached to their role as an engineer. The first interview examined a student's interest in engineering, experiences within the discipline, and identity recognition and performance / competence. The second, follow-up interview further investigated identity development in reference to these elements and clarified questions arising from the first interview.

Semi-structured in-depth interviewing in a two-part series enabled the researchers to collect rich, high-quality data. The two-part design allowed participants to share their experiences and respond to follow-up questions or expand on responses as needed to provide greater understanding of their experience (Lincoln & Guba, 1985; Sandelowski, 1995; Strauss & Corbin, 1990). As Patton (2002) indicates, there are no rules for sample size in qualitative inquiry. This study's small sample allowed for the creation and maintenance of close relationships with participants and supported the open exchange of information. Through these close relationships, the researchers were able to address the complexities of individual engineering identity experiences and reach a deeper understanding of the phenomenon.

Data Analysis & Synthesis. Throughout data collection and analysis, researchers utilized phenomenological reduction to more fully understand the essence of the phenomenon. During

data collection, they asked participants to describe their identity and role experiences from a variety of standpoints and in rich detail, and then sought to reduce the phenomenon to its core understandings. Journaling activities encouraged the researchers to first identify surface appearances of the phenomenon, then seek more in-depth understanding through follow-up and trustworthiness activities.

To facilitate data analysis, the researchers used journaling and memoing activities to develop individual-level textural and structural descriptions of what they saw in the transcripts and distill the most important aspects of an individual's understanding of her role and identity as an engineer. Concepts from the study's conceptual frameworks (e.g. recognition, interest, and performance / competence, intersectionality) informed the descriptions. Textural descriptions included details about what students experienced in terms of the phenomenon (e.g. coursework, navigating campus), while structural descriptions included details about how participants experienced this phenomenon (e.g. interactions, communication). Examining each person's transcripts and descriptions of the phenomenon enabled the researchers to more fully understand the nuance of each person's engineering identity experiences. Then, the researchers created composite textural and structural descriptions of the experiences across the participants.

Synthesizing these composite descriptions, the researchers identified possible meanings and essences, or core understandings, of the engineering identity experience. Each researcher created a memo outlining participant interpretations of the key essences of the phenomenon. While guided by the concepts of role identity theory and intersectionality, memos focused on participant interpretations rather than researcher interpretations in order to remain focused on the lived experiences of the participants. Comparisons were made across researcher memos to synthesize core understandings of the phenomenon and formulate essences of the experience

across all participants. The researchers then engaged in consensus-building activities, comparing the development process across participants. To synthesize and verify the results, the researchers utilized transcript data to describe relevant elements of the identity development process.

Trustworthiness & Researcher Positionalities

To establish a rigorous study, trustworthiness mechanisms were woven in at each stage (Creswell, 2013; Lincoln & Guba, 1985). During phenomenological interviews, researchers conducted member checks, summarizing and paraphrasing participant experiences to allow participants to clarify meanings and elaborate on previous statements. Participants also reviewed and modified interview transcripts and responded to initial researcher descriptions. Throughout the study, researchers engaged in reflexive, consensus-building journaling, and memoing to ensure that interpretations were accurate. Finally, the researchers participated in peer-debriefing activities with two colleagues who read transcripts and provided feedback on research design, data collection, and analysis to ensure credibility and validity of the study. In order to be conscious of biases, values, and experiences, the current study's four researchers sought to understand their "positions" in relationship to the study (Creswell, 2013, p. 216). As Latina women, the first and second authors held insider perspectives and a sense of familiarity with the gender, cultural norms and expectations of Latina students; they also held outsider perspectives, as they were not in the engineering field. The study's third author, who identifies as a White woman, held insider status both as a woman who has previously completed an engineering degree and someone who has had extensive experience with collegiate women's engineering programming as a student affairs professional. The study's fourth author, who identifies as a Black woman, came to this study as a woman of color who left STEM, making her familiar with many of the challenges to identity development which the students in the study experienced.

Findings

Understanding the essence of how Latina undergraduate students in engineering develop their engineering identities requires an understanding of how these students made meaning of their engineering experiences and saw themselves in the role of an engineer. Undergraduate Latina students in this study defined the essence of their engineering identity development in terms of how their family interactions, involvement in identity-based engineering organizations, and intersectional identities shaped their role in engineering.

