



Do Students Value the Pro-Social Side of Electrical Engineering??

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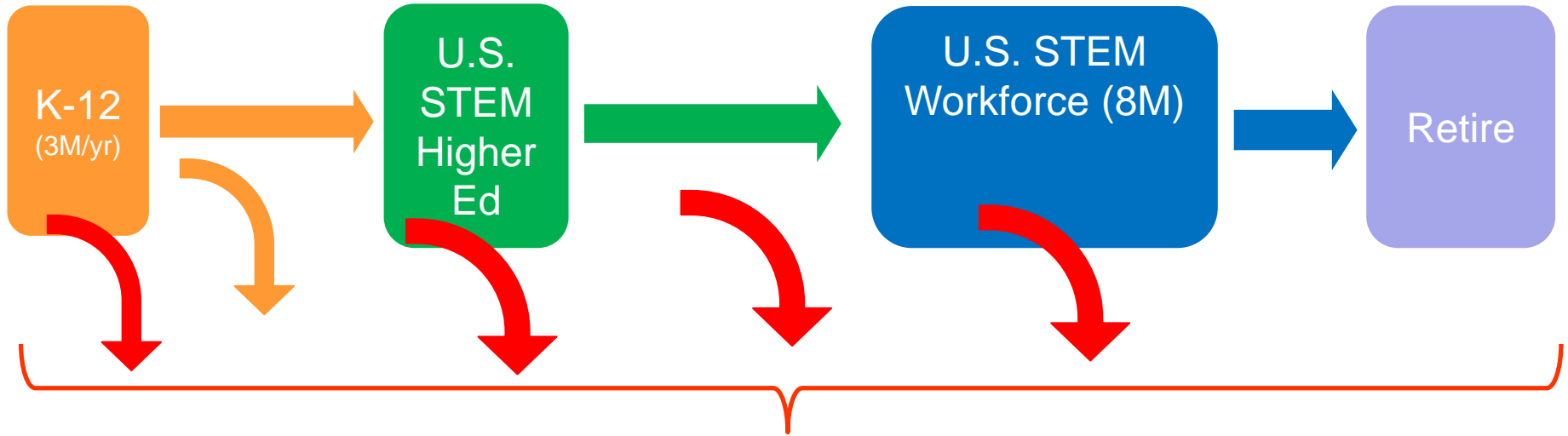
Division of Engineering Education & Centers

**→ PFE = Professional Formation of Engineers
(Award # 1544147)**

- the formal and informal processes and value systems by which people become engineers.



- RFE: The end goal is people working in the engineering profession.



We lose quantity.



We lose diversity in thinking.



We lose the investment.



- What Do Value Systems have to do with PFE?

1) COGNITIVE



- Our intellectual skills.
- The first thing we think of when we talk about “learning”.

In engineering we tend to live in the cognitive domain.



- What Do Value Systems have to do with PFE?

1) COGNITIVE



- Our
- The talk a

But higher ed is starting to pay attention to the impact of this domain.

2) AFFECTIVE



- Our feelings (attitudes, motivation, willingness to participate, value of what is being learned).
- Heavily influences success of cognition.

3) PSYCHOMOTOR



- Motor skills.
- Cognition is underlying component, but practice-makes-perfect.



- **Expectancy-Value Theory of Motivation**

Motivation



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Motivation



More than just wanting good grades & lots of money...

- Propels learning and fuels engagement during the engineering formation process.
- Will the person “choose” an engineering degree?
- Will the person “choose” an engineering career?
- Will the person “choose” to remain in engineering?



- **Expectancy-Value Theory of Motivation**

Motivation = Expectancy x Value



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(Atkinson 50's 60's, Eccles 80's)



- Expectancy-Value Theory of Motivation

Motivation = Expectancy x Value



Beliefs about one's own ability and chances for success.

- self efficacy
- self confidence

(Atkinson 50's 60's, Eccles 80's)



- **Expectancy-Value Theory of Motivation**

Motivation = Expectancy x Value

Beliefs about the importance of the task.

