

Work in Progress: Research: Understanding the Experiences and Faculty Role Perceptions of Graduate Student Women Engineers

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Background and Introduction

Women remain underrepresented in areas of engineering academic leadership, such as tenure-track and non-tenure-track faculty [1]. Although the lack of women's representation in academic positions has been acknowledged, little effort has been made to address this intra-occupational gender segregation in academic engineering. Women are more likely to hold non-tenure-track (NTT) roles than tenure-track roles [2],[3]. This pattern of intra-occupational gender segregation can be found in many male-dominated fields, such as medicine or the engineering industry, in which women hold lower positions of power [4],[5],[6].

Currently, there are two hypotheses of potential reasons for intra-occupational gender segregation in engineering academia. The first is a culture of high gender dynamics causing a chilly climate [7]-[13]. The second hypothesized contributor is the rigid nature of tenure-track careers, which impede heteronormative familial experiences and expectations for women [14]-[17]. Women are often culturally expected to hold more responsibility for childcare and home management than men, which leads to women being faced with opposition for not meeting the perception of professional legitimacy expectations [18]. This significantly impacts women's roles in academia. In particular, women wanting to achieve tenure may also be balancing childcare or navigating concurrent careers with a partner [18]-[20]. To add perspective, 44 percent of women with children are tenured professors, compared to 70 percent of men [21]. Achieving the notion of academic success is more challenging for women with children than for men with children [21]. Traditional pathways to tenure-track positions are not supportive of the various life circumstances that can result in an intermission or deviation from tenure-track, further impacting gender equity in engineering.

To address gender inequity in engineering, it is vital to understand the reasons women pursue NTT roles rather than TT, their experiences in these roles, and the conditions that can support transitions to TT.

The focus of this study is on women graduate students in engineering disciplines. It is instrumental and intuitive to study women engineering graduate students' perceptions of NTT and TT roles, as being a graduate student is an important stepping-stone to becoming a faculty member. Studying the perceptions women graduate students in engineering have of NTT and TT roles allows us to understand barriers already being identified by these students that deter them from TT and/or NTT roles, as well as potential supportive aspects encouraging them to pursue TT and/or NTT roles. Through the use of a diverse range of graduate program years, we can also identify patterns in how these role perceptions can change over the course of an engineering graduate program.

Research Questions

1) What are women engineering graduate students' perceptions of TT and NTT faculty roles? How, if at all, do these perceptions influence women students' career attitudes and aspirations?

Theoretical Framework

Our work leverages Social Cognitive Career Theory (SCCT), which provides interlocking models of career development that can be used to study career aspirations [22],[23]. SCCT proposes that career aspirations and choices are influenced by identity and background, task performance, interest, outcome expectations, goal choices, contextual factors, and performance attainment (Figure 1).

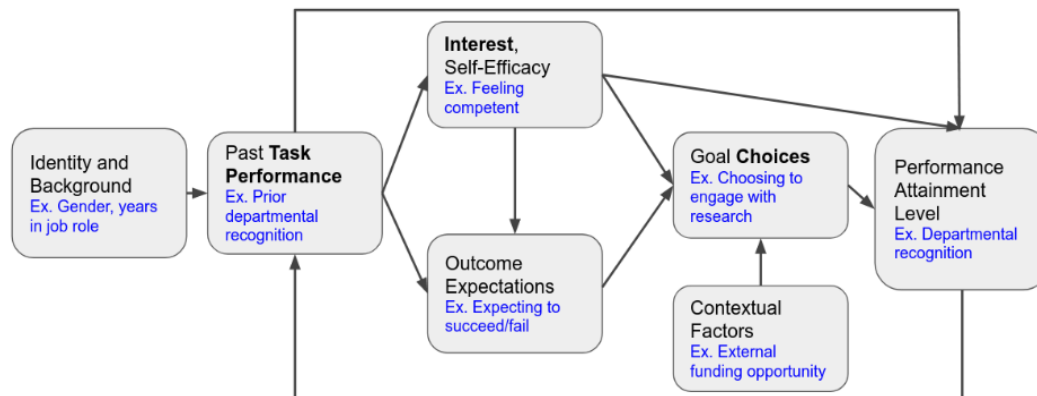


Figure 1. Social Cognitive Career Theory with examples for faculty careers.