Family Members are a Positive Influence in Latina Engineering Identity Development

The Latina students in this study expressed how family members, both engineering and non-engineering, influenced their emerging role as an engineer. Participants identified having multiple family members involved with the engineering community as a positive influence on their interest in the field and their recognition of themselves as engineers, with one participant even feeling “born into it.” For Ana, the experience of growing up with several engineers in the family meant a clear direction to what her future career might be:

There are a lot of engineers in my family, so that also influenced me. My older sister is an engineer, my dad is an engineer, a lot of uncles and aunts. So I guess I just knew that’s what I should do.

Brothers and fathers, in particular, were highlighted as important to the engineering identity development process. Brothers shared similar experiences, were often completing engineering degrees simultaneously, and were often a source of encouragement, paving the way for their sisters in engineering.

In Lydia’s case, her older brother led the way, inspiring her interests and encouraging her to become an engineer: “I think a lot of it was influence from my older brother...my brother always

really pushed me to do engineering.” Echoing Lydia’s experience, Sofia related that her brother also inspired her to pursue engineering:

We were super close and we still are. I saw how much [my brother] loved his major and when I was in high school he’d show me his textbooks and what kind of work he was doing. He was just so enthusiastic about it. I thought if he’s happy I know I would love it...I was kind of born into it.

Fathers emerged as individuals who nurtured engineering interests from a young age, taking their daughters to work with them. Lydia remembered that her dad, “would always take [her] along projects around the house or anything if it was building or designing something, I would tag along. So I think that’s where it started from.”

Not only did family members inspire initial and continued interest in engineering, they also served as a symbol of the importance of financially giving back and supporting their families in the future. Students wanted to succeed with their engineering degrees and beyond so they could support their families, like their families did for them. Ana’s family sacrificed personally and financially so she could come to the United States to study in a top engineering program:

My grandma helped and one of my uncles, too... I was the first one to come to the U.S. for undergrad... We are all a very close family, so it was very hard for my mom to let me come to the U.S. but she knew there would be better opportunities here than me getting an education in Mexico... I try to work hard in college and in general to be able to get a good job and help my family... Most important I want to make my parents’ effort of having me here worth it and that it is not in vain.

Similar to Ana, Dora’s family experienced many financial hardships, so she pursued an engineering degree in order to ease their burden in the future. Dora purposefully chose a major

which would provide her with the financial stability to not only support her family, but also ensure that her younger sister was able to “follow in her footsteps” in terms of an engineering career:

I wasn't going to get into a major that wasn't going to allow me to achieve a financial stability that I can provide for my family...One of [my sisters] is going to hopefully be an engineer like me too. The seven-year-old really wants to follow my footsteps.

Families influenced how participants thought of their interests, recognized themselves as engineers, and shaped their future roles and goals as an engineer. Participants connected their engineering identity development and role as a future engineer to the ways in which they made sense of their past familial experiences and desires for the future. A sense of engineering identity became stronger when students could connect their interests to an altruistic goal of helping their families, seeing engineering as a means not only to lift their family from poverty but also to ‘pay back’ (through financially supporting their families) or ‘pay forward’ (through encouraging other members of their families to study engineering).

Identity-Based Engineering Organizations Encourage Identity Development

On campus, an essential part of participants’ experiences with understanding their role as an engineer was participating in identity-based engineering organizations. These organizations provided opportunities to understand their role as women and Latina/o/x students in engineering. These spaces built community in order to support academic performance, encourage recognition as an engineer, and inspire other women and Latina/o/x students to assume future roles as engineers.

Sofia felt her participation in the women in engineering program was integral to her success. She felt lost much of the time in the beginning and was unsure what she would have done without the built-in support system associated with the organization for women in engineering.

Actually, after that first interview, I went and talked to my friends and said “I couldn’t describe why [connecting with women engineering students] is so important. I just couldn’t put it into words” and I asked them if they could explain it ’cause they felt the same way. They said, “just because other people don’t understand.” It’s good to have people that you’re comfortable with because you can’t really excel or succeed if you feel intimidated or if you don’t want to speak out....I just feel like being around other women is less intimidating. I was able to bring up more ideas or be more comfortable with the environment I was in. If I’m around a lot of guys I do tend to be more quiet and more shy and I don’t know, more quiet-spoken I guess.

