# Should I Stay or Should I Go? Engineering Students' Persistence is Based on Little Experience or Data

Gary Lichtenstein, Heidi G. Loshbaugh, Brittany Claar, Tori L. Bailey, Sheri Sheppard



"I see my dad, he's an engineer. He sits in his cubicle, at his computer all day, typing up code and doing stuff. I don't really want to be doing that but that's engineering for you. I haven't really thought about 'Well, after school, what am I gonna be doing?' I think it's sit in a cubicle all day and I might be doing this, might be doing that, and I really don't know."

Roger, Mountain Tech, Freshman



"I see my dad, he's an engineer. He sits in his cubicle, at his computer all day, typing up code and doing stuff. I don't really want to be doing that but that's engineering for you. I haven't really thought about 'Well, after school, what am I gonna be doing?' I think it's sit in a cubicle all day and I might be doing this, might be doing that, and I really don't know."

Roger, Mountain Tech, Freshman



# Academic Pathways Study (APS)

an element of the Center for the Advancement of Engineering Education

- Exploratory longitudinal study of 160\* research participants at 4 institutions
- Participants: selected Fall term of freshman year; self-reported interest in engineering
- Goal: Identify and characterize the pathways of students pursuing engineering
- Data: Interviews (semi-structured & structured), online surveys, ethnographic observations, engineering performance tasks, academic courses & grades



### Research Questions

- Skills
- Identity
- Education
- Workplace



### Research Questions

- Skills
- Identity
- Education
- Workplace



### Research Questions

- How engineering skills develop
- How engineering identity evolves
- How engineering education contributes to skills and identity



### Institutions

### **Coleman University**

- Private institution
- Research extensive
- 6700 undergraduates, 2003-2004
- West Coast
- Comprehensive focus

### Mountain Technical Institute

- Public institution
- Research intensive
- 2700 undergraduates, 2003-2004
- Rocky Mountain West
- STEM focus



# Qualitative Inquiry

- Annual Semi-Structured Interviews (n=32)
  - Interest in engineering
  - Current academic experiences
  - Projections about future career pathways
- Supplemental Data (n=76)
  - Online surveys
  - Academic course & grade records



# Data Analysis

- Analysis of semi-structured interviews of 32 respondents (first two years of data)
- Open coding based on skills, identity and education research questions



### Code Book

Academic Advice	Academic Assistance	Academic Courses	Academic Navigations
Academic Major Influences	Advice to Others	Pre- Professional Experiences	Career
College (Experience)	Concerns & Priorities	Engineering Definitions	Faculty Interactions
High School	Identity	Interest & Abilities	Professional Influences
	Projects	Non-Curricular Activities	



### Code Book

Academic Advice	Academic Assistance	Academic Courses	Academic Navigations
Academic Major Influences	Advice to Others	Pre- Professional Experiences	Career
College (Experience)	Concerns & Priorities	Engineering Definitions	Faculty Interactions
High School	Identity	Interest & Abilities	Professional Influences
	Projects	Non-Curricular Activities	



# **Emergent Themes**

 Students making academic major decisions based on little first hand knowledge and experience (about & in engineering)

 Students expressed varying levels of commitment towards their intention to major in engineering



# **Emergent Themes**

• Students making academic major decisions based on little ixposure owledge and experience (about & in engineering)

• Students expressed varying levels of commitment threation intention to major in engineering



### Exposure

# Exposure to engineering before entering college

- Low: no direct engineering experiences
- Moderate: direct mentored experiences related to engineering activities
- High: in depth, broad and direct mentored experiences related to engineering activities



# Exposure

Exposure	Coleman (n=15)	Mountain Tech (n=17)	Totals (n=32)
Low	10 (67%)	10 (59%)	20 (63%)
Moderate	1 (7%)	5 (28%)	6 (19%)
High	4 (53%)	2 (11%)	6 (19%)



Low Moderate High



Low

Moderate

High

### Mark, Mountain Tech

- Excelled in math and science in high school
- Strong interest in meteorology
- Applied to MT because of regional reputation
- Enrolled in MT because of Geophysics major



Low

Moderate

High

### Mark, Mountain Tech

- Excelled in math and science in high school
- Strong interest in meteorology
- Applied to MT because of regional reputation
- Enrolled in MT because of Geophysics major
- Majored in Meteorology and left MT