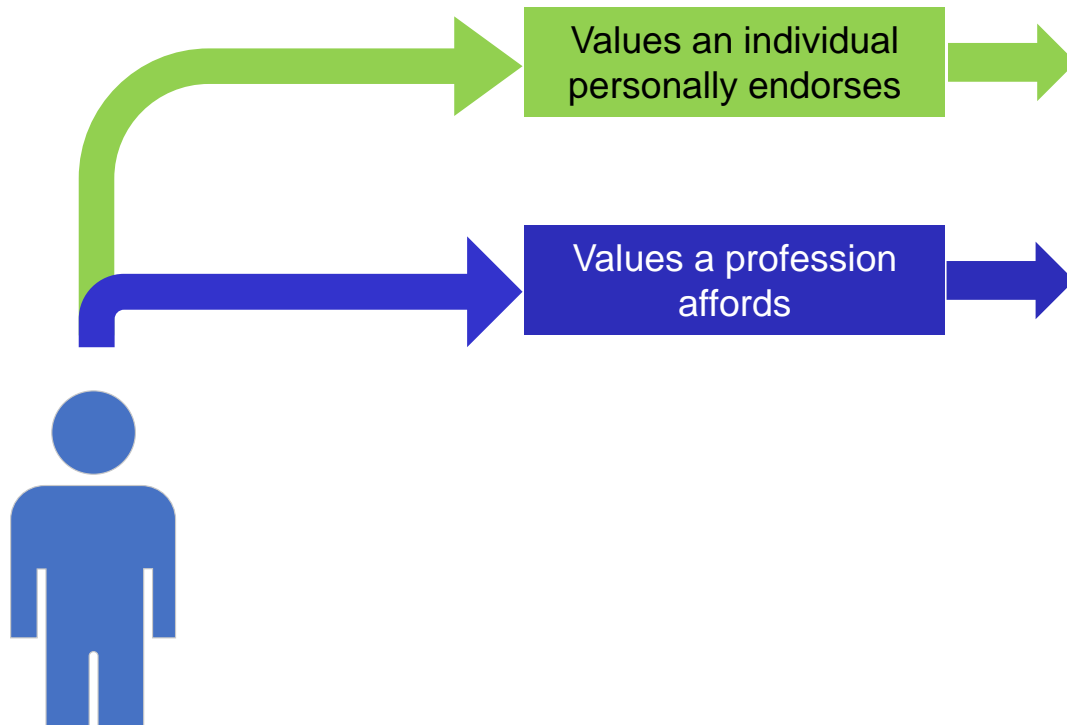
- attainment (importance for identity)
- intrinsic (enjoyment or interest)
- cost (effort)
- and utility (relevance).

(Atkinson 50's 60's, Eccles 80's)



- **Goal-Congruity Theory**

People are more motivated to pursue careers that afford the values that they endorse

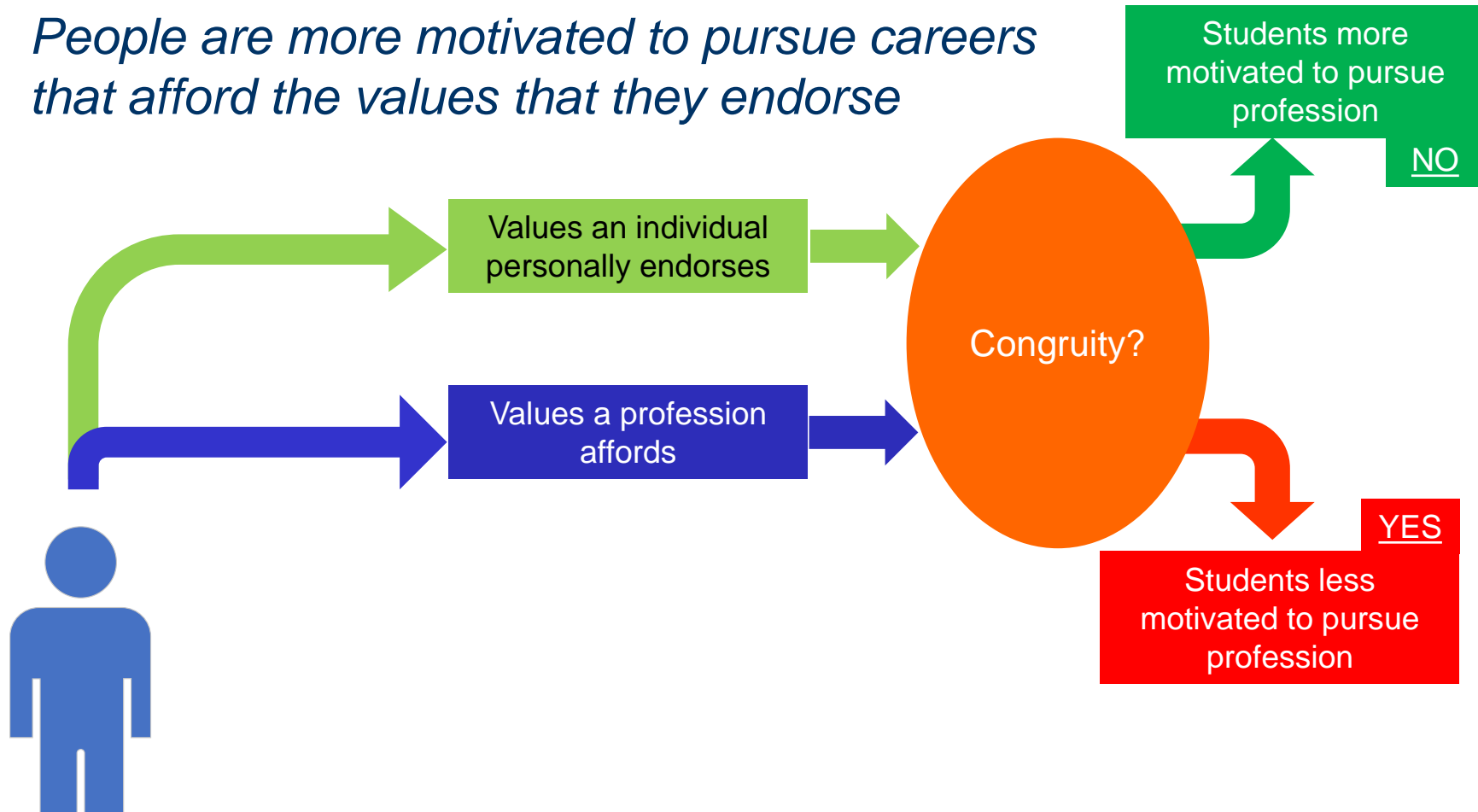


(Diekman 2010, 2011)