For Sofia, her male-dominated engineering discipline was intimidating, so she appreciated the built-in support that participating in the women in engineering program provided. While she felt too intimidated to speak out in the traditional engineering setting, she felt comfortable interacting with her female peers, whom she met through the women in engineering program. With female peers, she felt at ease asking questions, voicing her opinions, and sharing an understanding of the struggles that women in engineering face.

The students in this study highlighted how their involvement with Latina/o/x-centered engineering student organizations nurtured their engineering identity development. In their search for a sense of belonging in the engineering context, Latina/o/x-based engineering organizations enabled them to build a network of support and sense of community with other Latina/o/x students. Finally, participants commented on worries about how others might view

their race as an unfair advantage or how they might be used to fulfill quota requirements for diversity.

In Latina/o/x-focused organizations, students found their niche within the engineering community and built a sense of support among fellow Latina/o/x colleagues in STEM. Lydia found that participating in a Latina/o/x engineering organization allowed her to connect with Latina/o/x peers, especially Latina engineering peers. The organization allowed her to meet some of her “best friends” and other Latina/o/x professionals during her college career. With her involvement as president, she found it a community of Latina/o/x engineering majors that was like her “family.”

We always have the tagline of “[Latina/o/x engineering organization] Familia” just because it’s hard to find a Hispanic community within STEM so knowing that it’s your support system that you didn’t bring to college there for you. So yeah we always talk about our [organization’s] familia atmosphere.

Lydia’s involvement with the organization provided opportunities to hear from other Latina students in engineering through the organization’s Latina subgroup. She found a support system with these women. They talked about classes, commiserated about coursework and projects, and inspired each other.

It was really exciting because I came from not knowing anybody who wanted to do engineering – specifically girls – to going to this organization and seeing so many girls who were doing engineering who were Hispanic just like me. It was really exciting. They actually have a program within [the organization] called [Latina subgroup], which is specifically for the girls in retention program for Hispanic girls. That was a big part of it. It’s hard and you sometimes don’t know who to go to if you have a question or...if

you're thinking... "Do I really want to do engineering or do I want to keep going?" It's hard because I don't feel like you have a lot of people to go to and ask questions....The people who are girls and are in engineering, we kind of look for each other.

The Latina engineering subgroup provided Lydia the ability to see other Latina students interested in engineering, as well as the opportunity to engage with a supportive community of her Latina peers. Lydia's involvement with the Latina subgroup went beyond interacting with Latina/o/x students in engineering and became more specific to supporting and being supported by her Latina engineering peers. In this way, her experiences with the student organization represent an intersection between her racial and gender identities and the influence that this experience had on her engineering identity development.

Relevance of Intersecting Identities and Engineering Identity Development

In this study, Latina college students made sense of their experiences and developed their engineering identities as a result of how their multiple identities manifested and were negotiated through their college years. The essence of their descriptions of this identity development was that multiple aspects of identity were salient in shaping their engineering identity, including international or immigrant student status, race/ethnicity, gender, and motherhood. These identities influenced how others recognized them as engineers and the way in which these students chose to perform their engineering identities.

For two participants, national or immigrant identity was a salient identity that intersected with their engineering identity development. Both Ana and Dora expressed that their statuses as international or immigrant influenced their identity experiences. For Ana, it was neither her Latina identity, nor her gender that she felt had been the most challenging identity to navigate within her engineering experience, but rather her status as an international student:

The fact that I am international has been what has I guess made it harder for me. Not the fact that I am Latina but the fact that I am not from the U.S....I don't think about it being different that I am a girl in engineering because I guess I've been I don't know I don't think about the fact that I am different because I am a girl in engineering.

Dora's experience as an immigrant to the United States, while similar in many ways to Ana's, was distinct, as the lens of her immigrant status filtered her sense of worthiness and success:

I think the only reason they helped me is because they saw that I was an investment. That I wouldn't turn out the way that they expect everyone else that came from my situations...I'm the model citizen that all these conservatives want immigrants to be. If I had been something else maybe they wouldn't have liked it.

Participants felt their engineering identity development experiences were negotiated through the lens of their racial/ethnic and gender identities as Latina female college students. They believed that their peers considered them inferior and did not recognize them as future engineers. Lydia noted that due to her race and gender she was not generally considered an engineering person:

I think it's rewarding and just being an engineer, people look at you differently. In that sense it's nice but just knowing that you're in engineering and you're finishing engineering. People I think do look at that especially because you're a girl people don't expect you to be a Latina girl who's an engineer. They do look at you different...

