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Types of Stereotype Threats that Latinx Students Experience in Undergraduate Engineering Education (Research)

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Stereotypes and Stereotype Threats Experienced by Latinx Undergraduate Engineering Students

Abstract

Latinx students in engineering often experience stereotypes in their programs that can lead to stereotype threats, or the fear of inadvertently confirming a negative stereotype about oneself or one's group. Stereotype threats can not only affect a person's self-esteem, but it can influence their academic performance and persistence. They can also lead to, among many things, a heightened awareness of one's own actions, which in turn takes away from the mental space required for academic studies. While previous studies often cover the broader impacts of stereotype threat on the educational experience of minorities, there is a gap in the research regarding the specific types of stereotype threats; specifically, those experienced by Latinx undergraduate students in engineering. This research provides an analysis of various stereotypes and stereotype threats that Latinx undergraduate engineering students face using data collected from 28 interviews. Data was collected across three universities, one Hispanic Serving Institution and two Predominately White Institutions. Data analysis on these interviews resulted in the identification of nine major stereotype themes and nine major stereotype threat themes. The coding frequency indicated that the assumption of academic abilities and assumption of behaviors were the most commonly experienced stereotype themes. The results of this study contribute to the body of knowledge on stereotype threats by identifying and categorizing the various stereotype threats that Latinx undergraduate engineering students face. These results also help to diversify pathways in engineering by better informing educators through increasing the visibility of the negative subtle behaviors that Latinx students experience.

Introduction

Latinx students continue to be underrepresented across higher education institutions in the U.S., making up only a fifth of the student population (PNPI 2019). According to the National Science Foundation, in 2019 only 15% of the bachelor's degrees in engineering were awarded to Latinx individuals. The underrepresentation of Latinx individuals extends to the engineering work field, with only 6% of the employed bachelor's degree holding population identifying as Latinx (NSF 2019).

Lack of Latinx representation continues to persist in engineering programs and it is important to investigate possible factors, including stereotypes. Stereotypes, or widely held but fixed and oversimplified images or ideas of a particular type of person or thing (Oxford Dictionary 2021), are commonly faced by Latinx individuals (Reny, et al. 2016). Stereotypes can also lead to stereotype threats - the fear of inadvertently confirming a negative stereotype about oneself or one's group. These stereotypes and stereotype threats can affect a student's academic performance and persistence (Owens 2010).

Research regarding stereotypes and stereotype threat is growing (Shapiro 2011) (Eschenbach, et al. 2014) (Thomas, et al. 2018), with the main focus being on the impacts on individual's academic performance (Owens 2010), along with the developed coping mechanisms (von Hippel 2005). While research on the resulting consequences of stereotype threat is important to study, identifying the stereotype and stereotype threat themes is essential and current research on the types of stereotypes faced by Latinx students pursuing a bachelor's degree in engineering is little to none.

This study aims to broaden the body of research, create a method of organization for further data, and examine the types of stereotypes experienced by Latinx undergraduate engineering students and the frequency in which they are internalized and become stereotype threats, as identified by the students themselves. To provide an analysis of the various stereotype threats that Latinx undergraduate engineering students face, this research aimed to answer one main question: *what are the prevailing gender and ethnic stereotypes and stereotype threats that Latinx engineering students face?* Answering this question will have an important impact on broadening participation of Latinx students in engineering. 28 students across three universities (two Predominately White Institutions and one Hispanic Serving Institution) were interviewed via Zoom. The collected audio was coded in the qualitative analysis software NVivo for stereotype frequency. The identified stereotypes were sorted into nine themes and the identified stereotype threats were sorted into nine themes. Of these themes, the most frequently coded were assumption of academic abilities and assumption of behaviors.