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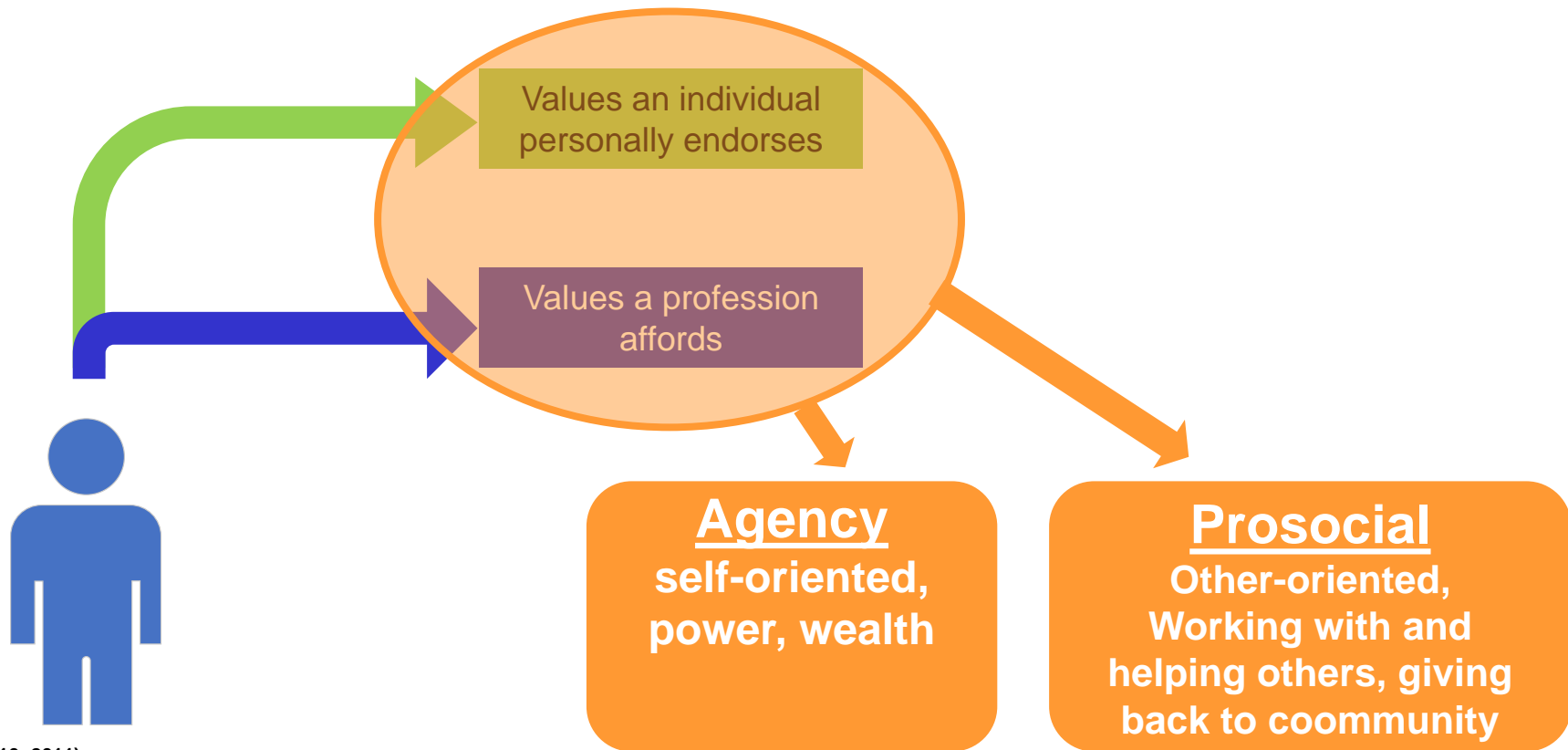


