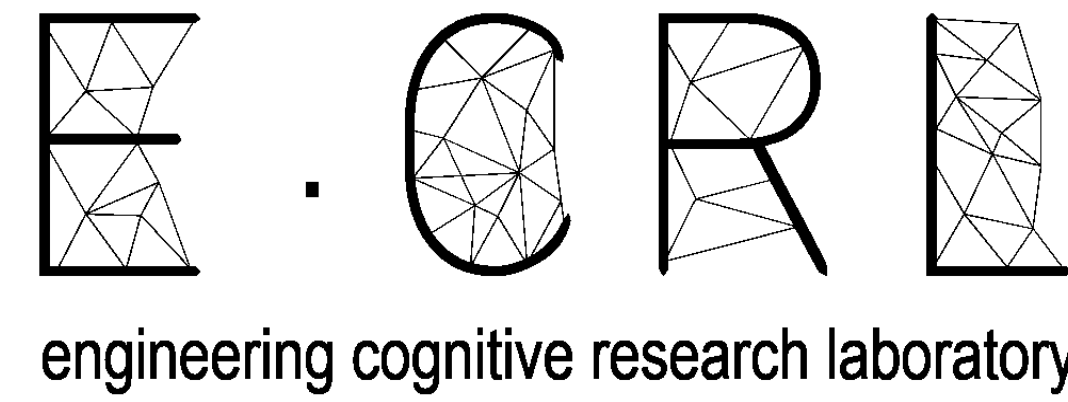
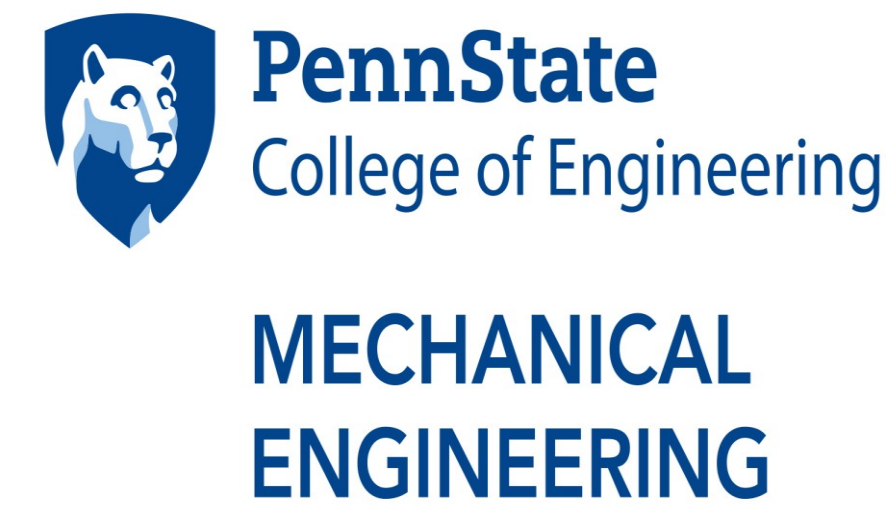


# Investigating the Formation of Engineers and the Future Professoriate: Linking Writing Approaches and Attitudes to Doctoral Socialization, Persistence, and Attrition



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This material is based upon work supported by the National Science Foundation under Grant 1733594. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.



The objective of this study is to investigate the linkage between engineering writing and disciplinary discourse with other mechanisms of engineering graduate socialization, such as identity formation, socialization, persistence, and desire to pursue academic careers.

## Motivation

Ten-year Completion Rates are only 65% for Men, 54% for Women; and 48% for Black and African American Doctoral Engineering Students in the U.S.

