

# Effects of Research and Internship Experiences on Engineering Task Self-Efficacy on Engineering Students Through an Intersectional Lens

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## Abstract

High-impact academic experiences, particularly research and internship experiences, have positive impacts for engineering students on engineering task self-efficacy (ETSE), a measure of students' perception of their ability to perform technical engineering tasks. However, under-represented racial/ethnic minority students (URM) and women in engineering are found to have relatively lower self-perceptions across several academic and professional self-efficacy measures. Previous studies examined the impact of research and internship experiences on ETSE for students categorized by gender and URM status separately. The current study explores the impact of these experiences on ETSE for the intersection between these two identity categories.

This study found that both non-URM and URM women that participated in research and internship experiences had lower ETSE scores than non-URM and URM men, respectively. However, URM women that participated in *both* research and internship experiences had a statistically similar ETSE score to non-URM men that had not participated in either. This study uses multiple linear regression to measure the association between engineering internships and student's reported ETSE (effects of participating in research were not found to be significant across identities). Preliminary findings indicate that differences in ETSE between internship participants and non-participants are highest for URM women when compared to their counterparts. Consistent with the literature, this research finds that there is a greater positive effect in ETSE scores, as a result of participation in both research and internship experiences, for URM women than their majority counterparts.

These preliminary results provide a foundation for further studies to causally investigate the link between academic experiences and self-efficacy levels for students who are underrepresented in engineering programs. Future implications of this work include the creation of targeted intervention efforts to increase support for all URM students' access and participation in research and internship experiences. Additionally, this work seeks to challenge the bias towards monolithic interpretations of women and URM engineering students as separate categories and encourage intersectional perspectives when analyzing data to produce more inclusive results.

**Key Concepts:** intersectionality, self-efficacy, engineering task self-efficacy, learning outcomes, academic pathways, inclusion, engineering experiences, research, internships

## Introduction

This study considers the intersectionality of students' identities as underrepresented minorities (URMs) and women in evaluating the impacts of undergraduate research and internship experiences on engineering task self-efficacy (ETSE). This analysis is based on the first Engineering Majors Survey (EMS), which provides a large dataset (Total N = 5,819; URM women N = 274; URM men N = 533) useful for statistically evaluating nuances of particular intersections of identities. This study focuses on intersections of gender and URM status for engineering students, the analysis of which has historically been limited due to small sample sizes. The EMS is part of a multi-year National Science Foundation (NSF) funded research initiative (Epicenter<sup>1</sup>) with a goal to identify experiences and environments that encourage innovation and entrepreneurship amongst engineering students over time. EMS is a longitudinal dataset of nationally representative engineering students<sup>2</sup> who are surveyed at three time points: (1) as undergraduate students, (2) upon graduation, and (3) early years in the workforce. This analysis is based on the first time point; juniors, seniors, and 5th year undergraduate engineering students. The survey includes measures of ETSE, participation in experiences such as undergraduate research and engineering internships, and demographic information including race/ethnicity and gender.

Using Bandura's Social Cognitive & Self Efficacy Theory and conceptions of feminist intersectionality theory as a framework, this study explores the differences in ETSE measures of URM women (N = 274) that engage in research and internship experiences in college as compared to those of their engineering majority counterparts non-URM women (N = 1,448) and non-URM men (N = 3,564) in engineering. One-way ANOVA, multiple linear regressions, and Cohen's d were employed to test for levels of significance across sample means.

## Background

Intersectionality, first coined by Kimberlé Crenshaw [1], is a term used to describe how identities, such as race and gender, can interact such that the experiences of URM women, for example, are different than the experiences of both URM men as well as non-URM women. Frameworks built using Feminist Intersectional Theory posit that research conducted along strict single dimensions of identity, such as by considering race and gender separately, may overlook the more nuanced effect on individuals with intersectional identities.

Many scholars studying engineering education often present their results by either parsing the data by gender or racial lines. Consequentially, the data comparing gender often is dictated by

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<sup>1</sup> <http://epicenter.stanford.edu/>

<sup>2</sup> For the purposes of this study, underrepresented minority (URM) is defined as any respondent who indicated a Latino/a, African American, Native American or Pacific Islander race or ethnicity.

