Broadening the Participation of Latinx in Engineering: Highlights from a National, Longitudinal Study

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Abstract

To broaden participation of Latinx in engineering, we conducted the largest scale, longitudinal retention study of an underrepresented minority group in engineering to date. Here, we present quantitative and qualitative findings of the first 3 years of this 5-year project, which investigated the temporal effects of social cognitive, personal, and contextual factors on engineering students' persistence decisions as posited by Social Cognitive Career Theory (SCCT) [1, 2]. We present themes that emerged from individual interviews with 32 Latinx and White engineering students [3]. Using a large sample of over 800 Latinx engineering students from 6 Hispanic Serving Institutions and 5 Predominantly White Institutions, we found that SCCT predictors contributed significant variance in satisfaction and persistence outcomes, with self-efficacy and supports serving as reliable predictors [4]. We found nonsignificant, single-group differences in associations within the model (i.e., Latinxs vs. Whites); however, intersectional differences were found. Specifically, we found contextual differences for Latinx engineering students (i.e., differences between Latinxs attending HSIs and PWIs). These results suggest that interventions aimed at broadening Latinxs' participation in engineering need to be tailored for Latinx student subgroups.

Introduction

The National Science Foundation's (NSF) Strategic Plan identifies developing a diverse STEM workforce as a key objective [5]. Despite this, slow progress has been made over the past decades to broaden the involvement of underrepresented racial minorities (URM) in engineering [6], which remains one of the most race-segregated professions. For example, in 2014, Latinos (7.5%), and Latinas (2.1%) received a small percentage of bachelor's degrees in engineering relative to White men and women (50.3% and 11.2%, respectively; [6]). Latinos and Latinas have one of the highest labor force participation rates (76%, and 55.8%, respectively; [7]), but represented only 6%, and 1%, respectively, of the engineering workforce [6]. Without new knowledge regarding factors related to Latinx' experiences in engineering, our nation is at risk of underutilizing a significant segment of the labor pool that remains untapped in engineering.

In this paper, we summarize quantitative and qualitative findings from the first 3 years of the largest scale, longitudinal retention study of an underrepresented minority group in engineering to date. This 5-year project investigated the longitudinal effects of social cognitive, personal, and contextual factors on engineering students' persistence decisions as posited by Social Cognitive Career Theory (SCCT) [1, 2]. The findings from the project extend our prior work, a 3-year longitudinal project conducted with over 500 Latinx and White engineering students enrolled at a Hispanic Serving Institution (HSI), a college or university where at least 25% of undergraduates are full-time Latinx students [8-13].

Theoretical Framework

Our research is guided by Social Cognitive Career Theory [1, 2], which provides multiple pathways for explaining how people develop career interests, make career choices, and perform in career activities. SCCT is widely regarded for its applicability to understanding the career development of URM due to its focus on how personal (i.e., cultural) and environmental (i.e., contextual supports) factors influence career decisions. Importantly, SCCTs findings have been linked to career interventions to modify social cognitions that shape career decisions (e.g., [8, 13]).

Derived from Bandura's (1986) social cognitive theory, SCCT was originally conceptualized as three segmental models that explain the development of career interests, choice, and performance [1, 2]. New SCCT models were developed to explain vocational satisfaction and well-being [10, 11], and career management [9]. At the core of the original SCCT model, and most of the SCCT models that followed, are *self-efficacy* (i.e., confidence in the ability to successfully perform a domain-specific task, like a specific engineering skill), *outcome expectations* (i.e., anticipated outcomes of a particular behavior), *interests* (i.e., patterns of likes/dislikes for career activities), and *goals* (i.e., determination for a particular outcome). Taking this one step further, Lent *et al.*'s [9] integrative social cognitive model of academic adjustment, derived from both SCCT [1, 2] and the social cognitive model of academic satisfaction [10, 11], explains how people achieve satisfaction and persist in academic or career domains (see Figure 1). The integrative SCCT model accounts for personal (i.e., personality and affective traits) and environmental (i.e., supports, resources, obstacles) factors that are hypothesized to influence social cognitions (i.e., self-efficacy and outcome expectations). In turn, these social cognitions are believed to inform the development of domain-specific interests and satisfaction. All of these variables are theorized to be a direct or indirect source of persistence in a given academic or career domain. We hypothesize that the variables will relate to one another as predicted by SCCT (see Figure 1). Analyses regarding group differences in the relations among the SCCT variables are exploratory.

