

## **Board 85: Engineering Prosocial Engagement in Electrical & Computer Engineering**

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# Engineering Prosocial Engagement in Electrical & Computer Engineering

## 1. Overview

This paper describes a research study to measure how students' affordance beliefs about the electrical and computer engineering (ECE) profession impact motivation to persist in their degrees, and ultimately into the profession. A cross-sectional study was conducted at a 4-year land grant institution on students in both novice and advanced ECE courses. Surveys were used to measure student beliefs about the value of the ECE profession, their interest in the class, and their intentions to persist. The surveys also measured personal endorsements including the importance of ethical considerations in engineering decisions, the value of professional skills compared to technical training, and empathy. Data analysis revealed that among novice students, the more they believed that the ECE profession afforded opportunities to benefit society and work with others (i.e., had prosocial value), the more interested they were in the class and in turn, the more they intended to persist in their ECE degree program. This persistence intentions relationship was not true for student beliefs about the ECE profession affording opportunities to gain wealth, power, and prestige (i.e., agency). Additionally, the students in the advanced ECE class showed significantly lower levels in their beliefs that the profession afforded opportunities to benefit society, yet they maintained the same levels of belief found in the novice students that ECE provided opportunities for personal gain. An intervention was then introduced in the novice ECE class that had the students produce 3-minute videos where they described how the content from the course benefitted society and allowed them to work with others. This forced the students to make connections in their own minds on the prosocial value of ECE. This intervention has the potential to increase the students' prosocial affordance beliefs about the ECE profession, and in turn, increase persistence rates both within degree programs and into the workforce. The initial study on student beliefs and endorsements was completed in 2017 and the video production intervention was piloted in 2018. At the time of the 2019 ASEE annual conference, the data analysis on the intervention will be complete and will be presented at the poster session.

## 2. Background

Goal-Congruity Theory (GCT) states that people are more likely to pursue a career that affords the values they endorse (Diekman, 2010). From the perspective of a student, there are two places that values are important: 1) what values does a student personally hold dear? and 2) what opportunities does a student believe a given career provides for? When these two types of values are congruent, motivation improves. Goal congruity research has further found that there are generally two categories of values: agency (self-oriented, wealth, prestige) and communal (other-oriented, working with and helping others, giving back to their community) (Thoman, 2015; Diekman, 2017). Agency and communal goal affordance perceptions are not mutually exclusive as a student can believe a profession provides both. Engineering is perceived as affording agentic values in that it can provide a career that brings wealth and prestige

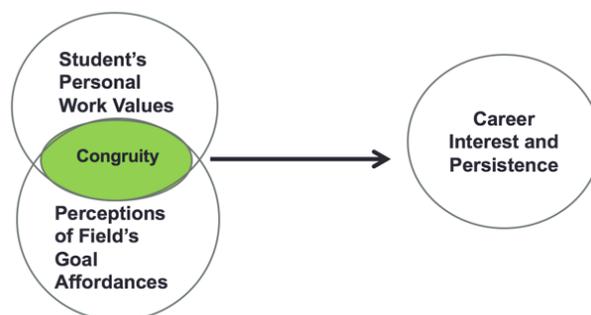


Figure 1. Goal-Congruity Model.

(Cheryan, 2015). However, GCT research has found that the majority of students primarily desire professions that allow them to work with and help others (i.e., a career that affords communal value). Furthermore, the positive influence of communal value perceptions about a profession accounts for motivation above and beyond those of agency values (Brown, 2015). Additionally, women, first generation college students, and underrepresented minorities (URMs) are especially attracted to professions that afford high levels of communal value (Morgan, 2001; Harackiewicz, 2014; Smith, 2014). This is partly because the social roles of these student groups tend to be those of caregivers, so they endorse communal traits as part of their identity (Diekman, 2017; Bardi, 2003; Priniski, 2017).