White and Asian women, whereas comparing by race is often dictated by Black and Latino men (given the national averages of students enrolled in undergraduate engineering programs). This inadvertently leaves URM women's experiences out of the conversation and potentially misses new areas of research.

Intersectionality is a necessary framework in engineering education because college campuses, and notably male-dominated fields, have long been presumed to have a "chilly climate" that is not conducive to, and possibly hinders women's learning [2]. However, underrepresented identities in engineering such as: women, minorities, members of the LGBTQ, people from low-income backgrounds, and disabled people, may experience compounding effects of this chilly climate as they confront multiple systems of oppression simultaneously [3]. Exploring the intersections of these identities may reveal unique aspects of engineering culture and climate that contribute to its staunch lack of diversity.

Given the complex ways that students' college experiences can be impacted by their identities, URM women may face additional difficulties as a result of being underrepresented in engineering programs by both race and gender, as evidenced by their lower ETSE scores. The authors hypothesize that participation in high-impact academic experiences such as research and internships may cause URM women to see greater differences than their counterparts in their ETSE measure, controlling for social factors.

#### Bandura's Social Cognitive and Self-Efficacy Theory

Self-efficacy was considered through the framework of Bandura's Social Cognitive and Self-Efficacy Theory. Bandura defines self-efficacy as a belief in one's ability to bring about a specific desirable outcome by exhibiting certain behaviors [4]. Bandura identifies four sources of self-efficacy: (1) mastery experiences, (2) vicarious experiences, (3) social persuasion, and (4) reduction of negative somatic and emotional states.

First, mastery experiences consist of attempting relevant tasks that both produce successful outcomes and require perseverance. These experiences build a foundational belief in an individual's ability to overcome challenges and ultimately succeed. Early or persistent failure or a lack of obstacles can undermine the development of self-efficacy.

Second, self-efficacy may be formed vicariously, rather than directly, when an individual is able to observe that someone with a similar identity experiences a successful outcome. Particularly relevant to this work is the concept that the more similar the perceived identity, the more positive the impact on self-efficacy. For example, a Latina woman's self-efficacy may not be enhanced by observing white men succeed at the same task.

Third, self-efficacy may also be enhanced or undermined by the positive or negative persuasion of those in the individuals' social circle. This persuasion may come in the form of verbal affirmation or discouragement, or by guiding the individual to attempt tasks at an appropriate level of difficulty. Negative persuasion is particularly powerful in undermining self-efficacy, as individuals who have been told they will fail tend to avoid mastery experiences.

Fourth, the mitigation of negative interpretations of somatic and emotional states during the task can help develop self-efficacy. Physical and psychological experiences such as increased heart rate and rapid breathing before a presentation, or tiredness of muscles after exercise, can either be interpreted as a positive performance-enhancer or as something to be avoided. Reframing negative interpretations of these states can build self-efficacy directly and encourage more mastery experiences.

Contextual examples of each of Bandura's four sources of self-efficacy in undergraduate engineering education: first, mastery experiences could consist of completing practice problems to master theory, engaging in project work and hands-on activities to build engineering skills, and successfully working in teams and giving technical presentations. Second, role models who share a similar identity in populations of upper year students, alumni, outside speakers, or faculty may provide vicarious experiences. Third, classmates, teaching assistant, professors, mentors, friends and family may all provide social persuasion, and fourth, an individual's' personal or extra-curricular training may influence reaction to somatic and emotional states. For this research, we posit that undergraduate research and internship experiences may provide more opportunities for these four sources of self-efficacy, particularly for URM women.

### Measuring Engineering Task Self-Efficacy

Engineering task self-efficacy (ETSE) was assessed with a 5-item self-report measure for an ETSE Instrument which is defined as an individual's belief in their ability to successfully perform technical engineering tasks. The technical engineering tasks probed by the survey were motivated by engineering and career outcomes in previous work [5]. The process of adapting the items and selecting a representative five-item set from a more exhaustive list using factor analysis is described in detail elsewhere [6-7]. This instrument asked participants *"How confident are you in your ability to do each of the following at this time?"* The items on the survey were ranked on a 5-point Likert scale from 0 to 4 with five response options labeled: (0) not confident, (1) slightly confident, (2) moderately confident, (3) very confident, and (4) extremely confident. Scores on all five items were then averaged. Possible overall scores ranged from 0 to 4. The five survey items were:

1. Design a new product or project to meet specified requirements.
2. Conduct experiments, build prototypes, or construct mathematical models to develop or evaluate a design.
3. Develop and integrate component subsystems to build a complete system or product.
4. Analyze the operation or functional performance of a complete system.
5. Troubleshoot a failure of a technical component or system.

