

# Unpacking Engineering Doctoral Students' Career Goal Setting and Future Time Perspectives

## Derrick James Satterfield (Graduate Research Assistant)

Derrick Satterfield is a doctoral candidate in Engineering Education at the University of Nevada, Reno. His research focuses on engineering graduate students' experiences and motivation centered on career planning and preparation.

## Mackenzie C. Parker

Mackenzie is a doctoral student at the University of Nevada, Reno in the Department of Engineering Education. She received a Master of Science degree in Materials Science and Engineering from the same institution in 2018. Her research explores facets of engineering graduate student experiences relating to professional identity, motivation, work-related stress, and mental health.

## Matthew Bahnson

Postdoc in Engineering Education at Penn State with Catherine Berdanier.

## Heather Lee Perkins (Post-Doctoral Researcher)

I entered the Applied Science & Community Psychology program in the fall of 2014, after completing my Bachelor of Science in Psychology at the University of Cincinnati, and graduated in Spring 2021. I'm currently a member of the STRIDE lab at Purdue University as a Postdoctoral Researcher, and will be joining Indiana University's Department of Psychological and Brain Sciences as a Visiting Assistant Professor. I've participated in various research projects, most of which focus on identity and stereotypes. My current primary research interests are identity processes, STEM education, and the influence of stereotypes.

## Marissa Tsugawa

Marissa Tsugawa is an assistant professor in the Department of Engineering Education at Utah State University. Their research interest is in neurodivergence and how it manifests in engineering education. Past work includes exploring motivation and identity of engineering graduate students, women of color's experiences on engineering teams, and experiences around LGBTQ+ advocacy in STEM. Dr. Tsugawa uses mixed-method approaches with a social constructivist paradigm.

## Kelsey Scalero (Graduate Student)

Kelsey is an engineering education Ph.D. student at the University of Nevada, Reno. She has a master's degree in mechanical engineering and 5 years of experience working in the aerospace industry. Her research focuses on identity development and motivation. After graduation, she plans on teaching project-oriented mechanical engineering classes or returning to industry working in training or retention.

## Cheryl Cass (Senior Global Academic Program Manager)

# **Adam Kirn (Associate Professor)**

TBD

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## Introduction

This work-in-progress paper provides evidence to support goal-setting theory and future time perspective measures to expand existing analytical motivation lenses used with engineering doctoral students.

Doctoral education develops specialized domain expertise; however, national reports highlight that within STEM fields, students and employers alike believe there is a misalignment between the reality and expectations of how prepared students are for their future careers [1]–[4]. The ongoing lack of alignment devalues advanced degrees that students obtain and prioritizes getting a credential rather than developing valuable knowledge, skills, and abilities that can create change and address areas of global need.

Previous research has examined how doctoral students think about and are motivated by their future goals; however, research only examined the cases in which students have goals and not the process of developing those goals [5]. Currently, we lack measures to examine students' ability to conceptualize and plan for their future careers. Without tools to measure and assess students' ability to conceptualize and plan for their future careers, our ability to evaluate and change engineering graduate education is limited. Therefore, we present preliminary evidence to guide tool development that supports the use of goal-setting theory alongside future time perspective to analyze engineering doctoral students' career planning and preparation.

## Theoretical Framework

The guiding theory in this study was future time perspective theory or the ways students' future goals encourage the completion of tasks in the present that are aligned with that future [5], [6]. In addition to the existing constructs used in future time perspective theory, the ways students talked about planning for their future careers aligned with goal setting theory [7], [8]. Goal-setting theory examines how individual and organizational factors mediate performance on prescribed goals. Because engineering doctoral students hold the dual roles of students and employees, this theory has the potential to fill the gap in how we measure and assess students' actions towards their future goals. Here, we focus on a subset of constructs for this preliminary analysis, described in Table 2. These subconstructs are derived from the High-Performance Cycle of goal-setting theory [9], [10].

Table 2. Definitions of the goal-setting subconstructs [9], [10].

Construct	Description
Goal Commitment	The extent to which an individual wants to achieve their goal.
Strategy	If an individual has a plan for reaching their goal, how appropriate they perceive the plan to be, and how much they reflect on the goal.
Feedback and Supervisory Support	The feedback that an individual gets within their job and the amount and form of resources from a boss or supervisor.