Literature Review

Stereotype Threat

The term stereotype threat, the fear of inadvertently confirming a negative stereotype about their social identity—their race, gender, ethnicity, social class, sexual orientation, etc., was first introduced by Steele and Aronson (1995) in a study on how college freshman and sophomores identifying as Black performed more poorly on standardized tests versus their White peers when race was emphasized. After this initial study, the body of research on stereotype threat continued to grow (Shapiro 2011) (Eschenbach, et al. 2014) (Thomas, et al. 2018), with much of the research focusing on race and gender-based stereotypes and stereotype threats, the impacts on individual's academic performance (Owens 2010), along with the developed coping mechanisms (von Hippel 2005). This research body determined that stereotype threat can take up valuable when experienced, which can affect many things including cognitive mechanisms and academic performance and persistence.

When an individual from a stigmatized group is presented with a negative stereotype, it can cause a heighted awareness of one's own actions. This heightened awareness often leads to a reduction in self-efficacy (the belief in one's ability to complete a task), which can have a significant impact on one's persistence and motivation. Mind wandering, thought suppression, and cognitive appraisal are a few of the common resultants of stereotype threat in a cognitive

context (Schunk 1989). Research suggests that if an individual of a stigmatized group is presented with stereotypes before a task and/or anticipates a stereotype-based task, they are likely to have an increased amount of thoughts and worries regarding the task (Rydell, et al. 2014). The effects of the increased amount of thoughts and worries were later tested, and through indirect measures were found to decrease task attention, which in turn effected performance (Mrazek, et al. 2011). Another major impact on mental capacity is patterns of thought suppression. Similar to mind wandering, thought suppression taxes cognitive resources and can become distracting. When an individual experiences stereotype threat, they become highly aware that their task performance is being judged through the lens of a negative stereotype (Croizet, et al. 2004). The mental distractions caused by the combination of increased awareness and efforts to suppress any associated negative thoughts can impact task performance. Lastly, cognitive appraisal can play a significant role in task performance. Cognitive appraisal occurs when an individual evaluates a task based on the performance implications of a negative stereotype. When individuals evaluate the task based on their ability to defy the negative stereotype, two of the possible outcomes include seeing it as a challenge or as a threat. If it is seen as a challenge, an individual is more likely to perform better at the task in an attempt to disprove the stereotype. On the other hand, if the task is seen as a threat, an individual is more likely to perform poorly and disengage from the task. These impacts of stereotype threat on cognitive function can not only effect task performance but can also impact academic performance and persistence.

One of the spaces where stereotypes and stereotype threat can be most disruptive is in an academic setting, creating a disadvantage to individuals in a stigmatized group pursuing an education (Flore, et al. 2015) (Raphael 2016). In the study that coined the term stereotype threat (Steele, et al. 1995), the hypothesis that implicit stereotypes regarding negative academic performance would create stereotype threat and reduce the academic performance of stigmatized groups was tested. White and Black college students performed a test, and half of the participants were informed that the administrator of the test would be evaluating their academic abilities based on the test thus initiating stereotype threat. The other half of the participants were not told that their academic abilities would be judged based on this test. The resulting data from this test indicated that Black students who were not informed that their academic abilities were being evaluated based on this test performed equally as well when compared to their White counterparts. However, for the other group of participants that was informed, the Black students performed worse than their White counterparts. Subsequent research was conducted that produced similar results (Aronson, et al. 2002), and other studies have found similar results when evaluating the influence of stereotype threats on Latinx academic performance (Blanton, et al. 2002). Although this general research is beneficial, studying the individual stereotypes and stereotype threats experienced by specific minority groups is important.

Stereotypes Experienced by STEM Majors

Often, the root of a stereotype threat centers around a negative stereotype regarding an individual's social identity. These stereotypes can be detrimental to one's ability to complete a

task successfully. Literature indicates that the stereotypes that Latinx students in higher education face have two main focuses, the race-based stereotypes, and the gender-based stereotypes. For women in higher education, specifically in STEM fields, there is a large amount of overlap. When evaluating the stereotypes experienced by Latinx individuals, there is a noticeable amount of similarity with identified microaggressions. Microaggressions are everyday verbal, nonverbal, and environmental insults, intentional and unintentional, that communicate hostile, derogatory, and/or negative messages to target a person in a stigmatized group.