## Undergraduate Research and Internship Experiences

In 2008 George Kuh identified ten “high impact practices” in higher education literature found to increase student engagement and learning outcomes [8]. These ten practices are: first-year experiences, common intellectual experiences, learning communities, writing intensive courses, collaborative assignments, experiencing different worldviews, community-based learning, capstone experiences, undergraduate research, and internships. In particular, undergraduate research and internships are relevant to engineering education but are not utilized by all undergraduate students (as opposed to a required capstone design experience). This understanding of high impact practices, the engineering education landscape, and the variations in access to these experiences amongst students led to the focus on the role of undergraduate research and internships on engineering task self-efficacy (ETSE).

Engineering alumni that participated in a formal engineering undergraduate research program at University of Delaware were more likely to pursue a graduate degree [9]. Respondents were also more likely to cite their undergraduate research experience as “extremely” or “very” important in their decision to attend graduate school [9]. Respondents reported the highest overall benefit from undergraduate activities was participation in an internship, followed by involvement in undergraduate research. It is worth noting that students who self-select to do undergraduate research may already be curious about graduate school and using a research experience as an opportunity to hone in on that focus [10]. There is no causal link between participation in undergraduate research and attending graduate school. Although, a study at Georgia Institute of Technology found that 93% of alumni in a formal undergraduate electrical engineering research program aimed at recruiting upperclassmen students (Summer Undergraduate Program of Research in Electrical Engineering for Minorities, i.e. SUPREEM) reported starting salaries over \$35,000, compared to only 34% of the control group without undergraduate research experiences [10].

In a 2004 three-year study, researchers interviewed 76 students, mostly rising seniors in eight science disciplines across four small private STEM-serving institutions [11]. They conducted three interviews: two before graduation and the third post-graduation. For students who had completed an undergraduate research experience, 91% of them reported gains after graduating. Gains were based on a checklist of possible faculty-defined benefits derived from literature.



There were seven different kinds of gains including: personal/professional, thinking and working like a scientist, and gains in various skills. Seventy-four percent of the comments in the personal/professional gains category referenced increase in confidence, and 27% related to creating a professional identity as a scientist. The study did not mention whether the results differed greatly from students in their control group that did not participate in summer research (N = 139). The authors of the study warned research should be cautious in claiming undergraduate research experiences influence students to *choose* graduate school; a more appropriate claim is that they can *encourage interest* in attending graduate school and refine/clarify/reinforce such a choice.

In a study from Iowa State University, respondents were tasked to rank the best setting to develop ABET (3a-k) competencies [12]. Respondents ranked the engineering workplace as the best setting, followed by cooperative education/internships. They stated that co-ops and internships also help provide exposure to opportunities for mastery, vicarious experiences, verbal affirmations, and positive emotional states. The traditional classroom setting was ranked last showing a general perception that co-ops, internships and engineering work experience, better prepare students with technical engineering skills that lead to a greater sense of being an engineer [12]. To support this claim, two separate studies found engineering majors with co-op experience earned higher cumulative GPAs than engineering majors without co-op experience [13-14].

## Research Questions

**RQ1:** How does engineering task self-efficacy vary with respect to gender, race, and the intersection of these identities amongst upper-year engineering students?

**RQ2:** Is the experience of undergraduate research or an internship associated with higher engineering task self-efficacy amongst upper-year engineering students?

**RQ3:** Does the relationship between a research and/or internship experience and engineering task self-efficacy change when considering race and gender? How does considering intersectional identities add insight to the relationship between internship/undergraduate research experiences and engineering task self-efficacy?

## Methods

### Engineering Majors Survey

The Engineering Majors Survey (EMS) respondent analysis dataset, including responses from 5,819 juniors, seniors and fifth year students, forms the basis for this analysis. EMS, an NSF

funded three-year longitudinal research study, is designed to explore engineering students' engineering, innovation, and entrepreneurial interests and experiences over time. EMS 1.0, the first edition of the survey, sampled students from 27 institutions, with a ratio of research to non-research schools that is consistent with the ratio across all ASEE Engineering schools [7]. A breakdown of respondents' demographics is shown in Figure 1. In this sample, the proportion of non-URM and URM students reporting an internship experience was 62% and 47% of women, respectively, as well as 56% and 38% for men.