For example, a woman graduate student who receives a teaching award may have their self-efficacy (i.e., feelings of competency in a certain task) increased, which may then motivate them to pursue more teaching or course development opportunities. Women engineering graduate students' perceptions of TT and NTT faculty roles may serve as a relatively early indicator for women's career pathways into NTT and TT roles.

Methods

We interviewed fifteen women graduate students in engineering at a public, R1 institution over Zoom in the Fall of 2025 in an IRB-approved study. Approximately 30% of the college of engineering faculty at this institution were NTT faculty. Seven participants were in their first 1-3 years of graduate school. Eight participants were in years 4-6 of graduate school. Engineering majors represented include Aerospace Engineering ($n=2$), Biomedical Engineering ($n=1$), Chemical Engineering ($n=1$), Civil and Environmental Engineering ($n=1$), Computer Science and Engineering ($n=2$), Electrical Engineering ($n=2$), Materials Science and Engineering ($n=2$), Mechanical Engineering ($n=2$), Naval Architecture Engineering ($n=1$), and Robotics ($n=1$).

Interviews followed a semi-structured protocol and lasted about one hour. Questions related to components of SCCT (Table 1).

SCCT Factor	Example Questions
Outcome Expectations	How would you describe TT faculty roles compared to NTT roles? Compare perceived prestige, salary, work-life balance, and leadership potential for TT and NTT roles.
Contextual Factors	What support/encouragement have you experienced for pursuit of a faculty role?
Self-Efficacy	How would you navigate a day in the life of a TT/NTT faculty?
Interest and Goals	What factors are important to you as you consider pursuing or not pursuing a faculty role?
Identity and Background	What if any do you feel is the impact of different identities or experiences on different roles or careers?
Goal Choices	What professional opportunities have you engaged in that would help you in a TT or NTT faculty role?
Past Task Performance	Have you received recognition or awards for any professional achievements?

One research team member cleaned interview transcripts, redacting identifiable information, and coded them to identify emergent codes that could be added to supplement the a priori codes based on SCCT factors (Table 1) in our codebook. Emergent codes, such as higher salary, desire for work-life balance, and high workloads, were sorted by relevance to a priori codes. For example, higher salary and high workloads were sorted under “Outcome Expectations” because these were perceived outcomes for tenure-track roles. Desire for work-life balance was sorted under “Interest and Goals” because a work-life balance was noted as an important factor for participants’ deciding career goals.

Our ongoing analysis step involves creating an SCCT map for each participant’s transcript. These diagrams will map summaries of participant choices and perceptions onto our framework, providing a clear causal connection of how participants’ perceptions of TT and NTT faculty roles influence their career attitudes and aspirations. We plan to synthesize across these maps to then answer our research question.

Initial Findings

Emergent themes identified in the transcripts were often related to outcome expectations between academic and industry jobs as well as contextual factors that influence choices. Participants

tended to group tenure-track and non-tenure-track roles together under academia when comparing job expectations and considerations between industry and academia.

Identity and Background

Identity and background often seemed to play a stronger role in pursuing graduate school and engineering than in career considerations. For example, participants who had parents with graduate degrees were encouraged to pursue graduate degrees themselves. Participants mentioned gender impacting their engineering academic experience, such as being the only woman in a class, but did not seem to often consider gender as strongly impacting their motivation to pursue engineering or graduate school. Once in graduate school, contextual factors seemed to play a stronger role in influencing participants' career interests and role considerations. This shift in motivations and expectations based on contextual factors may be a reflection of the generation [24, 25]. Younger generations (e.g., Gen Z) seem to value wellbeing and work-life balance more than older generations (e.g., Baby Boomers) who seem to value company loyalty and prestige [24, 25].

Self-Efficacy and Past Task Performance

Participants either felt they were more inclined to pursue either research or teaching, but few had past teaching experiences. Many participants thus had a preference for more research-oriented roles because they felt well-trained in research and lab skills, but a general uncertainty about tenure-track roles still was a common theme across interviews:

"[I'm interested in] academic roles, yes, but probably not tenure track because I know it's very competitive. Considering I kind of am more hesitant about [tenure track roles], I don't think I would compete well with those that know for sure that it's something that they want... I think I would enjoy a non-tenure track role, like a research faculty...I don't think I would want to be a teaching non-tenure track, but that's also because I'm not as confident in my teaching abilities, but more confident in my research abilities." - Bridget

Bridget is confident in her research skills but not teaching, which persuades her to be interested in only research positions in academia. She was not able to build her teaching self-efficacy as much as her research self-efficacy. These findings of perceived low self-efficacy influencing career aspirations is related to Erin Cech's "professional role confidence," [26]. According to Cech, low confidence in their ability to fulfill career role expectations is a contributor to women's decision to remain in engineering or pursue certain careers.