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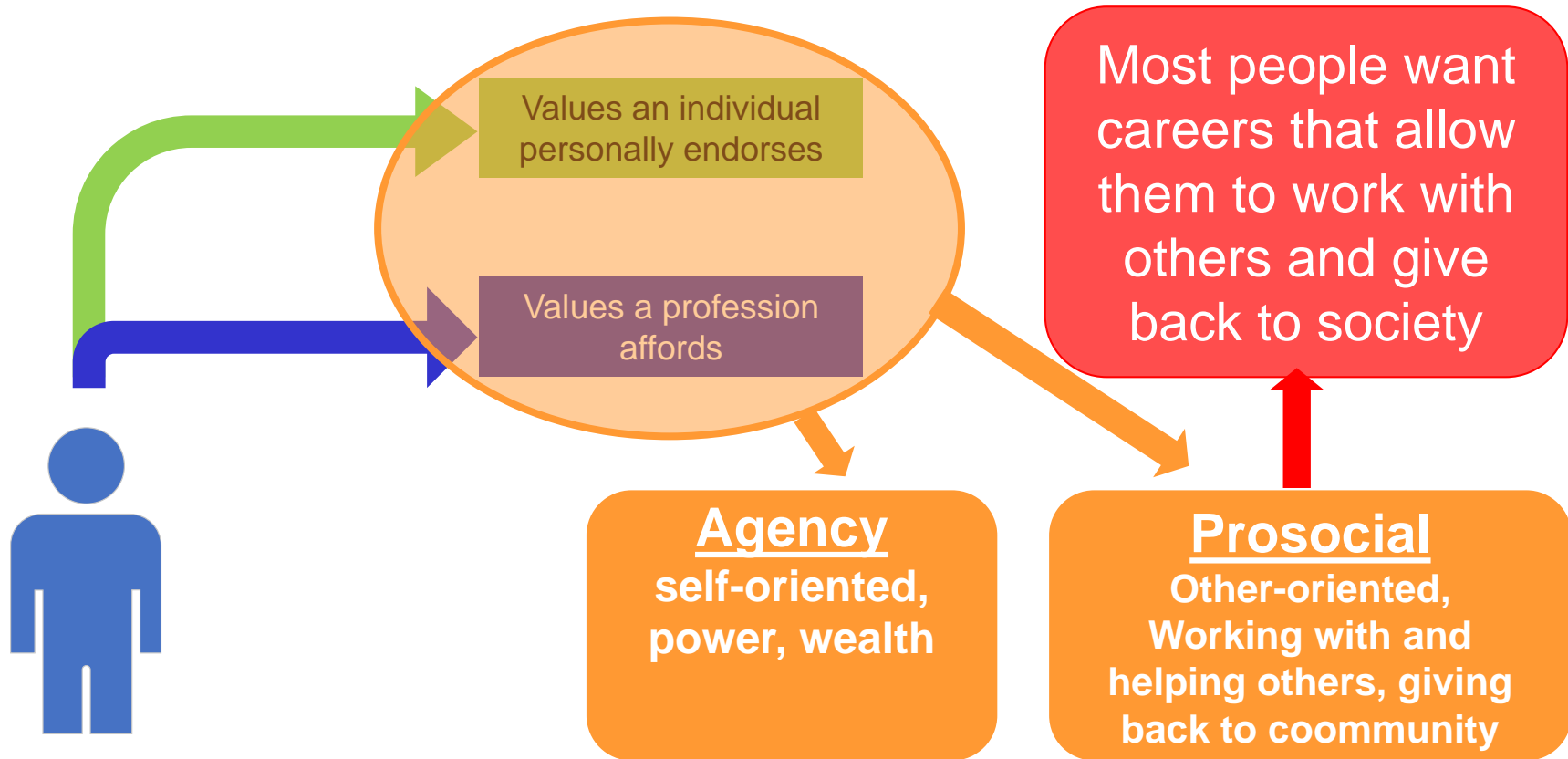
(Diekmann 2010, 2011)

Do Students Value the Prosocial Side of Electrical Engineering?



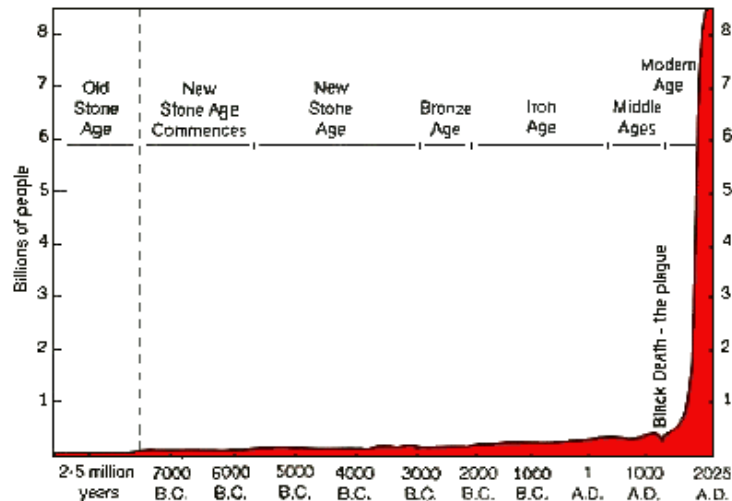
- **Goal-Congruity Theory**

People are more motivated to pursue careers that afford the values that they endorse



- **This is a good thing!**
 - The problems society faces in the 21st century are massive.
 - We need an engineering workforce that wants to benefit society.
 - We need an engineering workforce that wants to work with others to solve large-scale problems.