The engineering profession is misperceived as not affording opportunities to work with others in collaborative environments. Indeed, engineering embodies the stereotype of individuals working in isolation with a singular focus on technology (Cheryan, 2013). While there are certainly parts of engineering that involve working alone, 21st century engineering problems are predominantly solved by teams working collaboratively to create solutions that benefit others. The inaccurate stereotype about the engineering profession not affording opportunities to work in collaborative environments could be a factor in why high performing high school students that could certainly excel in engineering do not choose it as a major. Indeed, professions that are perceived as providing communal value such as medicine and the biological sciences have either made significant progress toward, or achieved, gender parity (Diekman, 2010) while those that are perceived as not affording communal value such as ECE still have the lowest participation of women (10%) of any engineering discipline (NSB, 2018).

Prosocial engagement lies at the intersection of social responsibility (i.e., evaluating the broader impacts of a one's work on public welfare) and communal value (i.e., a person's desire to work with and help others). Prosocial engagement is a key variable in understanding the formation of the engineering workforce because it contributes simultaneously to the recruitment and retention of students who want to work in collaborative environments (Diekman, 2017) and shapes the culture of the engineering to one that holds public welfare paramount (Cech, 2014). Our work seeks to produce fundamental knowledge on how prosocial engagement leads to increased motivation to persist in ECE and contributes to a socially attuned ECE workforce.

### **3. Procedure & Results - Measuring Student Beliefs about ECE and Personal Endorsements**

An online survey was designed and administered to students enrolled in an introductory -level ( $n=79$ ,  $M_{age}=19.97(SD=2.02)$ ) and an advanced-level ( $n=51$ ,  $M_{age}=23.18(SD=3.15)$ ) ECE course during the same academic year. In both classes, 60-65% were majoring in electrical engineering and 20-25% were majoring in computer engineering. Table 1 provides the means, standard deviations, and effect sizes for differences between novice and advanced students and the one-sample t-test values testing the ratings against the neutral point.

Table 1. Descriptive Statistics and T-Tests for Study Variables.

Variable	Class	n	M (SD)	Between Group T-Test	Cohen's d Senior vs. Freshman	One Sample T-Test <sup>+</sup>
ECE Agency Affordance	Advanced	51	3.88 (.84)	0.68	0.13	7.52*
	Novice	77	3.78 (.72)			9.63*
ECE Prosocial Affordance	Advanced	51	3.52 (.81)	3.84*	-0.67	4.56*
	Novice	77	4.01 (.64)			13.96*
Ethical Responsibilities	Advanced	49	3.98 (.74)	1.38	-0.26	9.27*
	Novice	79	4.20 (.93)			11.34*
Empathic Concern	Advanced	51	2.49 (1.13)	8.04*	-1.40	-6.41*
	Novice	76	3.85 (0.78)			3.90*
Experience of Interest in ECE	Advanced	51	3.19 (.45)	7.76*	-1.44	3.12*
	Novice	77	3.98 (.63)			13.79*
Persistence Intentions in ECE	-	-	-	-	-	-
	Novice	77	4.46 (.58)			22.19*

Note 1: ECE = Electrical and Computer Engineering.

Note 2: <sup>+</sup> Tested value was the midpoint of the scale. Greater numbers indicate stronger endorsement.

Note 3: All items are on a 1 to 5 scale with the exception of empathetic concern, which was on a 1 to 6 scale.

Note 4: \* indicates a significance level of at least  $p < .01$  as required by Bonferroni correction.

Multilevel regression modeling was used to test whether prosocial or agency beliefs of novice students were associated with intentions to persist in an ECE curriculum. The process was mediated through the experience of interest variable as shown in Figure 2. In this figure, solid arrows indicate paths with significant indirect effects while dotted lines are insignificant.

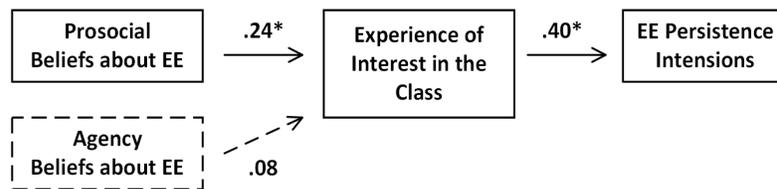


Figure 2. Process analyses for the indirect effect of prosocial beliefs on novice students' motivational experiences in ECE. Numbers represent standardized regression  $\beta$ . Significant indirect effect (bootstrapped; 95% CI: .01 to .34).