Another reason participants described for not wanting to pursue a tenure-track faculty position was because of watching others, such as their advisors, seem to experience high stress and low work-life balance:

"Looking at my advisor, I've seen him just stay in campus till 10 PM. I have seen him call students on weekends, send emails at 2 AM. I don't know if he just likes operating like that or if it

happens as a result of the environment. But I think all the professors seem really busy to me, or otherwise their groups are not doing as much research. So it seems like if either you have to be like that, you have to lose out on work-life balance to do good research, or you compensate on not doing as many projects and just focus more on teaching” - Bridget

This key vicarious experience through their advisors seemed to form their main perception of what a faculty role would be like, which they then often decided is not what they want for themselves, in part because they do not believe they would be successful or happy in such a working environment.

Outcome Expectations

Most participants were not sure of the different role expectations between NTT and TT faculty roles. However, they still had particular perceptions about what a role would be like from their past observations and experiences. They were often in agreement that TT positions have higher salary, more prestige, and more leadership opportunities. Perceptions of work-life balance varied. Some participants believed TT roles to have more work-life balance because they are more flexible and do not require as much teaching expectations. While others believe NTT roles have more work-life balance because there are less expectations of research and less pressure to prove yourself for tenure.

Whether they perceived TT or NTT to have a higher workload, outcome expectations of work-life balance seemed to have the most influence on career interests:

I guess coming into grad school I had thought about being tenure track professor and it was mainly focused on a perceived prestige of being a tenure track and doing your own research at an institution and developing new technologies and changing industry and really helping shape the future of [science]. But as I've gone through grad school... I realized the need for work-life balance, . . . Now I've shifted away from wanting to be a professor, a tenure track professor, and looking more into industry jobs and potentially adjunct professor because that work-life balance has become a lot more important to me in grad school. - Josefina

Though once motivated by prestige, as Josefina went through graduate school, she realized that work-life balance was more important to her than prestige. Josefina is now mainly interested in pursuing industry roles because she expects them to have a better work-life balance than academia. Other participants also mentioned not wanting to pursue academic roles because of their expectation of a poor work-life balance. This aligns with the generational shift towards valuing work-life balance over prestige, salary, or other factors [24,25]

Contextual Factors and Goal Choices

Many participants described that the differences between NTT and TT roles were not formally taught. This led to variation in where and how these women learned about these roles. For example, Blair's initial introductions included a one-credit course and a panel where faculty

spoke about their career paths in academia, but these were very “broad strokes.” However, Blair was beginning to apply for jobs, she made a large spreadsheet of job listings. She describes,

“Honestly, I think I learned a lot, and maybe this is going to be embarrassing for me, but I think I learned the reading through the job postings that listed responsibilities, cause that gave me a much clearer picture of what was actually expected in each role. I mean, also, honestly, it seems like things also vary from department to department and from school to school.” - Blair

This spreadsheet of job listings provided a “much clearer picture” of what was expected in NTT compared to TT roles than she had before beginning her job search. Blair also noted a significant amount of variation between job postings.

In lieu of clear distinctions between NTT and TT roles, many participants considered alternate key considerations to guide their career decisions. Some of the frequently referenced considerations included outcome expectations for work-life balance, location, stability, salary, and passion.

Limitations

As this project is a work-in-progress and the SCCT maps have not been completed yet, the current results address the elements of SCCT in isolation. Future work, described below, will describe the interrelation of factors that influence women graduate students’ career decisions.

Future Work

We plan to complete the creation of participant SCCT maps and the ensuing analysis. Additionally, in the continuation of this project to better understand role considerations among women faculty in engineering, we plan to interview 8-10 women faculty who have transitioned from NTT to TT roles about their experiences. Including graduate student perceptions and aspirations as our first timepoint has given insight into how, when, or why these perceptions and aspirations change as women enter faculty roles. The end goal of this research is to understand the factors that influence career decisions for women in academia, and then to use these findings to develop supports for women who wish to enter academic roles but do not due to barriers.

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