World Population Growth Through History

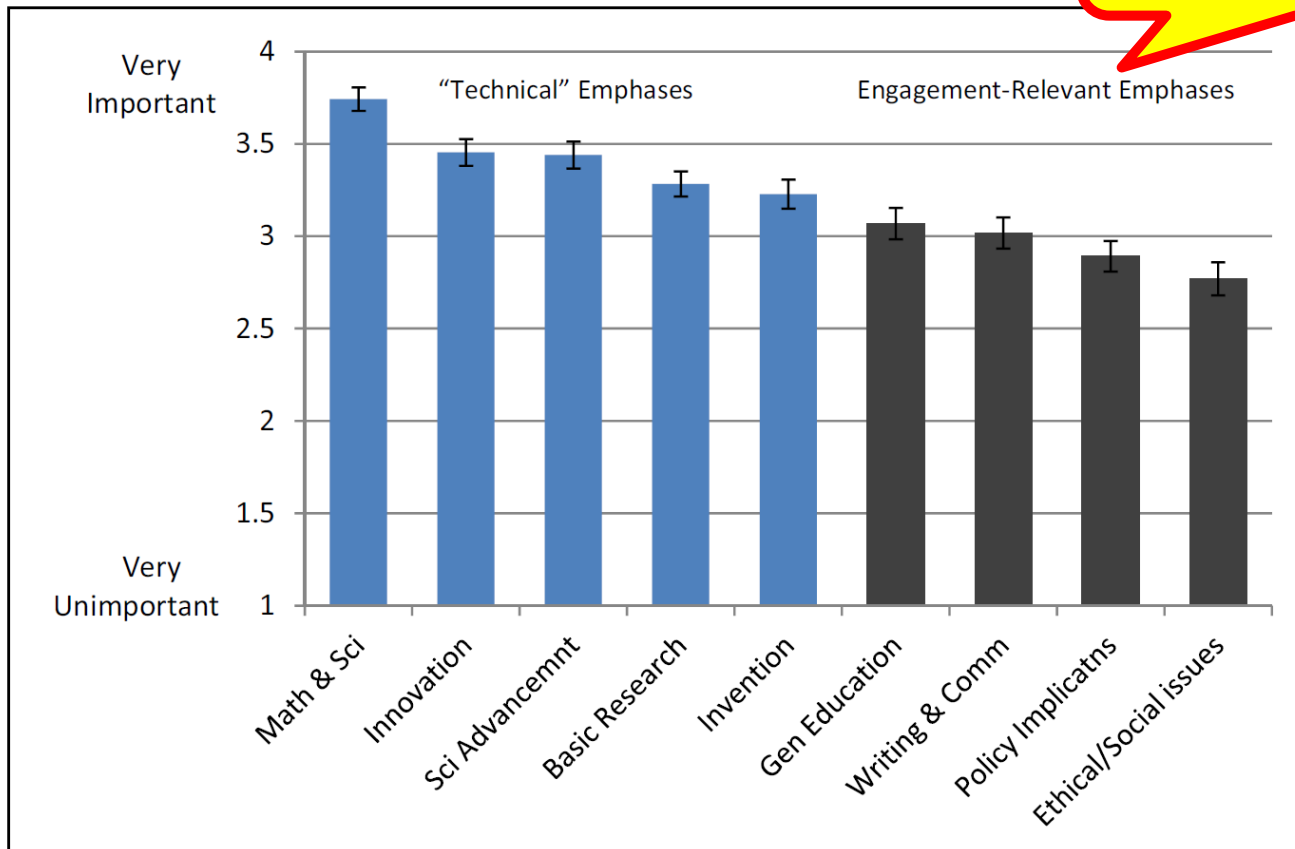


- **The problem (affordance beliefs)**
 - Engineering isn't always perceived as affording high prosocial value.
 - Prosocial trait endorsement has been shown to diminish over time in engineering.



- The problem (trait endorsement)