Council of Graduate Schools (2008); Sowell, Allum, & Okahana (2015); National Academies (2018)

**Academic Literacies Theory Posits that Academic Writing Builds Academic Identity, Promoting Persistence**

Bartholomae (1985); Rose & McClafferty (2001); Hasbun, Matusovich, & Adams (2016); Locke & Boyle (2016)

**Writing is a Required, yet Untaught Competency in Graduate Education and Academic Engineering**

Paré, Starke-Meyerring, & McAlpine, (2009, 2011); Di Piero (2007); Simpson, Clemens, Killingsworth, & Ford (2015); Leydens (2007, 2008, 2012)

## Research Questions

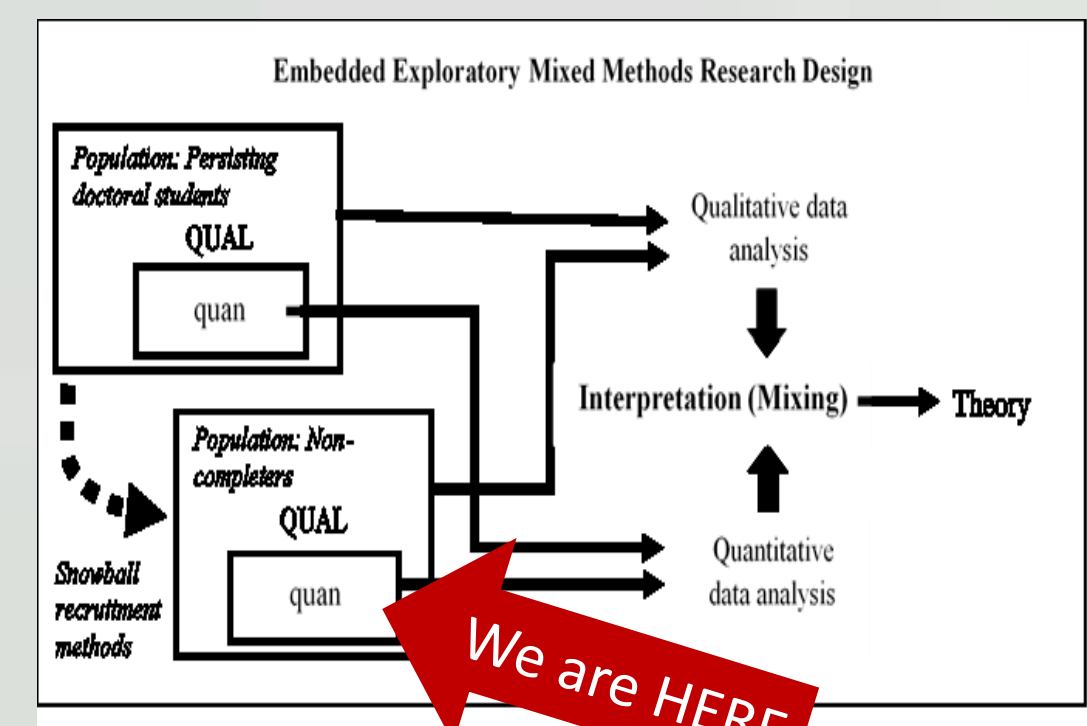
1. How do graduate students at various stages in their PhD programs in engineering perceive the role of academic writing as it relates to academic socialization and success in future academic careers?
2. How are these perceptions different or similar for graduate students who are considering leaving or have left their PhD programs before graduating?
3. Can existing surveys of writing concepts, attitudes, and self-efficacies predict students' risk for attrition?

## Methods

**Recruitment: Current Students:** Email recruitment of engineering graduate students at ten R1 institutions across the U.A. **Noncompleters:** Snowball sampling, emails to professional societies, social media

**Qualitative Methods:** Semi-structured interview protocols with subset of survey completers

**Quantitative Scales.** Inventory of Graduate Writing Processes (Lavelle & Bushrow, 2007): Categorizes responses into dominant processes of writing when they approach the actual writing process. We are interested in an individual's primary and secondary processes. **Graduate Concepts of Writing** (Lonka et al., 2014): Categorizes beliefs about the writing process. We are interested in an individual's primary and secondary concepts.