Organizational  
Support

The systematic structures within a company or organization in the form of sufficient resources and policy that align with attaining goals.

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## Methods

The fifteen participants in this study were all engineering doctoral students who participated in multiple phases of a more extensive mixed-methods study on engineering graduate student identity, motivation, and experiences. Participants' self-selected pseudonyms and pertinent demographic information are listed in Table 1. These students were sampled from institutions across the nation and participated in 30–45-minute semi-structured interviews about their future time perspective and graduate student experiences. The institution types and sampling approach have been described previously [11].

Table 1. Participants' self-selected pseudonyms, self-identified gender, major, and race.

Pseudonym	Gender	Major	Race
Steve	Male	Materials Science and Engineering	White
Jacob	Male	Materials Science and Engineering	Multi-Racial
Jim	Male	Mechanical Engineering	Asian
Alice	Female	Nuclear Engineering	Hispanic
Mark	Male	Electrical Engineering	Middle Eastern
Sean	Male	Electrical Engineering	Asian
Olivia	Female	Materials Science and Engineering	White
Carey	Female	Nuclear Engineering	Multi-Racial
John	Male	Chemical Engineering	White
Tim	Male	Civil Engineering	White
Fred	Male	Environmental Engineering	White
Amelia	Female	Biomedical Engineering	White
Carl	Male	Material Science and Engineering	White
Arthur	Male	Industrial Engineering	Hispanic
Alex	Female	Chemical Engineering	Asian

Directed content analysis informed by interpretative phenomenology was selected due to a previously developed codebook [5] and the methodological need to develop emergent themes [12]. The ability to code for emergent themes within the interview data allowed the researchers to explore phenomena discussed by the students which have not previously been integrated into the theoretical framework of future time perspective for engineering doctoral students. Interpretative phenomenological analysis informed this study through its multi-pass analytic

approach to examining the interview transcripts using descriptive, linguistic, and interpretive lenses [13]. This study uses descriptive and linguistic lenses to analyze participants' content and specific language when discussing their future goals.

## **Results**

Preliminary results indicated four emergent themes closely aligned with goal-setting theory constructs. When asked about their future time perspective and career preparation, students frequently talked about strategies for reaching goals, commitment to future goals, and support structures (e.g., advisor support and program support). These themes align with the goal-setting theory constructs of goal commitment; strategy; feedback and supervisory support; and organizational support. The following sections connect participant quotes to these constructs about students conceptualizing and planning for their future careers.

### ***Goal Commitment***

Engineering doctoral students perceive having multiple opportunities available to them. Across the interviews, participants talked about becoming managers, lead researchers, professors, running non-profits, and government positions. However, the extent to which these students were committed to these goals varied. For example, one student, Fred, talked about how he was not committed to a single future and needed to explore.

*"The next five years that will really help me narrow down [where I will thrive]. If I wanted to, I could sit down, and I could write out five or ten unique different career paths that I could envision myself doing, but I think it really comes down to getting my feet wet."* (Fred)

These discussions around gaining experience were a common theme why the students seemed hesitant to commit to a career goal. In some cases, this was due to being unhappy with job prospects after previous degrees or that students were unsure about the availability and expectations of these jobs. As was the case for Arthur with a tenure-track faculty position, students were confident in committing to a career when they already had a position secured.

*"I already have the position accepted, so it is not like there is other future options. Like I said, the only thing is going through the tenure process, and then the more subjective or tentative part is how far I get [towards] tenure."* (Arthur).

The security in the commitment to the career also aligned with Arthur being interested in a professor position, which academia is known to excel in training students for [14]. However, these two quotes indicate the breadth with which students committed to their goals, with many students expressing similar hesitancy to commit as Fred.

### ***Strategy***

The next theme that the students discussed was their strategies for reaching their future goals. Students talked about having loose plans, no plans, and very concrete plans for their future. These often coincided with how much students' previous degrees aligned with their current doctoral degrees. For example, Tim, whose last degree was in environmental policy, mentioned how due to the rigors of his engineering graduate program, *"the blinders have been on. The most I have been able to think ahead is maybe two years"* (Tim). Students commonly

talked about how they had a strategy for when they wanted to reach graduation. However, when considering their time beyond graduation, they talked about needing to be flexible when thinking about their future. When talking about his future goals, Mark mentioned that "*the way you work towards a plan should be flexible, because you know, things change at some point, different plan for the next five or ten years, or twenty years.*" (Mark)

While many participants shared the hesitancy and need to be flexible, those who partnered with industry, had a support system, or were going into academia, like Arthur, could articulate actionable strategies for reaching their future careers.