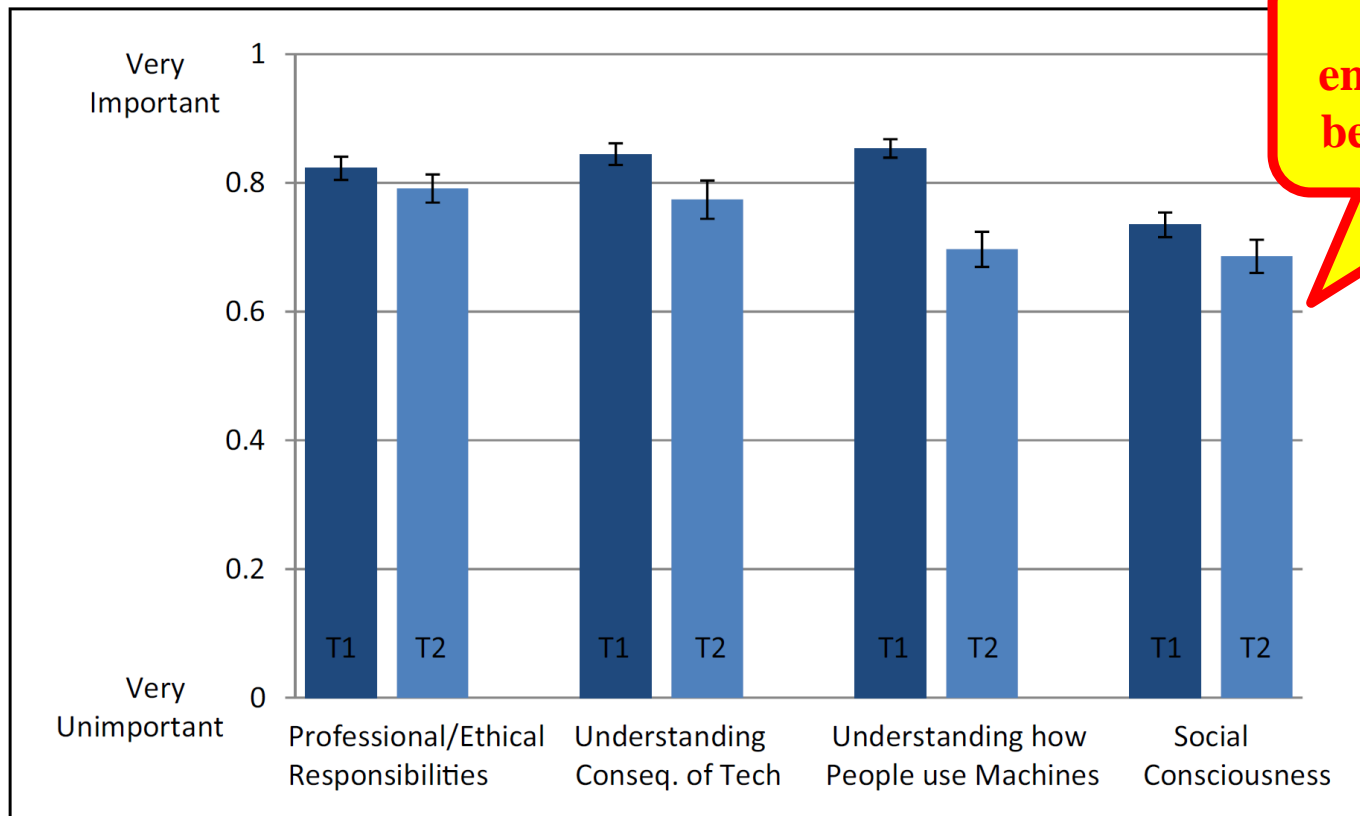
Technical skills are most valued.



(Cech 2014)



- The BIG Problem: Diminishing Prosocial Trait Endorsement**



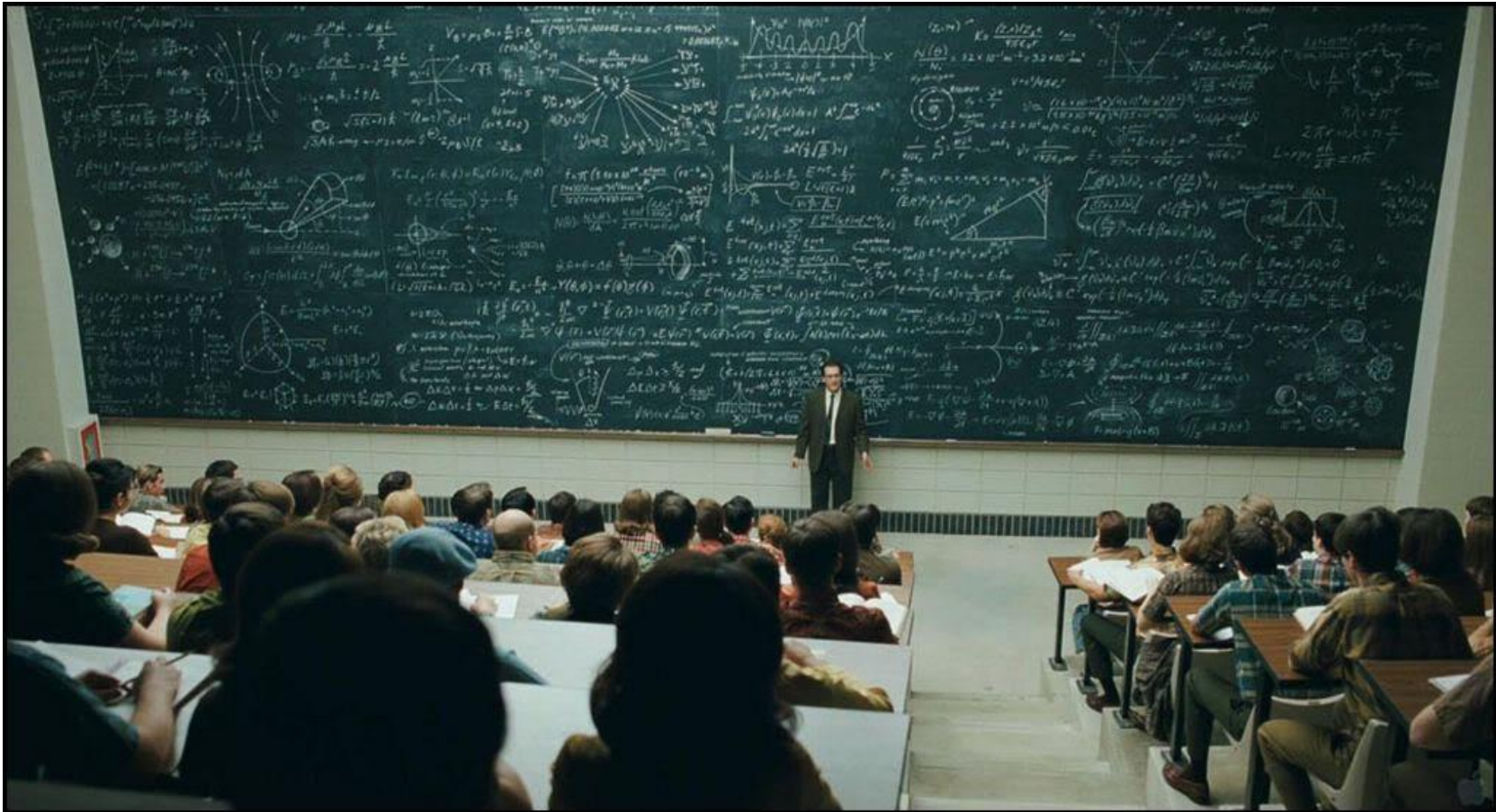
**Over time,
engineering students
become less engaged**