As mentioned earlier, Bandura's social cognitive theory is at the core of SCCT [12]. According to this theory, self-efficacy beliefs are influenced by four learning experiences: mastery of prior performances, vicarious learning, verbal persuasion, and physiological states. Prior meta-analyses found support for the social cognitive model in STEM domains [14, 15]. Specifically, these studies reported that the learning experiences explained significant variance in STEM self-efficacy and STEM outcome expectations.

Findings from Prior Project

The questions that we explore in the current project are informed by what we learned in our prior 3-year project. In the prior project, we used path analyses to test whether the data fit the SCCT model. In addition, we performed multigroup analyses using path analyses to compare the associations among the SCCT variables across Latinx and White students who attended one HSI. Across these studies, we found that (a) SCCT predictors accounted for a significant amount of the variance in academic satisfaction and persistence, (b) self-efficacy and social supports were especially important in academic satisfaction and persistence, and (c) relations among the SCCT variables were generally consistent across Latinxs and Whites, suggesting that educational interventions would be equally effective for these students [16-21]. However, when we examined the data of Latinx students only across three time points, each a year apart, results of a latent growth modeling analysis indicated that Latinxs showed *decreases in perceived social supports and coping efficacy* and *increases in perceived barriers* across time, suggesting that *long-term efforts* are needed to support Latinx engineering students across their time in college [22].

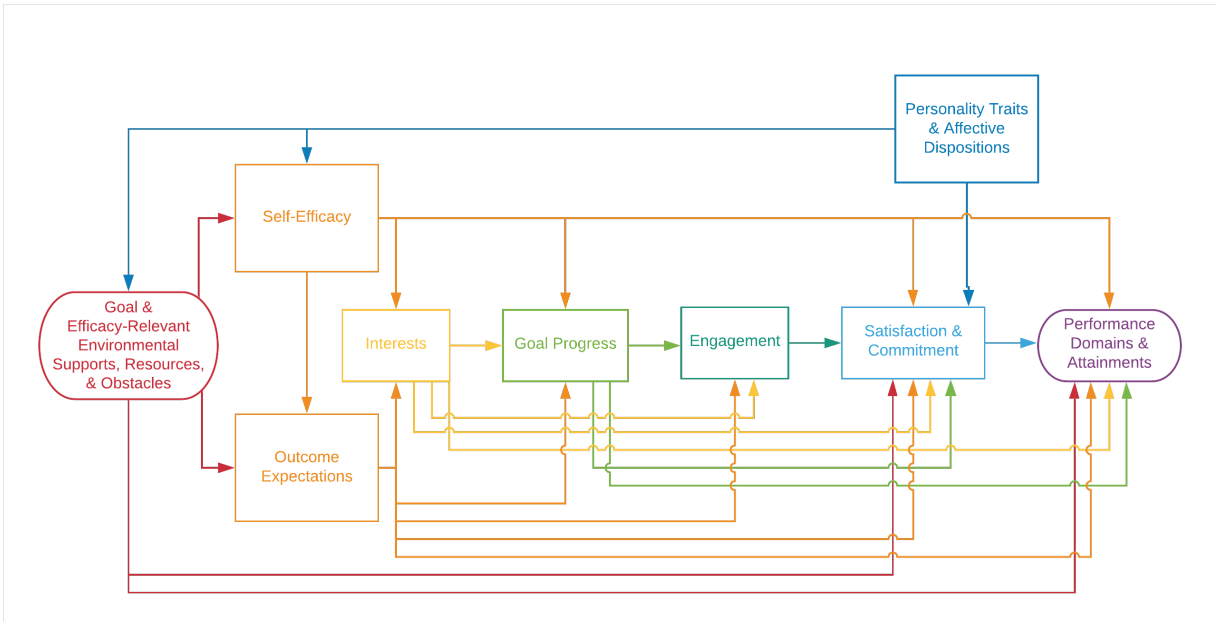

Figure 1. The Integrative Social Cognitive Career Theory Model describes the relationships among several factors, including self-efficacy and outcome expectations, and performance and attainments.