Gender stereotypes play a large role in the academic performance and persistence of Latinx women in higher education. The majority of this body of research focuses on the effects of these stereotypes on women in STEM fields. The most common stereotype themes focus on academic abilities, persistence, and traditional roles. In many of these cases, the stereotypes faced follow the organization of microaggressions. Some of the common microaggression categories that encompass stereotypes are assumption of second-class status and assumption of cultural norms. For women in STEM fields, stereotypes that fall under these themes may trend towards academic capabilities and "traditional" women's roles. Examples of this may be a negative stereotype such as "women are emotional and will drop out of college because that can't handle it" or "women always end up in the home taking care of children". The underrepresentation of women in STEM fields can also make it harder to eliminate gender-based stereotypes. While these stereotypes can affect women in higher education, women who identify with multiple minority groups (such as Latinx women) can experience multiple social identity related stereotypes at once.

For Latinx women in higher education, the category of negative stereotypes broadens, and they experience what is coined as a double-minority status (Blanton, et al. 2002). Given that stereotype threat can directly affect an individual's task completing ability, it can be reasonably inferred that the stereotype threats experienced can be sourced from the connection to multiple groups. Shih, et al. (1999) explored the type of influence a stereotype could have on an individual based on its group source. This was done with a group of Asian women, and it was concluded that they either performed better on a math test when race was emphasized and poorer was gender was emphasized. This research creates a direct connection between task performance in a particular domain to multiple group influences. For Latinx women in engineering, they could not only experience gender stereotypes, but also ones connected to their race.

Latinx identifying individuals often experience stereotypes solely based on race and ethnicity. Many of these negative stereotypes can be categorized under microaggressions. Sue, et al. 2007 categorizes microaggressions to include: assumption of criminal status, denial of individual racism, and assumption of second-class status. Although these categories do not fully encompass all stereotypes experienced, it helps to create a framework for future stereotype identification. For Latinx individuals, the category of assumption of criminality typically includes negative stereotypes such as "all Hispanic individuals are drug dealers or are affiliated with one." While common, non-education specific stereotypes are encompassed by categories such as these,

Latinx students in higher education experience an additional set of stereotypes that does not fit in a preexisting microaggression category. In addition to racial stereotypes, Latinx identifying individuals often face additional stereotypes related to academic abilities and persistence. Some of these negative stereotypes are more strongly experienced by first generation students, such as "Hispanic's fail out of engineering due to lack of education".

Research Methods

Participants and Research Sites

For this study, two Predominately White Institutions (PWI) and one Hispanic Serving Institution (HSI) were selected based on the geographic and demographic diversity. The two PWI's are located in the Southeast and the Midwest United States. The university located in the Southeast has an undergraduate student population consisting of approximately 77% Whites and 4% Hispanics. The university located in the Midwest has an undergraduate student population consisting of approximately 84% Whites and 6% Hispanics. The HSI selected for this study is located in the Southwest region of the United States. This university has an undergraduate student population consisting of approximately 22% Whites and 57% Hispanics.

Data Collection

Recruitment for this study was done entirely via email at all three universities. Flyers were sent to the undergraduate engineering population, and Latinx students were provided with an email to contact a research team member for an initial eligibility screening. This approach was also accompanied by researchers directly contacting potential participants. After initial contact, participants received an informed consent form along with an audio release form via Qualtrics link. The consent form ensured that the participants were at least 18 years of age and identified as Latinx. 28 participants took part in a semi-structured, 15 to 45 minute long individual interview with a trained researcher and were given a $25 Amazon gift card as an incentive. All data collection materials were for ethical compliance by the Institutional Review Board (IRB) at lead university on this study.

Individual interviews ranging from 15 to 45 minutes long were conducted via Zoom with students identifying as Latina, Latino, Latinx, or Hispanic to collect the audio data needed to identify the common stereotypes and stereotype threats that they experienced. These interviews included diverse groups in terms of their major and year in college to allow sufficient representation based on diverse college experiences.