(Cech 2014)



*Do Students Value the Prosocial Side of
Electrical Engineering?*

- What are we doing to these kids???



- **Measure Prosocial Engagement within Electrical Engineering**

R1: Do the prosocial affordance beliefs about EE diminish between freshman and senior year?

R2: Do the prosocial trait endorsements of EE students diminish between freshman and seniors?

R3: Are prosocial (or agency) beliefs about the EE profession associated with intentions to persist?



- **Survey Design – Overview**

- 133 question survey that took 10-15 minutes to complete.
- Administered in required 100 and 400 level electrical engineering courses.
- Given 6th week into the semester.
- Cover story was that we were collecting feedback on classroom environment preferences for future engineering building (under construction next door).
- \$10 amazon.com gift card offered for completion.
- Deception questions added about learning environment preferences.
- Attention check questions added throughout.
- Voluntary, confidential, no impact on student grades.



- **Survey Design – Instrument Selection**
 - **Used instruments that were tested for validity and reliability in other studies.**
 - **Prosocial Trait Endorsement** (trait empathy, concern for public welfare)
 - **Agentic and Communal Affordance Beliefs about the EE Profession.**
 - **Experience of Interest**
 - **Persistence Intentions**



- **Participants**

	<u>Freshman Class</u>	<u>Senior Class</u>	
Enrollment	117	66	Total = 183
Took Survey	85 (73%)	53 (80%)	Total = 138
Major			
- EE	51 (60%)	34 (64%)	
- Computer Eng	24 (28%)	14 (26%)	
Gender			
- Male	65 (76%)	40 (75%)	
- Female	13 (15%)	8 (15%)	
Race			
- White	62 (73%)	39 (74%)	

Note: Only reporting most significant groupings.



- **One-sample T-tests were conducted to find strength and direction of rating.**
- **Independent t-tests were conducted to test for degree and direction of differences between freshman and senior students.**
- **Where applicable, a paired sample t-test was conducted to test for differences in ratings between two constructs.**
- **Relationship among variables were tested with a specified path analysis with a maximum likelihood estimation and indirect effects using bootstrapped standard errors.**



- Descriptive Statistics and T-Test Values**

TABLE I
DESCRIPTIVE STATISTICS AND T-TEST VALUES FOR STUDY VARIABLES

Variable	Class	n	M (SD)	Between Group T-Test	Cohen's d Senior vs. Freshman	One Sample T-Test ⁺
EE Agency Affordance	Advanced	51	3.88 (.84)	0.68	0.13	7.52*
	Novice	77	3.78 (.72)			9.63*
EE 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 EE	Advanced	51	3.19 (.45)	7.76*	-1.44	3.12*
	Novice	77	3.98 (.63)			13.79*
Persistence Intensions in EE	-	-	-	-	-	-
	Novice	77	4.46 (.58)			22.19*

Note 1: EE = Electrical Engineering.

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

Note 3: All items are on a 1 to 5 scale (midpoint = 3) with the exception of empathetic concern, which was on a 1 to 6 scale (midpoint = 3.5).

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



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Both freshman and seniors had significantly high levels of agency affordance beliefs about the EE profession.

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Seniors had significantly lower prosocial affordance beliefs about the EE profession than freshman.