Lydia's sense of identity around the study of engineering connected to her other identities, her femaleness and what could be called her sense of *Latinidad*, or feeling of connection to the Latina/o/x community. She acknowledged that "people look at you differently" and that her experience was mediated by the fact that she held other identities simultaneously. The "people" she referred to in this statement were primarily her engineering peers, but she also extended these

ideas to include faculty members and potential engineering employers. She felt instantly set apart by society due to the demographics of her field, thus making her view her science identity, and subsequent achievement in graduating from this field, in terms of her multiple identities.

Dora discussed the extra burden that was placed on her as both a racial/ethnic minority, an immigrant, and a woman in engineering:

I realize that as I'm minority, as Latina, I have to work extra hard because whether someone believes that I got to where I'm at because of my color or because of my origin instead of actually myself, my hard working. I always have to prove that I can accomplish things on my own... I always try to be able to inspire other girls I guess, to be able to motivate them that they can also be in a male field and achieve success in it.

Victoria talked about how men tried to spoon-feed her information or shut her down during conversations in order to give them the “right” information:

A guy will be like, “Oh...no, you're wrong; don't say this. Here's the right answer. Don't even worry about answering the second one because I already answered it so you don't have to think about anything.”...[T]he guys try to spoon-feed you the answers but it's like, “Well I already know this; I don't need you to be telling me this,” and they're like, “Oh.”... and it's frustrating being put in that position where you know you have the potential and you know you can answer questions that you know you know the information but guys think, “No you don't. Here's the stuff, here's the information.”

According to Victoria, male peers who attempted to force-feed women information and provide them with what they felt were the correct approaches and answers to problems. Men believed their thoughts and actions were superior and devalued women's knowledge as a result of the patriarchal and sexist structures that undergirded their assumptions. These male peers

assumed that their female peers were intellectually inferior and in need of help, so they played the role of provider of knowledge, assuming that they knew what was best. Sofia described hesitating to seek help from engineering peers for fear that she might be considered inferior:

If I needed help with math or something with homework, I would prefer to ask someone who was a really good friend as opposed to someone I didn't really know because I don't want people to think "Oh she's dumb. Why doesn't she know?" If it's one of your really good friends you know they aren't going to judge you, I guess.

In terms of being a woman, she said that she often feared sounding "dumb." Aware of the potential impacts of stereotype threat, Sofia preferred to seek assistance from female peers who she felt would not judge her for her lack of understanding. She did not want to appear academically inferior to male peers with whom she might have to work with on future projects. Sofia demonstrated the importance of being recognized as competent by male peers and illuminated what happens when one is not taken seriously in this capacity, describing a class project in which the female engineering students were "brushed off" by male peers:

...We'd been saying an idea since the very beginning. It's a semester long project. And then it kept getting brushed off but when some other guy said, now we're doing that idea but that had been ignored all the way until he said it.

Even though Sofia and her female peers reiterated their idea to the group, it was only when a male peer presented the idea that her other male peers recognized the idea as valid. In this instance, Sofia's female peer group's contribution was not acknowledged or given credit.

Victoria related how her identity as a young mother influenced the development of her engineering identity. For her, having a secret child influenced how she experienced college and motherhood. Her identities as a mother and as an engineer were complicated because she felt she

was not a great mom. This feeling was due to not being there for her daughter as much as she wished she could be. In order to have a full engineering experience, she did not feel she could have her child with her, as she would get passed over for opportunities; she made sacrifices to sustain and develop her engineering identity in the way that she (not her parents) wanted.

Victoria expressed her fear of playing into sexist and racist stereotypes. She feared judgment as a Latina teenage mother when she felt that she was more than that. Due to stereotype threat, she became more reserved, as she did not want to be the subject of gossip. She felt others would judge Latina students in engineering because she had a baby. Stereotype threat became an issue in her interactions with faculty and professional priorities:

...I am trying to not walk in like people have already made up their mind about me but it is really hard to. I feel like you can be naïve and give everyone the benefit of doubt but at the end how often is that going to be true? I mean I feel like a lot of people haven't really met a Latina in STEM. So if I am that one first impression I am sure who that if I met another Latina in STEM that wasn't pregnant did everything the way it is supposed to she would kind of be anchored by me at the end of the day I didn't choose well this is not the way I intended my life to play out it just happened that way and all I can do is move forward and try to do the best with what I can.