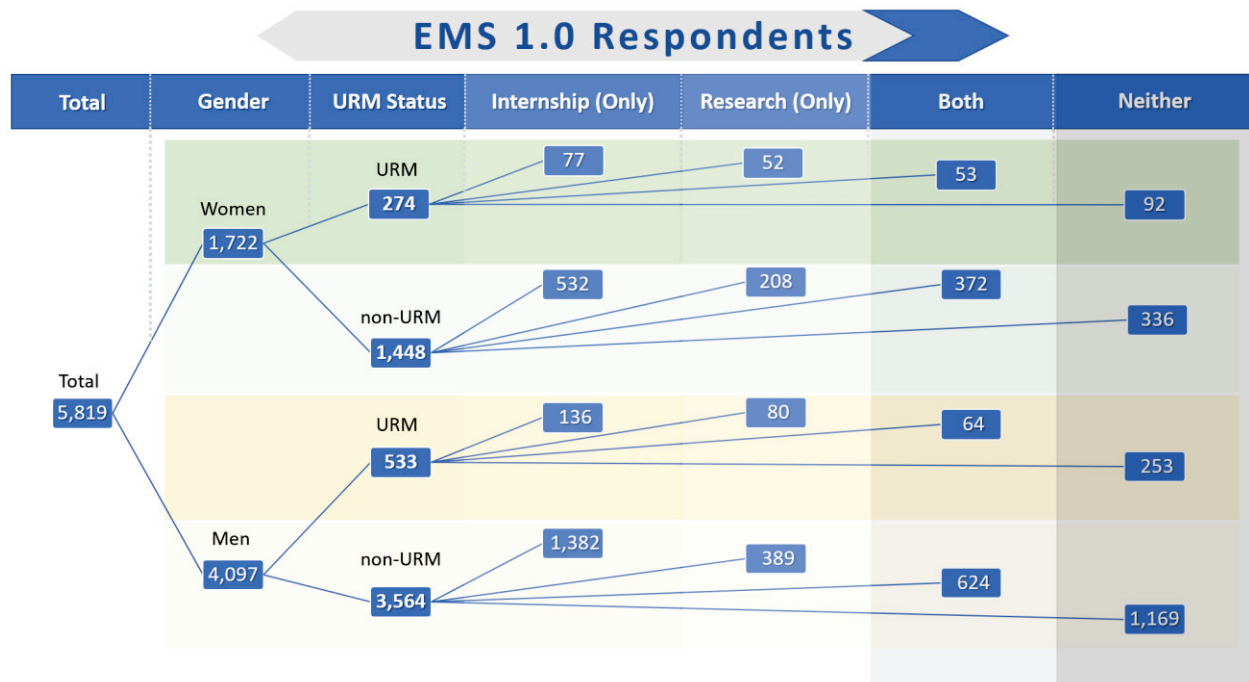


Figure 1. EMS 1.0 respondents by the numbers, based on demographics and participation in research/internship experiences

## Dependent and Independent Variables

This study explored the differences in engineering task self-efficacy (ETSE) measures of underrepresented minority (URM) women ( $N = 274$ ) and URM men ( $N = 533$ ) that engaged in undergraduate research and internship experiences in college as compared to non-URM engineering students (women  $N = 1,448$ ; men  $N = 3,564$ ). As the basis for the analysis, the dependent variable was chosen to be the ETSE score, calculated based on a five-item set from the EMS 1.0 survey. The four independent variables were: undergraduate research experiences, internship experiences, gender, and URM status.

For the undergraduate research and internship experiences, respondents selected “yes” (1), “no” (0), or “I prefer not to answer” (-9) to indicate their answers in two survey items:



*While an undergraduate, have you done (or are you currently doing) each of the following for at least one full academic or summer term?*

1. Conduct research with a faculty member
2. Work in a professional engineering environment as an intern/co-op

Gender was coded using respondent's answer to their sex, where an answer of "female" (0), "male" (1), "other" (2) a fill in the blank response, or "I prefer not to answer" (-9). Since the number of self-identified transgender/gender non-binary respondents was low ( $N = 7$ ), between-group statistical comparisons across gender was left to a man/woman binary variable.