All interviews were conducted in a private setting using an interview protocol that included questions regarding personal identity, stereotypes, stereotype effects and coping mechanisms, and institutional setting. At the beginning of each interview, the moderator described the goal of the study, the rules of the session, and the confidentiality requirements per Institutional Review Board guidelines.

Analysis

The responses collected in the individual interviews were transcribed using the transcription software, Trint, and were reviewed by a member of the research team for accuracy. These interviews transcripts were then reviewed to identify stereotype and stereotype threat themes. During biweekly meetings over a 3-month period, the research team identified the main themes across all interviews. These themes were then turned into a set of analytical codes, which then created a coding matrix that was used to analyze all interview transcriptions in NVivo.

Through analyzing the interview transcriptions, nine stereotype themes and nine stereotype threat themes were identified. During the data analysis process, stereotypes based on both race and gender were considered. The institution that the student attended as well as their year in school were also taken into consideration.

Results

Table 1 shows the nine primary stereotype themes that were identified based on the collected data with their accompanying definitions.

Table 1 – Stereotype Themes and Definitions

#	Stereotype Theme	Stereotype Theme Definition	% of interviews that mentioned it
1	Assumption of Criminality	Stereotypes that assume individuals criminal background	11%
2	Cultural and Religious Assumptions	Stereotypes that assume individuals religious background	7%
3	Denial of Racial Identity	Stereotypes that invalidate one's racial identity based on personal characteristics	32%
4	Assumption of Socioeconomic Class	Stereotypes that assume an individual's class	7%
5	Projection of Assumed Cultural Norms	Stereotypes that enforce over-generalized assumed cultural norms	18%
6	Assumption of Academic Abilities (based on race)	Stereotypes that discredit an individual's academic status and abilities based on race	46%
7	Assumption of Academic Abilities (based on gender)	Stereotypes that discredit an individual's academic status and abilities based on gender	39%
8	Assumption of Behaviors	Stereotypes that assume individuals' behavioral patterns	54%
9	Projection of Gender Roles	Stereotypes that assume an individual's skills based on assumed gender norms	14%

Based on the code frequency data from the interviews, the top three most frequently experienced stereotype themes were assumption of behaviors assumption of academic abilities (based on race), and assumption of academic abilities (based on gender).

Table 2 shows the 9 primary stereotype threat themes associated with the previously identified stereotype themes, and their definitions. The majority of the student participants mentioned being faced with stereotypes during their college education through a wide variety of sources. However, the frequency at which the stereotypes were identified as a stereotype threats differs. An encounter with a stereotype does not necessarily result in a stereotype threat; the response and internalization of the stereotype determines this. A stereotype threat is defined as the fear of inadvertently confirming a negative stereotype about their social identity; in order for the stereotype to become a stereotype threat, the threat (the fear of confirming the stereotype) must be identified.

Table 2 – Stereotype Threat Themes and Definitions

#	Stereotype Threat Theme	Stereotype Threat Definition	% of interviews that mentioned it
1	Assumption of Criminality	The fear of being associated with illegal actions	7%
2	Cultural and Religious Assumptions	-	-
3	Denial of Racial Identity	The fear of behaving or appearing in a way that dissociates an individual from their race and/or ethnicity	18%
4	Assumption of Socioeconomic Class	The fear of acting in a way that others associate with a certain class	4%
5	Projection of Assumed Cultural Norms	The fear of behaving in a way that confirms the assumed norm	11%
6	Assumption of Academic Abilities (based on race)	The fear of confirming the assumed academic status based on race	32%
7	Assumption of Academic Abilities (based on gender)	The fear of confirming the assumed academic status based on gender	32%
8	Assumption of Behaviors	The fear of acting in a way that confirms the assumed behavior	39%
9	Projection of Gender Roles	The fear of behaving in a way that confirms the assumed gender norm	14%

Based on the code frequency data from the interviews, the top three most frequently experienced stereotype threat themes were assumption of behaviors assumption of academic abilities (based on race), and assumption of academic abilities (based on gender).