Further, our prior project found that the effects of the four learning experiences (i.e., performance accomplishments, vicarious learning, verbal persuasion, physiological arousal) varied depending on the domain (i.e., Realistic or Investigative) and construct (self-efficacy or positive outcome expectations) for Latinx engineering students attending a single HSI [16]. Results of a path analysis found that three of the four learning experiences (vicarious learning, verbal persuasion, emotional arousal) had small effects on Investigative self-efficacy, but none had a significant effect on Investigative outcome expectations. On the other hand, *all four* learning experiences had significant, but small, effects on Realistic positive outcome expectations; only low physiological arousal had a small effect on Realistic self-efficacy. Most of the variance accounted for in Realistic and Investigative self-efficacy and outcome expectations were related to the effects of self-efficacy and outcome expectations from Time 1 to the same variable at Time 2. Analysis of interviews using consensual qualitative research[23] with ten Latinx engineering students identified five domains that played a role in their persistence decisions: institutional conditions, additive intersectional burdens, personal and cultural wealth, coping skills, and engineering identity [24]. However, the findings from this 3-year project were limited to a sample attending the same HSI. Another limitation of the project was that the sample size only allowed single group comparisons (i.e., Latinx vs. Whites) and precluded intersectional comparisons (i.e., Latinos vs. Latinas vs. White men vs. White women).

The current project extended our prior work by sampling Latinx and White engineering students across 11 institutions, including both Predominantly White Institutions (PWIs) and HSIs. Our *primary aim* was to investigate the effects of social cognitive, cultural, personality, and contextual factors on engineering students' satisfaction, engagement, and persistence. We also examined if the measured variables operated differently across groups by gender, race (Whites vs. Latinx), institutions (PWIs vs. HSIs), and the interaction of race X gender and race X institution. Our *secondary aim* was to use qualitative methods to identify salient individual and institutional factors related to persistence and drop out decisions.

Methods

We used both quantitative and qualitative research design. The quantitative study targeted Latinas, Latinos, and White men and women engineering majors enrolled at 11 partner institutions (6 HSIs and 5 PWIs). All Latinx and White engineering majors enrolled at the partner institutions in the 2014-2015 academic year were invited to participate in an online survey, which included measures (see Table 1 for a list of all measures with citations, total number of items, and internal consistency reliabilities) to assess demographic data, engineering learning experiences, engineering perceived supports, engineering perceived barriers, engineering self-efficacy, engineering positive outcome expectations, engineering negative outcome expectations, engineering interests, engineering academic satisfaction, engineering academic engagement, engineering persistence intentions, and persistence in engineering. All of the measures were previously used in research and demonstrated adequate reliability and validity with Latinx.