URM status was coded using a "mark all that apply" question with eight items for respondents to choose from including: "American Indian or Alaskan Native," "Asian or Asian American," "Black or African American," "Hispanic or Latinx," "Native Hawaiian or Pacific Islander," "White," "Other," or "I prefer not to answer." For the purposes of this study, any respondent that indicated one or more items determined by the authors to be an underrepresented ethnic/racial minority in engineering in the United States (i.e. Latino/a, African American, Native American or Pacific Islander) was considered a URM.

### Statistical Analyses

One-way ANOVA and Cohen's  $d$  were employed to statistically compare mean engineering task self-efficacy (ETSE) scores amongst the various groups. Multiple linear regression was then used to model the relationship between students' ETSE score, participation in research and/or internships, race (coded here as either URM or non-URM), and gender. Furthermore, these models controlled for various student-level covariates, including high school background preparation, family income, parental education, grade point average (GPA), and major; they also included school-level fixed effects for each of the 27 institutions. Interaction effects between academic participation and race/gender were also employed in the linear regression in order to show the relationship between reported ETSE, participation in research and/or internship experience, and student demographic background. To simplify interpretation of interaction effects, binary variables were created for each demographic group (i.e. non-URM men, non-URM women, URM men, URM women). Because ETSE is a continuous variable, multiple linear regression, as opposed to logistic regression, was chosen following conventions used with other publications on Engineering Majors Survey (EMS) data [15].

### Results

Using preliminary comparisons of means, both non-URM and URM women that participated in research and/or internship experiences had lower ETSE scores than non-URM and URM men,

respectively. An interesting finding, however, is that URM women that participated in both research and internship experiences had a similar ETSE score to non-URM men that had not participated in *either* (2.36 vs. 2.35, Cohen's  $d = .014$ )—meaning that the scores observed in both populations is statistically similar ( $d < .20$ ). These results suggest that the increased average ETSE scores, as a result of participation in both research and internship experiences, is greater for URM women than their majority counterparts (Table 1).

*Table 1. Breakdown by URM-status and gender for mean ETSE score based on participation in research and internship experiences*

	Non-Internship/Research Participants			Both Internship & Research Participants		
	Mean ETSE (SD)	Number of Participants	Percent of Group Total	Mean ETSE (SD)	Number of Participants	Percent of Group Total
<b>Non-URM Men</b>	2.35 (0.83)	1,169	32.8%	2.82 (0.78)	624	17.5%
<b>Non-URM Women</b>	1.92 (0.84)	336	23.2%	2.41 (0.78)	372	25.7%
<b>URM Men</b>	2.30 (0.89)	253	47.4%	2.77 (0.84)	64	12.0%
<b>URM Women</b>	1.85 (0.95)	92	33.6%	2.36 (0.83)	53	19.3%

Summaries of regression results can be seen in Table 2. As expected, both non-URM and URM women had significantly lower ETSE scores compared to their non-URM male counterparts, matching the results from preliminary comparisons of means. Even while controlling for background characteristics and high school experiences and involvement, there was a statistically significant interaction effect between internship participation and the binary variables for non-URM and URM women (see Table 1, interactions are shaded in grey for clarity). Thus, the difference in ETSE between those who did and did not participate in internships depends on the participant's race and gender, with URM women having the largest increase in ETSE between participants and non-participants at a significantly higher rate than non-URM men ( $p < 0.05$ ). The same regressions were run for research experience, but significant results were not found for the interaction between demographics and research participation ( $p = 0.06$ ). Given sample limitations and the use of fixed effects for the 27 institutions (see limitations section), this does not necessarily indicate that there is no effect and warrants future investigation.

To investigate this further, the predictive marginal ETSE scores were estimated for internship participants and non-participants of both URM statuses and genders (Figure 2). Both non-URM and URM women have lower ETSE scores than their male counterparts in the same internship condition (i.e. non-URM men that participated in internships have significantly higher ETSE scores than both non-URM women and URM women with the same experience). However, for URM women, the 95% confidence-interval for internship participants overlaps with the interval for non-URM men who did not participate in an internship, a result also found when comparing means across groups.