It was determined based on code frequencies that 86% of the pool of Latinx students experienced at least one stereotype theme during their time in college, and 68% experienced two or more stereotype themes. In some cases, certain stereotype themes and stereotype threats were coded more than once in an interview. It was also determined that 64% of the participants experienced one or more stereotype threat, and 36% experienced two or more stereotype threats. Tables 3 and 4 show the stereotype themes and threats experienced by gender, by institution, and by year of school.

Table 3 – Stereotype Themes by Gender, Institution, and Year in School

Total sample size, n = 28		**Stereotype Theme**								
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Gender	Female (n=12)	8%	0%	58%	8%	25%	50%	92%	50%	25%
	Male (n=16)	13%	13%	13%	6%	13%	44%	0%	56%	6%
Institution	PWI (n=19)	11%	5%	32%	5%	16%	47%	26%	47%	11%
	HSI (n=9)	11%	11%	33%	11%	22%	44%	67%	67%	22%
Year in School	Freshman (n=2)	0%	0%	50%	0%	0%	50%	50%	100%	0%
	Sophomore (n=8)	13%	13%	50%	25%	25%	50%	38%	63%	13%
	Junior (n=7)	14%	14%	43%	0%	14%	71%	57%	57%	14%
	Senior (n=11)	11%	0%	11%	0%	22%	27%	33%	36%	22%
TOTAL		**11% (n=3)**	**7% (n=2)**	**32% (n=9)**	**7% (n=2)**	**18% (n=5)**	**46% (n=13)**	**39% (n=11)**	**54% (n=15)**	**14% (n=4)**

Table 4 – Stereotype Threat Themes by Gender, Institution, and Year in School

Total sample size, n = 28		**Stereotype Threat Theme**								
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Gender	Female (n=12)	8%	-	33%	8%	17%	42%	75%	50%	33%
	Male (n=16)	6%	-	6%	0%	6%	25%	0%	31%	0%
Institution	PWI (n=19)	5%	-	16%	0%	5%	37%	21%	37%	11%
	HSI (n=9)	11%	-	22%	11%	22%	22%	56%	44%	22%
Year in School	Freshman (n=2)	0%	-	50%	0%	0%	50%	0%	50%	0%
	Sophomore (n=8)	0%	-	13%	0%	13%	25%	38%	50%	25%
	Junior (n=7)	14%	-	14%	0%	14%	57%	43%	57%	14%
	Senior (n=11)	11%	-	22%	11%	11%	18%	33%	22%	11%
TOTAL		**18% (n=5)**	**4% (n=1)**	**11% (n=3)**	**32% (n=9)**	**32% (n=9)**	**39% (n=11)**	**14% (n=4)**	**54% (n=15)**	**14% (n=4)**

When analyzing these results, there are some key comparisons to be made. When doing a comparative analysis of stereotype and stereotype themes across gender groups, it was evident

that Latinx identifying females experience higher rates of stereotypes, as well as higher rates of stereotype threat. Although less females were interviewed than males, they experienced more stereotype themes and stereotype threats. Stereotype themes 7 and 9 (i.e., Assumption of Academic Abilities [based on gender] and Projection of Gender Roles) showed the largest difference in experience between gender at 92% and 19% respectively. None of the male participants reported experiencing stereotype theme seven, while 92% of females did. When this theme became a stereotype threat, the percentage of females reporting they experienced it reduced to 75%, while the percentage of males remained 0%. Only 25% of females experienced stereotype theme 9, and it increased to 33% when it became a threat. Males reported 6% and 0%, respectively. In all stereotype threat categories, females reported experiencing them at higher rates than males. For the stereotype themes however, males reported experiencing themes 1, 2, and 8 (i.e., Assumption of Criminality, Cultural and Religious Assumptions, and Assumption of Behaviors) at higher rates than females.

When doing a comparative analysis of stereotype and stereotype themes across institutions, there was no notable difference in the rate at which students at a PWI and students at a HSI experienced stereotype themes. However, when comparing the rate at which students at a PWI and students at a HSI experienced stereotype threat themes, students at the HSI reported experiencing them at slightly higher rates than the students at a PWI.