Table 1: Variables for Survey

Variable	Source & Sample Items	# Items	Reliabilities
1. PERSONALITY TRAITS AND AFFECTIVE DISPOSITIONS			
Instrumentality	Spence & Helmreich (1980)	12	.80, .87
Sample item: *Choose which number describes where you fall on the scale between not at all competitive to very competitive.*			
Positive Affect	Watson, Clark, & Tellegen (1988)	10	.93
Sample item: *Indicate to what extent you felt interested over the past week*			
2. GOAL & EFFICACY-RELEVANT ENVIRONMENTAL SUPPORT, RESOURCES, AND OBSTACLES			
Future Family Considerations	Ganginis Del Pino et al. (2013)		
Sample item: *Having quality time for raising children will be the most important consideration in my career choice.*			
Ethnic Identity	Phinney & Ong (2007)	6	.81
Sample item: *I have a strong sense of belonging to my own ethnic group.*			
U.S. Acculturation	Zea, Asner-Self, Birman, & Buki (2003)	21	.94
Sample item: *Being U.S. American plays an important part in my life.*			
Engineering Supports & Barriers	Lent et al. (2005)	14	.86, .86
Sample item: *I get encouragement from my friends for pursing an engineering major.*			
Race- & Sex-related Career Barriers	Luzzo & McWhirter (2001)	12	.86, .86
Sample item: *In my future career, I will probably be treated differently because of my sex.*			
3. LEARNING EXPERIENCES			
Engineering Learning Experiences	Garriott et al. (in development)	20	In progress
Sample item: *I have successfully solved technical problems.*			
Realistic & Investigative Learning Experiences	Schaub & Tokar (2005)	40	.89, .84
Sample item: *People whom I respect have encouraged me to work hard in math courses.*			
4. SELF-EFFICACY EXPECTATIONS			
Engineering Task Self-Efficacy	Singh et al. (2013)	21	.93
Sample item: *How confident are you in* your abilities to design a new product to meet specified requirements?			
Engineering Self-Efficacy	Lent et al. (2005)	4	.91
Sample item: *How much confidence do you have in your ability to excel in your engineering major over the next semester?*			
Job Search Self-Efficacy	Caplan, Vinokur, Price, & van Ryn (1989)	6	.84

Sample item: *Confidence in contacting and persuading potential employers to consider you for a job.*			
Work Self-Efficacy	Avallone, Pepe, & Porcelli (2007)	10	.85
Sample item: *Thinking of future (current) work, how well can you achieve goals that will be (are) assigned?*			
5. WORK/ACADEMIC CONDITIONS AND OUTCOME EXPECTATIONS			
Engineering Outcome Expectations	Lent et al. (2003)	10	.89
Sample item: *Graduating with a BS degree in engineering will likely allow me to earn an attractive salary.*			
Engineering Task Outcome-Expectations	Singh et al. (2013)	11	.84
Sample item: *When I am successful at my work tasks, then my manager(s) will be impressed.*			
Negative Outcome Expectations	Lee et al. (2018)	21	.94
Sample item: *Being employed as an engineer will likely result in feeling intimidated by more outstanding coworkers.*			
Work Values	PI Developed (Flores & Navarro)	20	.88
Sample item: *How important is (engaging in the pursuit of knowledge and understanding) to you in your work?*			
6. INTERESTS			
Engineering Interests	Lent et al. (2003)	7	.89
Sample item: *Indicate your degree of interest in solving complicated technical problems.*			
Realistic & Investigative Interests	Adapted from Lenox & Subich (1994)	10	.90, .84
Sample item: *Indicate the degree to which you are interested in performing a scientific experiment or survey.*			
7. PARTICIPATION/ PROGRESS AT GOAL DIRECTED ACTIVITY			
Goal Progress	Adapted from Lent et al. (2005)	5	.86
Sample item: *How much progress they were making toward your academic (work) goal of ____________?*			
8. SATISFACTION			
Engineering Academic Satisfaction	Lent et al. (2007)	7	.94
Sample item: *I am generally satisfied with my academic life in engineering.*			
Work Satisfaction	Hackman & Oldham, 1975	3	.76
Sample item: *I am generally satisfied with the kind of work I do in my job.*			
9. PERFORMANCE ATTAINMENT			
Engineering Academic Engagement	Adapted from NSSE (2013) & Gasiewski et al. (2012)	15	.83, .75
Sample item: *Study with students from your engineering courses*			
Engineering Persistence Intentions	Lent et al. (2003)	4	.95
Sample item: *I plan to remain enrolled in the [school of engineering] over the next semester.*			
Persistence in Engineering	Self-Report	1	--
Sample item: *I am currently a student/employee in an engineering setting.*			
Turnover Intentions	Hom et al. (1984)	4	.90
Sample item: *I often think about quitting my job.*			
Work engagement	Schaufeli et al. (2006)	9	.77
Sample item: *I am enthusiastic about my job.*			