She feared faculty would believe she could not produce scholarship at a reasonable level because of her family and that she was a “gamble” whose personal life could become an issue. Victoria felt she might be overlooked for opportunities because others regarded her as “busy” with her family. In combating this potential bias, her undergraduate research mentor (a White woman) was a source of support throughout her graduate school and career planning. Victoria said,

I am kind of glad that she was more like ‘it is not in your head it is a real thing’ and so we talked a lot about strategy and how it should come up if it comes up at all.

Because her mentor was a woman, she understood the norms of the engineering environment and the biases around women and childcare responsibilities. Victoria’s mentor not only acknowledged the issues present within the engineering field, she also taught Victoria how to work within those norms in order to succeed. Her mentor did not discuss dismantling those gendered norms, nor did she attempt to have Victoria redefine those norms for herself.

Summary

Participants defined the essence of engineering identity development primarily as a function of family member interactions and involvement with identity-based engineering organizations. Family members in engineering professions supported student interest in the field and encouraged students to recognize their role in the engineering world. Families also inspired students to simultaneously recognize their role as an engineer as both a provider and an example for younger family members. Involvement with identity-based organizations allowed students to recognize their role in engineering as women and URMs in engineering. Organizations focused on women in engineering provided a less-intimidating space in which to develop a sense of competence and recognition as a valued member of the engineering community. Organizations focused on Latina/o/x students in engineering allowed students to recognize their role as part of a larger support system made up of Latina/o/x engineering students. Involvement in a Latina-focused engineering group addressed the role of Latina students within the engineering environment as both women and URMs and encouraged students to continue developing interest and competence and remain committed to engineering.

Participants also described how these essences were defined by the presence of multiple, intersecting identities, including international or immigrant student status, race/ethnicity, gender, and motherhood. As members of traditionally marginalized groups, students were not recognized in engineering roles. Their marginalized, intersecting identities shaped the expectations that others had for them and how they chose to invest in their success. Students acknowledged that negative stereotypes associated with marginalized identities encouraged others not to recognize them as future engineers. In order to see themselves in the role of an engineer and be recognized by others, students often felt a need to perform their competence for others.

Discussion

Latina undergraduate students developed their engineering identities by making sense of both informal and formal engineering experiences and their various identities. At the essence of these experiences emerged the importance of family, Latina/o/x and gender-based organizations within engineering, and the multidimensionality of identities that influenced the development of the participants' emergent engineering identity development. Students who had family, particularly male family members involved in engineering disciplines, tended to feel more comfortable identifying as an engineer and owning their role as a professional in this field. Essentially, what family members provided to the participants was external recognition and the nurturing of subject matter interest. This study affirms past research that has shown that strong family support encouraged initial subject interest and provided various forms of capital to Latina engineering students (Camacho & Lord, 2011; Decuir-Gunby, Grant, & Gregory, 2013; Villa et al., 2016; Wilson-Lopez, Mejia, Hasbún, & Kasun, 2016). This study provides new findings regarding the importance of fathers and brothers to engineering identity. The identification of male family members who have previously matriculated through engineering programs themselves illustrates

the historical imbalance of Latina/o/x males and females in this field and the importance of support provided in the home for future success in college. Fathers and brothers provided positive encouragement and mentoring to the participants prior to college, creating a foundation for the participants to envision themselves as engineers and the field as a family business.

This study also affirms prior research findings that, among other reasons, students select engineering because it promises practical utility and financial stability (Ortega-Alvarez, Atiqu, Rodriguez-Simmonds, 2016) that will allow them to provide for their families. And, while literature on Latino men often highlights a cultural and gender-motivated need to become financial providers (Saenz, Mercedes, Rodriguez, & Garcia Louis, 2017), this study demonstrates that Latina students in engineering may also feel that often masculine-attributed desire, perhaps as a result of their positioning within a male-dominated, potentially high-earning field. For many Latina/o/x families, cultural and gender-based expectations of *machismo* emphasize how Latino men are dominant and independent, in contrast to the expectations of *marianismo*, which emphasizes that Latina women are family-oriented, submissive, and dependent (Raffaelli & Ontai, 2004). Latina women may see providing for their families as a way to negotiate their engineering identities by displaying the family-oriented traits of *marianismo* while simultaneously demonstrating financial and educational independence.