Processes	Description	Concepts	Description
Sculptor	Write all at once; go back and find the story	Productivity	Able to stay on task, make progress
Task-Oriented	Linear thought process	Knowledge-Transforming	Believes writing is a way to build and test knowledge
Scientist	Organized and structured approach	Innate Ability	Believes writing ability is fixed and unable to be improved
Intuitive	Sensory connection to writing	Perfectionism	Will not finish tasks due to continuous editing and revision
No Revision	Fast writing style with limited revision	Procrastination	Puts off writing
Low Self-Efficacy	Doubts writing ability	Blocks	Tendency toward writers block
Elaborative	Writing is a tool to express an argument or story		

## Results

### Attitudes Toward Writing Correlate in Interesting Ways

Berdanier, C.G.P.\* and Zerbe, E. (2018). Quantitative investigation of engineering graduate student conceptions and processes of academic writing. IEEE Professional Communication Conference (ProcComm), July 22-25, 2018, Toronto Canada.

Melo, J., Zerbe, E. and Berdanier, C.G.P. (2019) Validating a Short Form Writing Attitudes Survey for Engineering Writers. Proceedings of the 126th ASEE Annual Conference & Exposition, Tampa, FL.

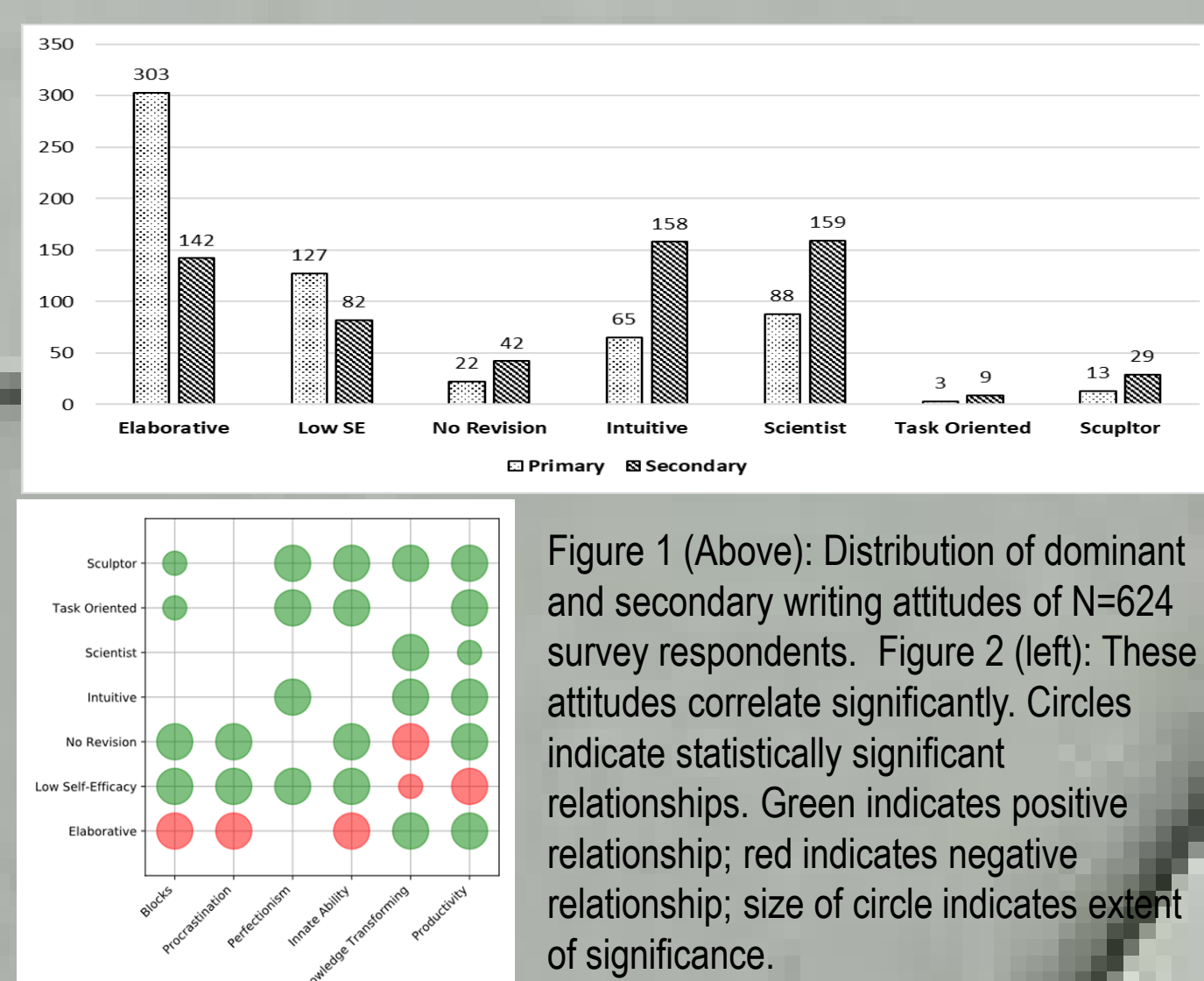


Figure 1 (Above): Distribution of dominant and secondary writing attitudes of N=624 survey respondents. Figure 2 (left): These attitudes correlate significantly. Circles indicate statistically significant relationships. Green indicates positive relationship; red indicates negative relationship; size of circle indicates extent of significance.

These scales, and our short-form survey, can help students and instructors determine personal writing "profiles" to leverage strengths and mitigate weaknesses.

### Writing Attitudes Correlate with Anticipated Career Trajectory

Zerbe, E.\* and Berdanier, C.G.P. (2018). Correlations between graduate student writing concepts and processes and certainty of career trajectories. IEEE Frontiers in Education Conference, October 3-6, 2018, San Jose, CA.