Furthermore, the contrasts of the predicted difference in ETSE between internship participants and non-participants was plotted to illustrate the higher increases exhibited by both non-URM women and URM women, with the largest differences for URM women (Figure 3). Because the participants with and without internship experiences are not the same students over time, these cannot be interpreted as causal gains; however, the difference in ETSE between internship

*Table 2. Regression analysis summary of internship prediction of ETSE scores for non-URM/URM women and men*

Regression Analysis Summary of Internship Prediction of ETSE				
	$\beta$	SE	$t$	$p$
Internship	.17	.03	5.39	0.00
Non-URM Women	-.41	.03	-13.41	0.00
URM Men	-.02	.05	-0.44	0.67
URM Women	-.46	.06	-7.51	0.00
Internship x Non-URM Women	.10	.04	2.30	0.03
Internship x URM Men	.05	.06	0.82	0.42
Internship x URM Women	.21	.07	3.21	0.00
Low-Income	.02	.03	0.58	0.57
Class Year: Senior	.16	.02	8.28	0.00
Class Year: 5 <sup>th</sup> Year or Above	.20	.05	4.24	0.00
Age	.01	.00	3.26	0.00
Father Attended College	.03	.03	0.77	0.45
Mother Attended College	.01	.03	0.35	0.73
GPA	-.03	.01	-2.74	0.01
HS Art Exposure	.01	.02	0.56	0.58
HS Comp Science Exposure	.09	.02	4.45	0.00
HS Shop Class / Engineering Class	.11	.02	7.11	0.00
HS Robotics Exposure	.17	.02	8.28	0.00
HS Research Exposure	.12	.04	3.35	0.00
HS STEM Camp	.09	.03	3.61	0.00
HS Entrepreneurship Exposure	.10	.03	3.14	0.00
HS Founded Club or Company	.13	.02	5.50	0.00
Constant	2.09	.05	45.58	0.00
Observations			5667	
Groups			27	

participants and non-participants for URM-women is significantly higher than for non-URM men, without overlapping 95% confidence-intervals.

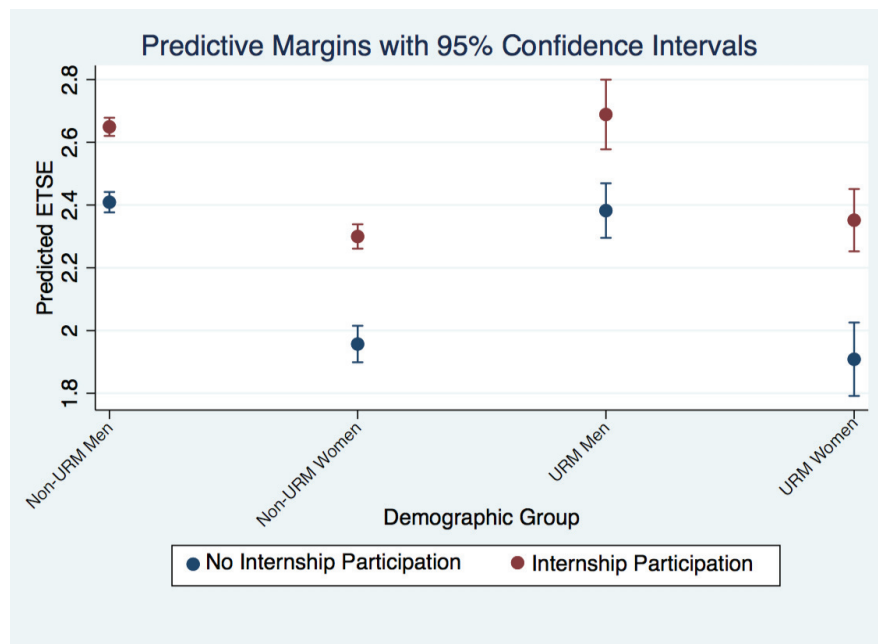


Figure 2. Predicted ETSE scores based on demographic group and participation in undergraduate internship experience