The first key findings of our study was the role of prosocial affordance beliefs on intentions to persist of novice students. Novice students were found to possess high levels of both agency and prosocial affordance beliefs about ECE. However, our regression modeling (Figure 2) showed that prosocial affordance beliefs, and not agency, was a significant predictor of intentions to persist. This finding is a unique contribution to the field as ECE students are typically assumed to be more motivated by agency values (Cheryan, 2013; 2015). What is especially interesting about this finding was that the novice students in the study were primarily men (76% reporting their gender as male). This means that while prosocial affordance beliefs have been shown to be particularly important to women and URM students, they can work to improve the persistence of all students.

The second key finding of our study was the difference in prosocial beliefs between novice and advanced students. Our study showed that prosocial affordance beliefs and prosocial trait endorsement (empathy) were lower in advanced students than in novice students. This finding yields multiple questions about the process of disengagement. First, do students with initially high levels of prosocial affordance beliefs and prosocial trait endorsements leave ECE before their senior year? Or, does the ECE curriculum somehow change these students' perceptions about the prosocial affordance of the profession, and even worse, diminish their empathy? These questions can only be answered by conducting the longitudinal study of a neutral classroom condition as is planned in future work.

#### 4. Procedure – Video Production Intervention

In order to force the students to make a connection between the course material and its prosocial value, students were assigned a video production assignment. The students were given access to a screen recording tool (Camtasia Relay) that is provided to all students by the university. This tool allows students to record their computer screen and associated audio and then produce a video that is uploaded to a secure server. Students were randomly selected into two groups, control and experiment. The control group was asked to produce a video where they described a course concept in their own words. The experiment group was asked to produce a video where they described how a course concept benefitted society and allowed them to work with others. Figure 3 shows screenshot examples from some of the student videos.

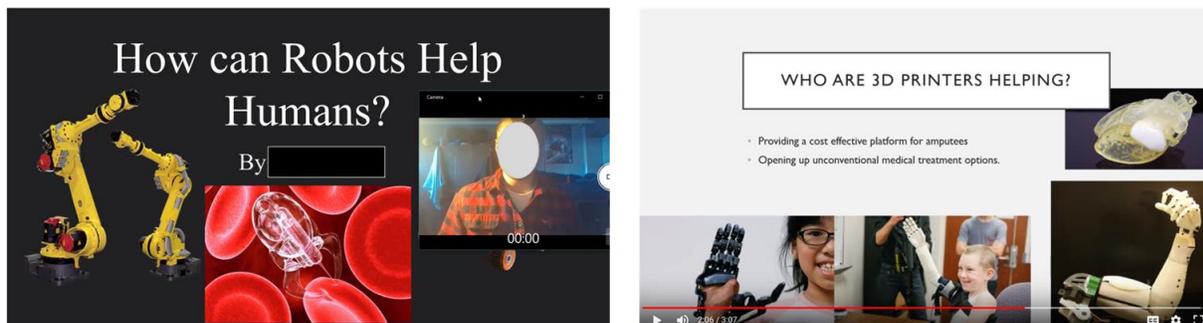


Figure 3. Screenshots of Two of the Video Production Test Assignment.

When the students turned in their videos (via a link to the secure server), they were asked to fill out a survey on the effort of the video creation procedure and on their beliefs about the ECE profession. The data analysis for the impact of creating the videos is in progress and will be reported at the 2019 ASEE Annual Conference.

#### 5. Conclusion

This project is studying the role of prosocial affordance beliefs about the ECE profession on motivation to persist in the profession. It also seeks to understand whether a simple classroom intervention that forces the student to think about the prosocial value of the course material can improve their beliefs about the profession, and in turn, their persistence intentions.

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