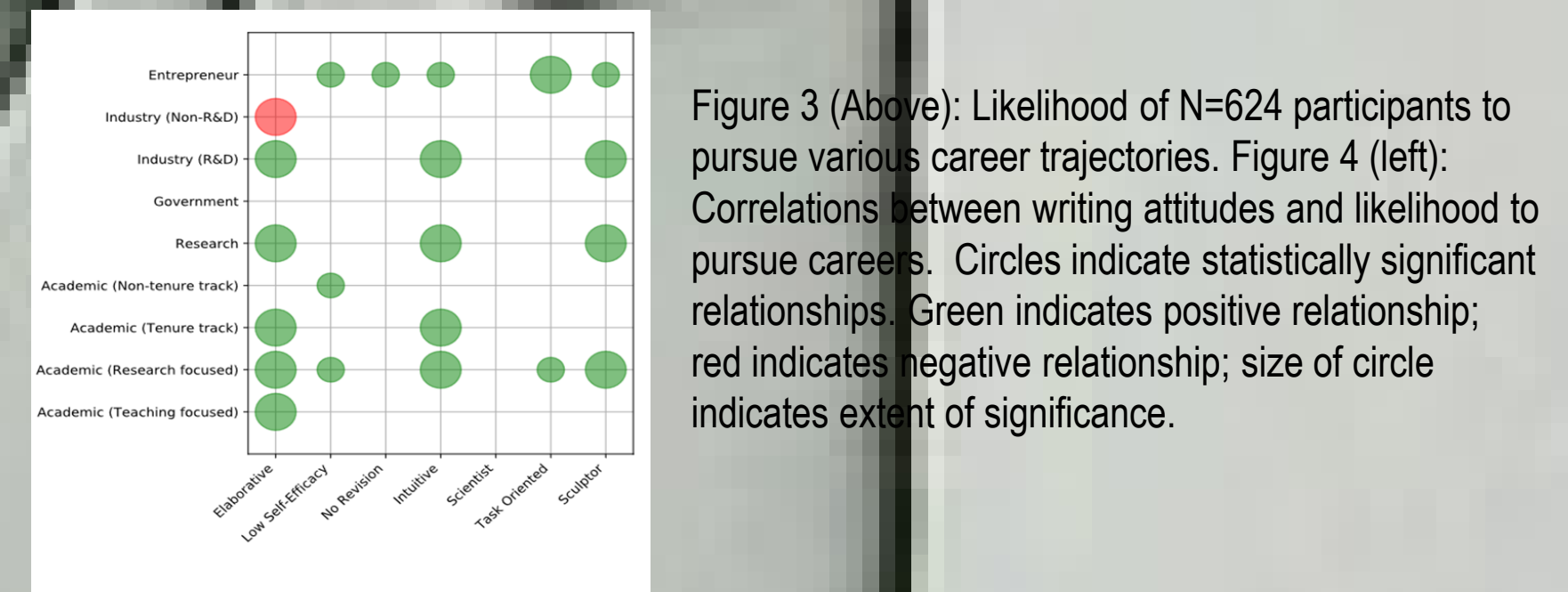
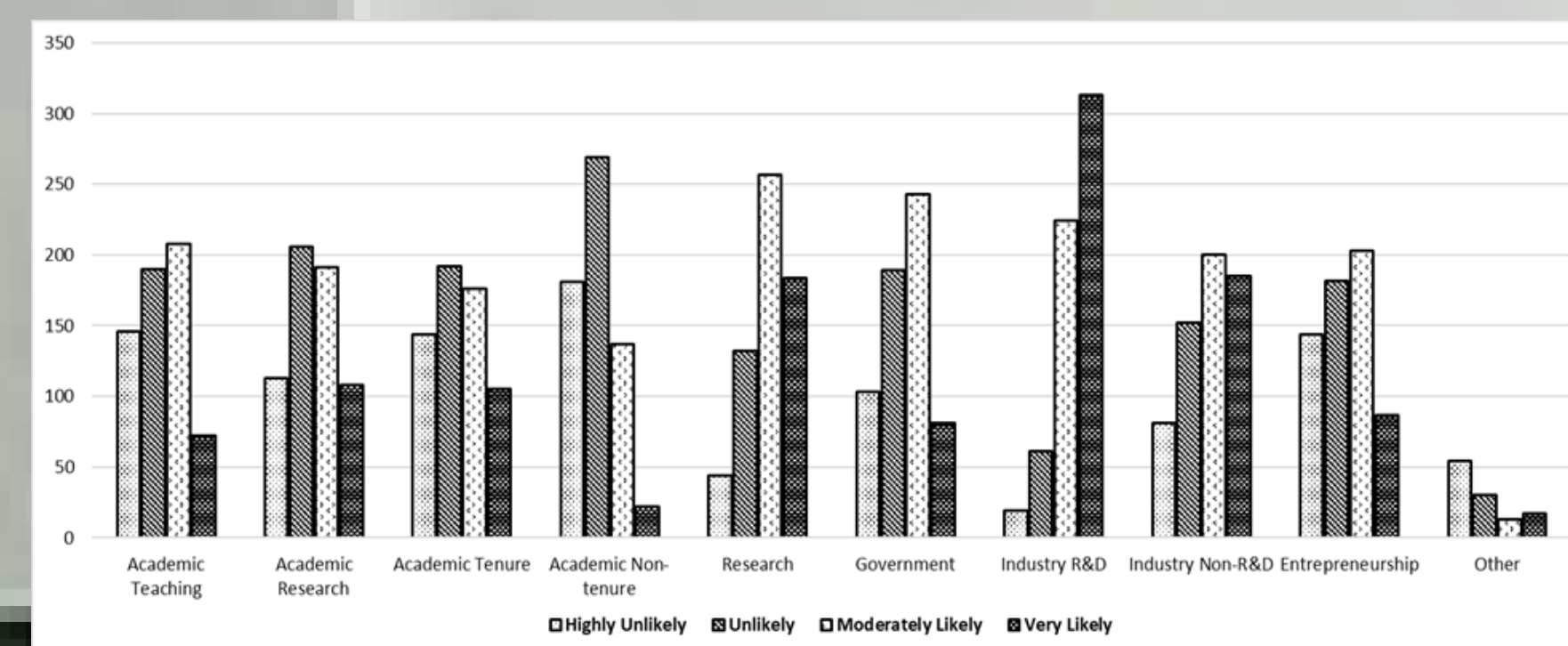


Figure 3 (Above): Likelihood of N=624 participants to pursue various career trajectories. Figure 4 (left): Correlations between writing attitudes and likelihood to pursue careers. Circles indicate statistically significant relationships. Green indicates positive relationship; red indicates negative relationship; size of circle indicates extent of significance.