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Both freshman and seniors believed ethical responsibilities were important for the EE profession.



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Seniors had significantly lower empathic concern for the impact of EE decision than freshman.



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Both freshman and seniors showed significant interest in the EE profession.



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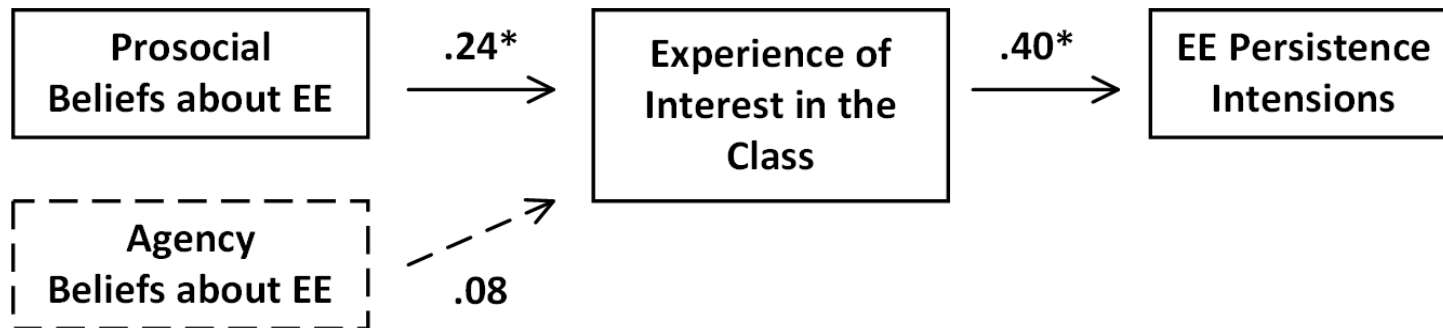
Overall, freshman showed significant intensions to persist in the EE curriculum.



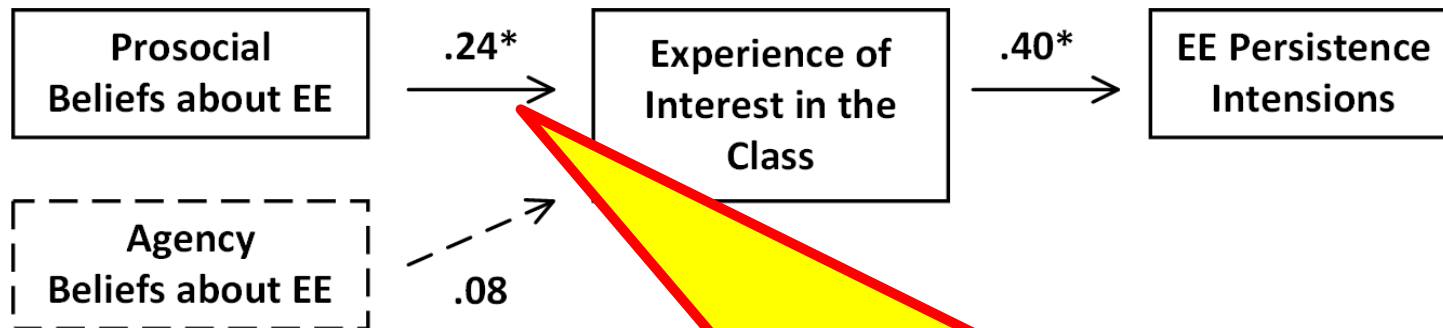
- **Testing associations between affordance beliefs and intentions to persist.**
 - Both prosocial & agency *beliefs* were correlated to interest.
 - *Interest* was correlated to *Intentions to Persist*
 - We created a process model to control for agency vs. communal



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The more students believed EE afforded prosocial value (and not agency), the stronger their intentions to persist.



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 - This is good! The students with the values we need to solve the grand challenges facing society are entering EE programs.



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 - Why: Did students that viewed EE as affording prosocial value leave the program? or did the curriculum marginalize this value? Or both?



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 - Why: Did students that viewed EE as affording prosocial value leave the program? or did the curriculum marginalize this value? Or both?
- **Trait Empathy of EE students diminished between freshman and senior students.**
 - Why: Did students with high levels of trait empathy leave the program? or did the change the students? Or both?



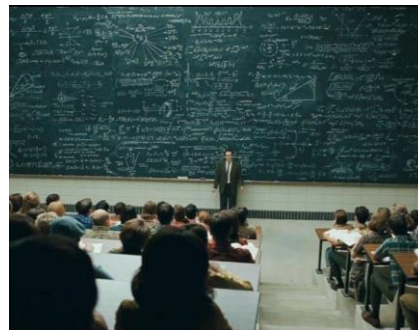
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- **If the curriculum is to blame for diminishing prosocial affordance beliefs, there are a number of low-effort, high-impact interventions that can be implemented from the field of Utility-value.**
- **If the curriculum is actually diminishing the prosocial traits of our students, we need to step back and re-think engineering education.**



Questions



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Electrical Engineering?*