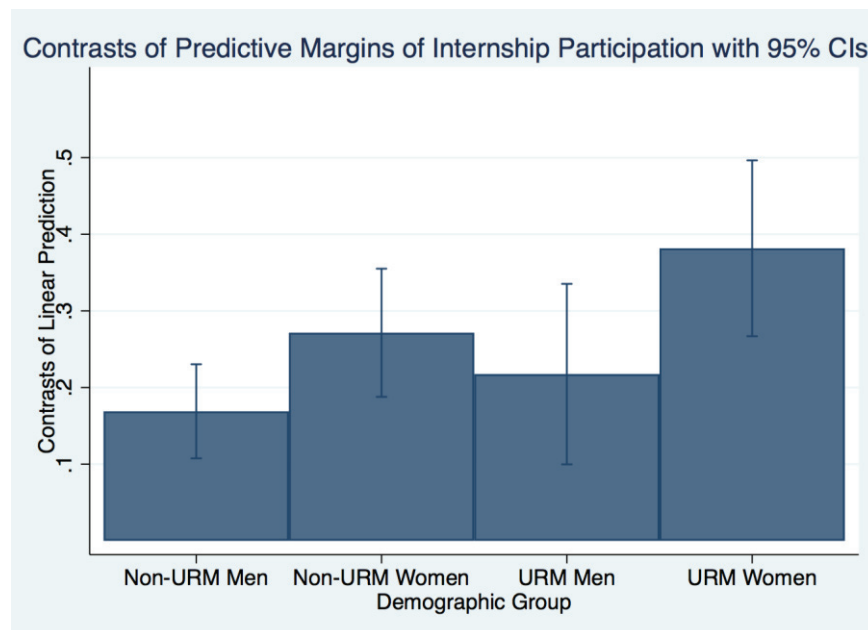


Figure 3. Depiction of contrasts of predictive ETSE scores that illustrates the difference in ETSE between undergraduate internship participants non-participants

## Discussion and Implications

### Self-Efficacy and Intersectionality

Results showed that non-URM and URM men had the highest measures of engineering task self-efficacy (ETSE), followed by their female counterparts. These results add evidence to the assertion that women often possess lower self-efficacy compared to their male peers [16-20], with concrete professional implications. Awareness of these results is important for engineering educators and administrators when interacting with diverse students in the classroom, in mentoring scenarios, and in planning support activities. Drawing from Bandura's sources of self-efficacy [4], engineering educators can be intentional about designing mastery experiences, providing explicit social encouragement, and creating environments that foster a positive interpretation of somatic and emotional responses, particularly for URM and women students. The presence or absence of URM women role models in the classroom, administration, alumni, and campus speakers could have an outsize impact on vicarious experience as a path to increasing ETSE.

Our results also suggest that URM status must be considered *alongside* gender when interpreting self-efficacy and self-confidence measures. A 2014 study, based on a large dataset of 7,833 students across 21 institutions, similarly found that personal, environmental, and behavioral factors influence STEM confidence differently depending on gender and race/ethnicity, with white women reporting the lowest STEM self-confidence controlling for other factors [21]. Our work adds to the nascent body of literature challenging the predominant monolithic interpretations of the URM or woman in engineering student and encourages intersectional perspectives when analyzing data.

### Impact of Research and Internship Experiences on Self-Efficacy

Results show that the ETSE scores associated with participation in internship experiences are greater for URM women than for their majority counterparts when considering the difference between participants and non-participants. These results may be explained by examining how the characteristics of internship experiences relate to the sources of self-efficacy. Such high-impact practices may provide additional opportunities for mastery experiences, social encouragement by mentors, supervisors, and colleagues, an increased opportunity to observe similar role models, and an environment outside the classroom that may lead to positive interpretations of somatic and emotional responses. Recent studies begin to add more detail to what these experiences look like with regard to developing skills and engaging in meaningful work for those just beginning their engineering careers [22-23]. Opportunities for mastery experiences, encouragement, and new environments apply to men and non-URM students as well, but we posit that the lower baseline of self-efficacy for URM women could allow for a larger difference in self-efficacy

associated with these high-impact experiences. While this study is not causal in nature and therefore differences cannot be interpreted as gains, the statistically significant larger difference between internship participants and non-participants for URM women provides preliminary evidence supporting hypotheses that these academic experiences may be more impactful for some students compared to others. In a 2007 study, researchers found that the benefit of tutoring was greatest for students with the weakest math proficiency [24]. This is consistent with the author's beliefs that URM women, likely to have less opportunities for vicarious experiences given the lack of women and URM students in the field of engineering, may start with a lower baseline of ETSE.