In Year 1, 1,413 students (779 Latinx, 610 White, 24 multiracial) completed the online survey. A total of 761 were men, 647 were women, and 5 were transgender; 827 were attending a PWI and 586 were attending an HSI. Participants represented a range of engineering majors and all levels in college (first year to final year). A year later, Year 1 participants were contacted via email and were invited to participate in the second wave of data collection, which included completing an online survey of all of the same measures from Year 1. In Year 2, we received data from 1,183 of the Year 1 participants, resulting in a response rate of 84%. In Year 3, we received data from 830 of the Year 1 participants, resulting in a response rate of 59% from Year 1 to Year 3. Students received an Amazon gift card for their time to complete the surveys; we used a graduated incentive schedule where the incentive increased each year based on the number of waves they had completed. Findings presented here are drawn from Waves 1, 2, and 3 of the online survey; we are still analyzing the data from Waves 4 and 5 of the survey.

Thirty-two participants who completed the Year 1 online survey participated in two 60 to 90 minute individual interviews, conducted one year apart. Interview questions aligned with conceptual dimensions of SCCT: life as an engineering student, perceived gains and negative consequences of studying engineering, self-efficacy, supports, challenges, organizational climate, relationships with students and professors, family expectations, and experiences of stereotyping, harassment, and discrimination (see Appendix A for the Interview Protocol). Participants in the qualitative study included 7 Latinas, 10 Latinos, 7 White women, and 9 White men. Nine of these participants attended HSIs, and the remaining (n = 23) attended PWIs. Participants' average age was 20.25 years. The interviews were audio-recorded and transcribed verbatim.

Summary, Findings, and Discussion

In this section, we summarize results from studies drawn from this project. When relevant, we also compare and contrast the findings in relation to results from our first 3-year project.

We performed a series of MANOVAs to examine differences in the measured variables across groups by race (Latinx, White), institution (HSI, PWI), and the interaction of race and institution (Latinx attending PWI, Latinx attending HSI, Whites attending PWI, Whites attending HSI). We compared scores on measures that assessed: engineering self-efficacy, engineering positive outcome expectations, engineering negative outcome expectations, engineering interests, engineering goal progress, intended persistence in engineering, engineering learning experiences mastery performance, engineering learning experiences vicarious learning, engineering learning experiences verbal persuasion, engineering learning experiences physiological arousal, engineering supports, engineering barriers, engineering race-related barriers, and engineering coping efficacy. Results indicated significant racial differences on interests, vicarious learning, verbal persuasion, barriers, race-related barriers, and coping efficacy and significant institutional differences on self-efficacy, negative outcome expectations, interests, goal progress, verbal persuasion, and coping efficacy (see Table 2; values highlighted in yellow indicate significant differences). No differences were found across race X institution groups on any of the variables, with the exception of perceived race-related barriers, with Latinx attending PWIs scoring the highest (2.70) followed by Latinx at HSIs (2.53), Whites at HSIs (2.19), and Whites at PWIs (1.97).

Table 2: Mean differences on the measured variables across race and institution.

	Race/Ethnicity		Institution	
	White	Latinx	PWI	HSI
Engineering Self-Efficacy	6.94	7.09	6.83	7.29
Engineering Positive Outcome Expectations	7.36	7.47	7.35	7.51
Engineering Negative Outcome Expectations	3.68	3.68	3.75	3.59
Engineering Interests	3.77	3.94	3.76	4.00
Engineering Goal Progress	3.19	3.19	3.15	3.25
Intended Persistence in Engineering	4.68	4.62	4.65	4.65
Engineering Learning Experiences - Personal Mastery	4.48	4.44	4.45	4.47
Engineering Learning Experiences - Vicarious Learning	4.60	4.48	4.52	4.55

Engineering Learning Experiences - Verbal Persuasion	4.17	4.16	4.08	4.27
Engineering Learning Experiences - Physiological Arousal	3.82	3.74	3.78	3.76
Engineering Perceived Supports	3.86	3.93	3.86	3.96
Engineering Perceived Barriers	2.02	2.28	2.09	2.26
Engineering Coping Efficacy	7.33	7.68	7.35	7.80
Engineering Perceived Race-Related Barriers	2.01	2.60	2.25	2.46