A second theme that emerged as part of the essence of engineering identity development was that involvement in engineering organizations played a key role in participants' ability to navigate the engineering discipline and develop an engineering identity. More specifically, the participants spoke about identity-based engineering organizations that enabled them to navigate their engineering experiences, build a community of engineering peers and faculty support, and address issues specific to experiences and roles as women and people of color in engineering. By

finding a niche where they shared similar racial/ethnic and gender backgrounds with peers, participants found an on-campus support network. This in turn led to recognizing their peers as both Latina and engineering majors and finding external recognition through seeing their identities mirrored back at themselves, empowering them to claim their emergent professional identity. These findings echo prior research that has highlighted the importance of identity-based organizations as spaces for vulnerability, expression, and peer connections with other engineering students (Alonso Revelo, 2015; Banda & Flowers, 2016).

This study furthers our understanding of identity-based organizations by demonstrating that these spaces can encourage greater creativity for women, who feel less inhibited in a predominantly female or Latina/o/x group, and allow them to become more comfortable and build support systems within their engineering environments. However, this also begs the question of how and why we might be asking Latina students to continue navigating such a hostile environment, rather than seeking to dismantle it. Such reliance on identity-based engineering organizations to do the work of dismantling ingrained racism, sexism, nativism, and other forms of bigotry does not address larger structural and cultural issues. In addition, this study draws attention to intersectionality and the existence of Latina subgroups within larger Latina/o/x engineering organizations. Despite a feeling of *familia*, or sense of a fictive family and support in Latina/o/x engineering organizations, Latina students may have unique raced and gendered experiences which necessitate further support not available in the larger Latina/o/x group. For example, Ana and Dora's experiences as an international student and an immigrant from El Salvador, respectively, were identities not necessarily addressed or validated by their participation in these organizations.

Finally, participants articulated how multiple intersecting identities were salient in shaping their engineering identity development, including their international or immigrant student status, race/ethnicity, gender, and motherhood identities. These identities reveal nuance to the experiences of the participants, showing that even among this small group of students on one campus, individual experiences can vary widely because their identities intersect differently. They also show the awareness students maintain of their intersecting identities and how these come to bear in their educational experiences and in the development of external recognition.

The findings from this study reinforce the importance of identity in shaping the experiences of Latina students, and other marginalized students, within the engineering environment (Rodriguez, Cunningham, & Jordan, 2017; Tonso, 2006). Research has shown that marginalized students often worry about stereotype threat (Steele, 2011) and feel a need to prove themselves in educational contexts (Solórzano & Delgado Bernal, 2001). A limitation of the previous research on engineering identity has been a focus on three particular identities: race/ethnicity, gender, and socioeconomic status. Through an intersectional lens, this study expanded upon prior research on intersectionality (Collins, 2008; Crenshaw, 1991; Museus & Griffin, 2011) by highlighting the ways in which Latina engineering students experience multiple forms of marginalization that present complex complications to feeling like an engineer. This study emphasized that the proving process in engineering is a multi-layered experience for Latina students. Not only do Latina engineering students have to prove themselves as women in a male-dominated field, but they must also prove themselves in terms of their international or immigrant student status, race/ethnicity, and motherhood identities.

Implications

This study addressed a significant gap in the literature which has failed to consider the essence of engineering identity development of Latina college students. This section provides implications for supporting engineering identity development, ultimately, improving undergraduate persistence among Latina students in engineering.

Implications for Future Engineering Identity Research

Several limitations to the current research study exist which provide opportunity for future engineering identity research. First, this study examined engineering identity in the aggregate, rather than disaggregating by engineering disciplines (e.g. mechanical, chemical, aerospace), Latina student subgroups (e.g. Mexican, Puerto Rican), or focusing on particular educational contexts (e.g. Hispanic-serving Institutions, community colleges). Second, this study was exploratory in nature; further scholarship is needed in order to address the ways in which family, student organizations, and intersectional identities influence the engineering identity development of Latina undergraduate students. Given the findings of this study, future studies might investigate family influences and interactions with engineering students using a community cultural wealth or asset-based funds of knowledge lens (Yosso, 2005). An asset-based approach may provide crucial information needed to understand how to engage Latina/o/x parents in the engineering college-going process.