Engineering graduate students with strong writing attitudes are more likely to consider a variety of career trajectories, indicating that building writing habits and writing self-efficacy may broaden participation in diverse sectors.

### U.S. Domestic Students Statistically Differ from International Students

Zerbe, E. and Berdanier, C.G.P. (2019). Quantitative Comparison between Writing Attitudes of U.S. Domestic and International Engineering Graduate Students. 126th ASEE Annual Conference & Exposition, Tampa, FL.

		Mean	Std. Deviation	Statistical Significance	
Processes	Elaborative	Domestic 3.07	0.37	0.089	
		International 3.12	0.35		
	Low Self-Efficacy	Domestic 2.69	0.39	0.000**	
		International 2.92	0.35		
	No Revision	Domestic 2.31	0.42	0.000**	
		International 2.43	0.38		
Concepts	Intuitive	Domestic 2.88	0.34	0.240	
		International 2.91	0.36		
	Scientist	Domestic 2.89	0.29	0.476	
		International 2.91	0.31		
	Task-Oriented	Domestic 2.29	0.25	0.000**	
		International 2.45	0.35		
Processes	Sculptor	Domestic 2.44	0.40	0.000**	
		International 2.70	0.37		
	Blocks	Domestic 2.89	0.84	0.013*	
		International 3.05	0.74		
	Concepts	Perfectionism	Domestic 2.72	0.77	0.004**
			International 2.89	0.74	
Innate Ability		Domestic 1.71	0.75	0.000**	
		International 2.29	0.95		
Productivity		Domestic 2.29	0.75	0.000**	
		International 2.65	0.83		

Table 1: Welch's t-test results to determine statistical similarity between U.S. domestic students and international students.

These groups statistically varied in most writing attitudes, but the categories where they do not vary provide opportunities for future interventions, particularly in leveraging the nature of writing as a knowledge-transforming activity, and overcoming procrastination.

### Students have Complex Relationships with Writing in terms of Pursuing Academic Positions

Zerbe, E. & Berdanier, C.G.P. (in review, 2019). Characterizing Doctoral Engineering Student Socialization and Attitudes toward Academic Career Trajectories. IEEE Frontiers in Education Conference, Cincinnati OH.

CAREER SECTOR	Self-reported likelihood to pursue career sector after graduate degree			
	Highly Likely (%)	Likely (%)	Unlikely (%)	Highly unlikely (%)
INDUSTRY				
R&D	27.8	22.2	0.0	0.0
Non-R&D	5.6	8.3	0.0	0.0
RESEARCH	5.6	0.0	0.0	0.0
GOVERNMENT	2.8	0.0	0.0	0.0
ENTREPRENEURSHIP	2.8	0.0	0.0	0.0
OTHER	2.8	2.8	0.0	0.0

Table 2: N=36 interview participants' likelihood to pursue various careers

### Dominant Conversations in Interviews with Current Doctoral Engineering Students (N=36):

1. Role of advisor, mentors, and support networks in setting career trajectory
2. Disenchantment with academic culture
3. Necessity of writing to support a laboratory
4. "Publish-or-Perish" as a deterrent to academic careers
5. Mental health

### Current Work Explores Narratives and Writing Attitudes of Non-Completers

Zerbe, E. & Berdanier, C.G.P. (in review, 2019) "If I knew what else I should do, I would have left by now": Two women engineering PhD students' experiences with Masters-level departure

**Questions:** Doctoral Students Uncertain of Whether to Stay in their PhD Programs or Depart with a Master's

**Departers:** Students who left the engineering PhD with a Master's degree

**Master's-level Departure:** The process of departing the PhD with a Master's degree

### Dominant Conversations:

1. The important of other identities and talents that may have been sacrificed to pursue graduate study
2. Inability to publish leads to feelings of academic unimportance
3. Incoming graduate students may not understand the PhD, and their goals may change over years
4. De-stigmatizing the desire to not do a PhD: Attrition is not failure on the part of the student
5. Academic self-concept theory may begin to explain the development, particularly the importance of "mastery experiences," "reflected appraisals" from others, and "psychological centrality"