In a study [25] with 655 Latinx students (400 Latinos, 255 Latinas) who completed the Year 1 survey, results of a path analysis indicated that perceived supports and the four learning experiences were significantly related with engineering self-efficacy. Specifically, mastery performance and verbal persuasion had medium effects and perceived supports, vicarious learning, and low emotional arousal had small effects on engineering self-efficacy. Perceived barriers were not significantly related to engineering self-efficacy. Engineering self-efficacy, perceived supports, mastery performance, verbal persuasion, and low emotional arousal were significantly related (ranging from small to medium effects) to engineering positive outcome expectations, whereas vicarious learning and perceived barriers had no significant effects. Together, these variables explained 38% and 28% of engineering self-efficacy and engineering positive outcome expectations, respectively. These findings contrast with the findings from the previous project, where the associations between the four learning experiences and self-efficacy and outcome expectations were assessed in Realistic and Investigative domains [25]. In the current project, when these variables are assessed in the engineering domain, we found that the learning experience variables explained a larger amount of variance in both engineering self-efficacy and engineering positive outcome expectations.

Using a diverse sample of 1335 engineering students from Year 1, we used path analysis to assess the fit of the data to the SCCT model. We also performed a series of multiple group analyses to compare the hypothesized model across groups based on race X institution and race X gender. Navarro *et al.* reported that the data fit the model well for the full sample and across 8 sub-samples based on race/ethnicity X gender (i.e., Latinas, Latinos, White women, and White men) and race/ethnicity X institution (i.e., Latinx at HSIs, Latinx at PWIs, Whites at HSIs, and Whites at PWIs), and the SCCT variables explained a significant amount of variance in engineering academic engagement, satisfaction, and persistence intentions for the full sample and 8 sub-samples [4]. *Specifically:*

- perceived supports, engineering self-efficacy, engineering positive outcome expectations, and engineering interests were **positively associated with engineering academic satisfaction**;
- supports, engineering self-efficacy, and engineering positive outcome expectations were **positively related with intended persistence**; and
- academic satisfaction was **positively related to intended persistence** indicating that efforts to increase students' satisfaction in engineering may enhance persistence intentions.

These findings partially support findings from the first project with engineering students attending a single HSI [21]. Importantly, different from the first project, the results from the current project with a larger sample of students across multiple institutions suggest that:

(a) positive outcome expectations are related to engineering academic satisfaction and

intended persistence, and
(b) interests are related to engineering academic satisfaction.

When comparing the associations among the variables in the model across Latinx and White students, we found no differences. We also found no differences in the associations in the model across Latinos vs. Latinas; Latinos and White men; and Latinas and White women. That is, there were no gender differences among Latinx students, and no racial differences among men or women. Further, we found no differences in the associations among the variables between Latinx students attending HSIs and White students attending HSIs or between Latinx students attending PWIs and White students attending PWIs. In essence, we found ***no racial differences among students attending the same type of institution***. However, we found institutional differences among Latinx engineering students. The relations from self-efficacy to both goal progress and academic satisfaction was significant and positive for both groups, but it was stronger for Latinx attending PWIs than their Latinx peers attending HSIs. Similarly, the relationship between perceived supports and academic satisfaction was significant and positive for both groups, but stronger for Latinx attending PWIs than Latinx attending HSIs. This indicates that ***self-efficacy and perceived supports are especially important in academic outcomes for Latinx students in institutional contexts where they are a minority***. Finally, the relation between interests and intended persistence was significant and positive for Latinx at PWIs and nonsignificant for Latinx at HSIs. Navarro *et al.* found that interests were not a predictor of intended persistence among a sample of engineering students at a single HSI, but when we tease apart the effects across institutions with the larger sample in the current project, we see that interests are important for Latinx students at PWIs [21].

Several themes and subthemes emerged from a thematic analysis of the interview data conducted in Years 1 and 2 [3]. These themes are presented in Table 3.