When doing a comparative analysis of stereotype and stereotype themes across years in school, juniors generally reported experiencing the most stereotype and stereotype threat themes. The freshman, sophomores, and seniors all reported experiencing assumption of behaviors the most at 100%, 63%, and 36%, respectively. The juniors reported experiencing assumption of academic abilities (based on race), at 71%.

The resulting data from the transcribed and coded interviews showed patterns in experienced stereotype themes and stereotype threats, which were influenced by gender, institution, and year in school. It can be noted from this data that, on average, 62% of the time a stereotype theme experienced by a participant became a stereotype threat. Table 5 below shows the percent chance that each stereotype theme will become a stereotype threat.

Table 5 – Stereotype Theme to Stereotype Threat Rate

Stereotype #	Frequency of it Becoming a Threat
1	67%
2	-
3	56%
4	50%
5	60%
6	69%
7	82%
8	73%
9	100%

Discussion

A diverse engineering workforce is essential and Latinx individuals remain underrepresented. Improving the diversity of universities is the first step in raising these numbers. Many Latinx individuals experience stereotypes that often result in negative experiences (Reny et al., 2016) that can reduce academic persistence (Owens, 2010). Exploring the stereotype themes and stereotype threat themes is important to understanding the student experience and finding a way that it can be improved. This study found that the assumption of academic abilities (based on race and gender) and assumption of behaviors were the most commonly experienced stereotype themes. For females, the assumption of academic abilities (based on gender) was the most experienced theme, at 92% of female participants reporting having experienced it. When discussed in interviews, males had no experiences with stereotypes regarding academic ability based on gender and some even stated that it was simply due to the fact that they were male. Males, on the other hand, experienced Assumption of Behaviors most commonly. In interviews, this theme was most often associated with stereotype such as “Hispanics are loud and aggressive.”.

While many reported that the stereotype themes that experience were also experienced as threats, a few reported that it gave them a sense of empowerment. For some participants, the Assumption of Academic Abilities (based on gender and race) made them feel empowered to prove the stereotype wrong and work harder academically. In other cases, participants pushed themselves to prove stereotypes wrong with their actions and/or tried to educate their peers. This, however, was the only noted positive effect of the stereotypes experienced.

This study has limitations that should be noted and used to provide future studies with research direction. First, this data has been collected through self-report measures. Despite the data coming directly from the source (the individual), there is still a risk of the participant choosing not to explicitly report all experiences. Additionally, this data was collected from various points in students’ academic careers, which could influence their perspective and experiences. Future research would benefit from data collect via methods other than self-reporting, as well as an extended timeline of data collection (possibly following students through all years of their undergraduate career).

Conclusion

The engineering workforce is generally less diverse than other professions. Despite the growing rate of engineering bachelor’s degrees being awarded, the numbers see no significant change. Recently, more research has been conducted on factors towards lack of diversity in the engineering field in an effect to improve this. This research includes the topics of stereotypes and stereotype threats, to identify underlying blocks to persistence. While this body of research is expanding, there is a gap in body of knowledge regarding the types of stereotypes and stereotype threats experienced by Latinx students pursuing a bachelor’s degree in engineering.

This study aimed to identify these stereotypes and stereotype threats and sort them into themes. The results showed a variety of different themes that affected everyone differently and differences were noted between genders, institutions, and year in school. Many noted that these stereotypes made them doubt their academic abilities and reduce their confidence in their ability to get the engineering degree they sought after. As long this continues, growth in the diversity of engineering programs may be impeded, which it turn effects the diversity of the workforce as a whole. In order to promote a more diverse field, issues surrounding these stereotypes and stereotype threats must be addressed and reduced. Follow-up research to this study needs to examine the effects of theses stereotypes on student persistence and explore coping mechanisms and strategies that help to reduce these experiences. Stereotypes foster a negative learning environment and engineering field; the goal is to eliminate these experiences among Latinx students in engineering.

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