A 2017 study examined the impact of mentoring in an undergraduate life sciences research experience on URM and women students [25]. In this study, URM students reported greater scientific identity, research productivity, and intention to pursue a STEM PhD after their experience. A key factor associated with these outcomes was a high frequency of interaction between the URM students and their faculty advisors.

The authors posited that increased interaction with a faculty mentor provided a role model and encouragement/validation. On the other hand, women students reported lower scientific identity, research productivity, and intention to pursue a STEM PhD, and had a low frequency of interaction with their faculty advisors. The authors suggest that due to socialization, women students were less likely to be aggressive in seeking out their mentors and asking for their time. Approximately 40% (N = 119) of the mentors were women and 19% (N = 7) were URM. Amongst the students, 64% (N = 169) were women and 20% (N = 32) were URM. No data was provided on the intersection of these identities.

Taken together, these studies suggest that experiences such as internships and undergraduate research may be particularly impactful for URM women students and warrant further investigation to more closely examine the positive impacts of these academic experiences on both ETSE and other outcomes such as persistence in engineering.

## **Limitations**

There are three main limitations the authors would like to highlight regarding the current study. First, the measurement of self-efficacy is only meaningful when it is domain-specific [26]. In the Engineering Majors Survey (EMS) from which these results were drawn, engineering task self-efficacy (ETSE) measures were drawn from relevant engineering and career outcomes [5], which were narrowed down by a factor analysis [6-7]. In producing a manageable number of five survey items, some domain specificity regarding specific engineering tasks may have been lost.



Second, these results focused on research and internship experiences and did not provide enough statistical power to account for all undergraduate experiences that may have also affected examined ETSE levels.

Third, an important subtlety worth note is the phrasing of the question item asking respondents about their undergraduate research experience. While the item focusing on internships explicitly states “Work in a professional engineering environment as an intern/co-op,” the item about research experience states “Conduct research with a faculty member,” leaving the interpretation up to the respondent to potentially include *all* undergraduate research experiences, regardless of field relevance. Specifying this item to ensure that it is asking about “Conduct engineering-related research or research with engineering faculty members,” may also impact the results observed. Future analysis should use this preliminary work as the basis for investigation of the effect of undergraduate research and internships on ETSE amongst different demographic groups.

## **Future Work**

There are five main areas that the authors would like to highlight for future areas of research. First, results from this research lay the groundwork for future longitudinal studies that explore the extent to which engineering task self-efficacy (ETSE) scores correlate with or explain actual engineering knowledge attained. This work would allow for scientific evidence to test the effectiveness of using self-efficacy as a proxy for retained knowledge within a diverse population of students. Given the large disparity in our sample of women and men’s participation in research and internship experiences (see Table 1), we need to better understand what opportunities students are seeing and being offered and how these decisions to pursue them are being made. Future implications of this work include the creation of targeted intervention efforts to increase support for underrepresented students’ access and participation in research and internship experiences.

Second, future work could ideally obtain both pre- and post-measures of ETSE scores for internship experience for students of various demographics in order to move beyond descriptive work and establish a causal link between internship experience and gains in ETSE for certain subgroups of students.

Third, a preliminary look with this data on the compounding effects of low-income status, on the two intersections of identities currently explored, showed a promising research direction. Several additional aspects of identity could be investigated, for example: citizenship status, first generation college student, and exploring gender on a non-binary scale.

Fourth, now in its third year of implementation, the Engineering Majors Survey (EMS), has collected data at three distinct time points: upperclassmen engineering undergraduate students, new-hire professionals, and engineering professionals with at least one year of working experience. This longitudinal data could be used to look at the effects of certain undergraduate engineering experiences and extracurricular activities on ETSE over time.

Fifth, previous work using EMS data has explored the effects of extracurricular activities on innovation self-efficacy (ISE). Determining which extracurricular activities contribute to higher ISE for different groups may also be an interesting direction to pursue.

In conclusion, *how might we continue to push the boundaries of what inclusive research results look like?* This work seeks to challenge the bias towards monolithic interpretations of a URM as separate from a woman in engineering and encourages intersectional perspectives when analyzing data.

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