Table 3. Themes and subthemes from Years 1 and 2 Qualitative Interviews

Themes	**Subthemes**
Dominance of White Male Culture	Marginalizing conditions
	White fragility
	Individualism
Resistance	Cultural humility
	Cultural wealth
	Inclusive conditions
Psychological Effects and Practices	Intentional coping
	Perceived barriers
	Normalized challenges
	Self-efficacy gains
Engineering Identity	Engineering culture
	Sense of purpose

To summarize, findings from the current project indicated ***racial and institutional differences in mean scores among several of the variables assessed through the online survey***. Specifically, Latinx students reported higher engineering interests, perceived barriers, perceived race-related barriers, and coping efficacy, but lower vicarious learning and verbal persuasion than their White peers. In addition, students attending HSIs reported higher self-efficacy, interests, goal progress, intended persistence, verbal persuasion, and coping efficacy, and lower negative outcome expectations than students attending PWIs. It is important to note that Latinx students report lower rates of observing others engage in engineering related activites and lower rates of receiving verbal encouragement for pursuing engineering related activites than their White peers. Qualitative themes suggest the institutional contexts of HSIs and PWIs interact with students' individual and cultural characteristics to explain persistence in engineering. ***Developing a strong professional engineering identity along with a psychological agency in their career path appeared to play an important role in engineering persistence for all participants, particularly those from underrepresented groups (i.e., women and Latinx students).***

Across both the prior 3-year and current 5-year projects, SCCT predictors explained significant variance in SCCT outcomes. In particular, self-efficacy was a consistent, robust predictor of academic outcomes (satisfaction, intended persistence). The findings from Hunt *et al.* suggest that engineering education can incorporate teaching strategies that capitalize on the four learning experiences (i.e., mastery performance, vicarious learning, verbal persuasion, physiological states) to build students' self-efficacy beliefs and positive outcome expectations in engineering [25]. Boosting students' self-efficacy and positive outcome expectations are two promising pathways for improving Latinx students' satisfaction and persistence in engineering. The development of self-efficacy-based interventions may influence the outcomes that are associated with persistence in engineering.

In the current project, and consistent with the prior project, no differences emerged between Latinx and White students. However, in the current project we were able to examine intersectional differences given the larger sample and we found that Latinx students across institutions differed across some of the paths in the SCCT model. These findings indicate that *context matters for Latinx students*, and points to potential areas to target for increasing the retention of Latinx engineering students attending PWIs, namely developing engineering-related self-efficacy, supports, and interests. It would be worthwhile to investigate cultural contexts that boost social-cognitive factors of Latinx stduents from a more detailed perspective in future studies. Also, positive outcome expectations emerged as a significant factor in academic outcomes in the current project, but not the prior project with engineering students attending a single HSI. These findings underscore the need for more studies that examine differences across intersectional groups and suggest that interventions need to be tailored by institutional context for groups of Latinx engineering students to enhance relevant SCCT variables that predict persistence in engineering. Uniform interventions may perpetuate the status quo and limit the efforts to broaden engineering to Latinx. Future research can also extend to exploring potential differences across other intersectional groups, including African American/Black and Native American students.

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Appendix A: NSF 2014 Qualitative Study Interview Protocol