*"So next semester, I am going to be an assistant professor, but I want to go through the full tenure process. Well, there is some visa immigration stuff on my end that I have to solve. That is the only concerning problem... I am very confident that with that out of the picture, I will probably get a promotion in three and a half years. Then after that, it sounds like three more, so in seven years, we are thinking about all the immigration stuff that will be taken care of. I am very confident I will be on a tenure track, with tenure completed."* (Arthur)

How Arthur talked about his future was contrary to many students. Many participants felt they needed to be flexible based on the job opportunities available and if they found the job to be something they enjoyed. A driving factor in Arthur's ability to plan for his future is his knowledge of the expectations in academia.

### ***Feedback and Supervisory Support***

How faculty supported their students was influential in how students perceived themselves and their future careers. Some students talked at length about how their advisor let them be very independent and rarely met with them. In contrast, others spoke about how their advisor guided them directly or indirectly to get the needed support to prepare for their futures. One experience that students talked about around their advisor's feedback and support was when they felt that their growth was prioritized with the research goals. Specifically, in the case of Carl, he talked about how his advisor knew very little about energy policy. However, he supported Carl in balancing research and development as a professional.

*"[My advisor] recommended early on that if I'm going to go for policy track that I need to be involved with something more than just lab work. So, he's the one who in my first year told me, you know, find a physics group, find someone where you can do something. Because it's going to be that experience more than the actual science you do in my group, I think that's going to get you, that's going to make you stand out."* (Carl)

While Carl's advisor did not have the experience or knowledge that aligned with Carl's needs, he was supportive of additional professional development opportunities alongside the research that supported Carl's future goals. Contrary to the support received by Carl from his advisor, Steve talked about how he was left to be independent and that:

*No one is going to tell you how best it's implemented or how is it done... Here is the tip, it's also regarded from my advisors' supervision style. I don't see him once every week or once every month on campus. I've been here for four years, and I*

*can count the number of times I met with my professor, three or four times."*  
(Mark)

Mark talked about how he felt he could work independently and be effective. However, the lack of interaction with his advisor was not preparing him to work in teams and with others, further undercutting any idea of how he is progressing in the program and towards his future goals.

### ***Organizational Support***

The last theme that emerged from participants' interviews was the support from their program in preparing for their future. Many of the ways students talked about their program were around events put on by their department and the classes they take as part of their doctoral program. In many cases, students found that the classes did not help prepare them for their future. Students also made recommendations on things their program could change that would be more beneficial.

When talking about the classes, how students talked about them ranged from unhelpful, like Amelia said, *"I didn't find [my classes] all that helpful, I just took them because I had to, and I just did what I needed to fulfill my requirements."* John described his classes by saying, *"It was all really just a trial by fire and push everyone to the limit and see who breaks method and that doesn't make sense to me"* (John). These quotes highlight the importance of strong pedagogy in engineering graduate classes aligned with supporting students.

When asked about what changes could be made to prepare him for his future, John mentioned that *"it would be useful if the department itself put more focus on to specific professional development events"* (John). However, whether John's program has these events, they are not being seen as useful or communicated in ways that students are encouraged to go. Therefore, this indicates a need to reflect on the availability of program support within individual programs and find ways to encourage students to use them before they are in their final semester.

### **Future Work**

In this work in progress, we presented preliminary data to support the inclusion of goal-setting theory alongside future time perspective theory to examine engineering doctoral students' motivations for their future careers. Future work will extend these findings by integrating the goal-setting constructs with an existing future time perspective survey to generate a survey tool and conceptual model of how students plan and prepare for their future careers. The developed tool and model will be designed to be used by students, faculty, and administrators to support the professional development of engineering doctoral students in ways that align with the needs of their future careers. We will provide directions for data-driven change in graduate education to address the lack of alignment between graduate education and the requirements of students' future careers.

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