In terms of intersectional identities, future research could extend the current study by investigating the multiple, intersecting identities of Latina students in more nuanced ways. On an individual level, researchers could push towards greater understanding of how intersectional identities such as the ones presented here (e.g. gender, immigrant, race/ethnicity, motherhood) create marginalizing experiences for Latina students and the ways in which students resist marginalization. Investigators might utilize transformational resistance as a framework for

exploring how Latina engineering students resist the dominant, negative narratives associated with the intersectionality of their race/ethnicity and gender (Solórzano & Delgado Bernal, 2001). On a societal level, future scholarship might investigate how intersectionality creates structural educational inequities for Latina students that inhibit engineering identity development. Such studies could explore how bias is built into the structures of educational institutions and how societal views influence the ways in which Latina students are marginalized in engineering.

Implications for Engineering Practices & Policies

This study found that Latina/o/x family members, both those in engineering and those not in engineering, essentially influenced the engineering identity development of Latina undergraduate students. Moving forward, greater attention should be paid to integrating engineering and non-engineering family members into the college-going process through different targeted outreach efforts. Institutions have the ability to create opportunities for Latina/o/x family members to be a part of the process from the time that Latina students are recruited to the time that they graduate, and throughout their role identity development. Institutions might offer specialized training on how to support engineering students and encourage engineering family members to be involved with potential internship placements, mentoring opportunities, and cross-engineering connections. For non-engineering family members, institutions might consider creative ways to introduce and socialize these family members to the engineering community through invitations to activities like engineering family nights or opportunities for engineering students to share their research. In addition, institutions might offer specialized training in how to support engineering students, including what matriculation through an engineering degree program looks like.

This study also found that involvement with identity-based engineering organizations provided essential influences for the way in which Latina undergraduates developed their

engineering identities. As such, institutions might consider enhancing support for and coordination of identity-based engineering organizations and efforts. Institutions might not only consider the formation and support of these organizations, but also have discussions about institutionalizing identity-based efforts, rather than allowing such efforts to be seen merely as add-on programming or student-only initiatives. Further, institutions should look into the long-term sustainability of these organizations so their livelihood is not completely dependent on the initiative and actions of students who are also completing their degree programs. Administrators, faculty, and scholars alike may want to initiate open discussions about the nature of identity and organizational involvement and what it means to become involved with identity-based organizations. Furthermore, educational stakeholders may want to think creatively about how identity-based organizations and engineering organizations can collaborate or co-sponsor events, encouraging multiple opportunities for building connections between students and a more holistic approach to engineering identity development.

Finally, this study found that Latina college students in engineering were influenced by multiple, intersecting identities during their engineering identity development process and negotiated how their role as an engineer fit within their other identities. The experience of Ana, who identified her status as an international student as more of a challenge than her Latina identity, demonstrated that there are multiple dimensions of student identity that need to be better understood. Institutions may consider how intersectionality can become a part of regular discussions associated with engineering curriculum, programming, and subsequent identity development. Institutions could focus on the ways in which Latina college students, and all other engineering students, bring with them a myriad of intersecting identities that may influence the engineering identity development process. Moving forward, institutions may want to focus on

training engineering faculty, staff, and students in understanding their engineering students and peers as complex human beings, integrating concepts of intersectionality into the curriculum and programming early (e.g. through freshman seminars or interest groups) and consistently through the middle years and towards the transition to graduate school or the engineering workforce. Institutions may also consider adding content on stereotype threat into such training in order to prevent its occurrence in teaching and laboratory spaces, group work, and student interactions.

Conclusions

This phenomenological study found that the development of a professional engineering identity for Latina undergraduates is not cultivated via the classroom experience alone. Instead, Latina students develop their roles as engineers through interactions with family, engagement in professional organizations, and in considering this identity in relation to other parts of their personal identities. They build their engineering identity in relation to their other identities, and these intersecting identities can create both positive and negative interactions. By understanding the essence of this developmental process, researchers, practitioners, and administrators can build in-class and out-of-class experiences that more holistically support students who have been underrepresented in engineering programs and their development as engineers.

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