1. **What motivated you to initially choose engineering as your college major?**
    a. *What or who helped you make this decision?*
        i. *Probe summer work workshops, family members, professional organizations, etc.*
    b. *Internal and External Motivators (Interests, Outcome expectations, Self-efficacy in their math and science)*
    c. *Make sure to determine when the decision was made (e.g., before arriving at college or during college)*
2. **Before beginning your major, what did you expect life to be like as an engineering student?**
    a. *Where do you think these expectations came from?*
        i. *Probe both positive and negative expectations*
3. **How would you describe your life as an engineering student?**
    a. *What have you enjoyed about being an engineering student?*
    b. *What has been challenging about being an engineering student?*
    c. *How have you coped with these challenges?*
4. **What do you expect to gain from studying engineering?**
    a. *Probe for emotional (e.g., feeling excited about solving problems), social (e.g., gaining respect from others), and self-evaluative outcomes (e.g., higher self-esteem)*
5. **What, if anything, do you expect to lose from studying engineering?**
    a. *Probe for emotional (e.g., lower well-being), social (e.g., social isolation), and self-evaluative outcomes (e.g., decreased self-esteem)*
6. **Tell me about people at the university who have supported you in your pursuit of an engineering degree.**
    a. *What did these people do or say that felt supportive?*
7. **Tell me about any other people in your life who have supported you in your pursuit of an engineering degree.**
    a. *What did these people do or say that felt supportive?*
8. **Tell me about any additional university offices, services, or organizations that have supported you in your pursuit of an engineering degree.**
9. **What, if any, challenges have you encountered as an engineering student?**
    a. *How have you dealt with them?*
    b. *How have these challenges affected your decision to continue as an engineering student?*
10. **Some people have noticed that the College of Engineering and the [specific sub-discipline] department have a particular climate/atmosphere/culture. How would you describe this climate/atmosphere/culture?**
    a. *How do you see yourself fitting within this culture/climate/atmosphere?*
    b. *How do you experience the environment in the classroom?*
    c. *What has your experience been participating in group projects?*
    d. *How are your ideas received?*
        i. Definition of Organizational Culture

1. "the specific collection of values and norms that are shared by people and groups in an organization and that control the way they interact with each other and with stakeholders outside the organization"
2. Valuing Specific behaviors and beliefs
3. Presence of unspoken or spoken expectations about interactions with professors and fellow students within engineering and in other university departments

ii. Definition of Climate: the prevailing attitudes, standards or environmental conditions of a group

iii. Definition of Atmosphere: general pervasive feeling or mood

11. How would you describe your relationships with other engineering students?
   a. *Are there any specific interactions with other engineering students that you remember vividly?*

12. How would you describe your relationships with engineering professors?
   a. *Are there any specific interactions with engineering professors that you remember vividly?*

13. In what way, if any, do you think being [insert participant's race/ethnicity and gender group] have influenced your experiences as an engineering student?

For Latinas only (women):

14. Have you experienced explicit harassment or discrimination based on your gender?
   a. *How did you handle the situation?*

15. Some people notice that their professors and fellow engineering students make assumptions about what a Latina woman engineer student is like. How, if at all, have you experienced that? (describe).
   a. *How did that affect you?*
   b. *How did you manage it?*

16. How did expectations of you as a Latina woman align with a career in engineering?

17. In what way did the expectations of your family align with a career in engineering?

18. Were there any ways in which an engineering career did not fit those expectations?
   a. *Personal?*
   b. *Familial?*
   c. *Friends/Peers?*

For Latinos only (men):

19. Some people report that they don't hear or see explicit racism, harassment or discrimination but they notice that their professors and fellow engineering students make assumptions about what a Latino engineering student is like. Have you experienced that? (describe).
   a. *How did that affect you?*
   b. *How did you manage it?*

20. How did expectations of you as a Latino man align with a career in engineering?

21. In what way did expectations of your family align with a career in engineering?

22. Were there any ways in which an engineering career did not fit those expectations?

a. *Personal?*
b. *Familial?*
c. *Friends/Peers?*

For White women only:

23. Have you experienced explicit harassment or discrimination based on your gender?
   a. *How did that affect you?*
   b. *How did you handle the situation?*

24. Some people report that they don't hear or see explicit sexism, harassment or discrimination but they notice that their professors and fellow engineering students make assumptions about what a woman engineer student is like. Have you experienced that? (describe).
   a. *How did that affect you?*
   b. *How did you manage it?*

25. How did expectations of you as a woman align with a career in engineering?

26. In what way did the expectations of your family align with a career in engineering?

27. Were there any ways in which an engineering career did not fit those expectations?
   a *Personal?*
   b. *Familial?*
   c. *Friends/Peers?*

Ask Everyone

31. In light of all the questions I have asked you today, do you have any final thoughts you would like to share with me about your experience as an engineering student?