Low

Moderate

High



Low

### Moderate

High

### Emma, Coleman

- Excelled in math and science in high school
- 5-week summer program focused on engineering
- Childhood engineering projects with Grandfather (an engineer)
- Interested in civil engineering, architecture, & sustainability



Low Moderate High

### Emma, Coleman

- Excelled in math and science in high school
- 5-week summer program focused on engineering
- Childhood engineering projects with Grandfather (an engineer)
- Interested in civil engineering, architecture, & sustainability
- Majored in Civil Engineering



Low

Moderate

High



Low

Moderate

High

### Joe, Mountain Tech

- Grandfather (an engineer) introduced him to metallurgical engineering
- Repeatedly enrolled in engineering laboratory course in high school
- Built trebuchet for high school English course
- Related blacksmithing hobby to his interests in metallurgical engineering



Low Moderate High

### Joe, Mountain Tech

- Grandfather (an engineer) introduced him to metallurgical engineering
- Repeatedly enrolled in engineering laboratory course in high school
- Built trebuchet for high school English course
- Related blacksmithing hobby to his interests in metallurgical engineering
- Majored in Materials and Metallurgy



### Intention

# Intention to declare or pursue a major in engineering

- Unsure: express several reservations about engineering; likely explore outside of engineering
- Mostly Sure: profess a lack of exposure to the engineering profession or coursework
- Positive: express minimal reservations about majoring in engineering



### Intention

Intention	Coleman (n=15)	Mountain Tech (n=17)	Totals (n=32)
Unsure	3 (20%)	8 (47%)	11 (34%)
Mostly Sure	4 (27%)	2 (12%)	6 (19%)
Positive	8 (53%)	7 (41%)	15 (47%)



Unsure Mostly Sure Positive



### **Unsure**

Mostly Sure

Positive

"Honestly, no, I had no idea what engineering was, I was just like, 'Okay, math and science school; we got it,' and then like somehow that just kind of became synonymous with engineer-, with that definition. They're like, 'Oh you can be an engineer,' I'm like, 'Okay, I guess so?' And I only really got a feel for what I'd be doing [after I got] up here....I don't know what it [engineering] is."





### **Unsure**

Mostly Sure

Positive

"Honestly, no, I had no idea what engineering was, I was just like, 'Okay, math and science school; we got it,' and then like somehow that just kind of became synonymous with engineer-, with that definition. They're like, 'Oh you can be an engineer,' I'm like, 'Okay, I guess so?' And I only really got a feel for what I'd be doing [after I got] up here....I don't know what it [engineering] is."





**Unsure** 

Mostly Sure

Positive

"Honestly, no, I had no idea what engineering was, I was just like, 'Okay, math and science school; we got it,' and then like somehow that just kind of became synonymous with engineer-, with that definition. They're like, 'Oh you can be an engineer,' I'm like, 'Okay, I guess so?' And I only really got a feel for what I'd be doing [after I got] up here....I don't know what it [engineering] is."



Jane, Mountain Tech (Majored in Physics)

2007 ASEE Annual Conference & Exposition Honolulu, Hawaii

June 25, 2007

Unsure

**Mostly Sure** 

Positive



Unsure

**Mostly Sure** 

Positive

"This quarter I'm taking (statics) in the engineering [college], so it's-, I'm kind of struggling with that class a little bit. It's pretty tough and I think that has something to do with me like really trying to figure out if I really want to be an ME. I'll see how it goes next quarter."



Grace, Coleman (Freshman)

Unsure

**Mostly Sure** 

Positive

"This quarter I'm taking (statics) in the engineering [college], so it's-, I'm kind of struggling with that class a little bit. It's pretty tough and I think that has something to do with me like really trying to figure out if I really want to be an ME. I'll see how it goes next quarter."



Grace, Coleman (Freshman)

2007 ASEE Annual Conference & Exposition Honolulu, Hawaii

Unsure

### **Mostly Sure**

Positive

"This quarter I'm taking (statics) in the engineering [college], so it's-, I'm kind of struggling with that class a little bit. It's pretty tough and I think that has something to do with me like really trying to figure out if I really want to be an ME. I'll see how it goes next quarter."

Grace, Coleman (Majored in Product Design)



Unsure

**Mostly Sure** 

Positive



Unsure

**Mostly Sure** 

Positive

"I think we're all for the most part pretty serious about school, and we're pretty sure we want to be engineers."



### Christina, Mountain Tech (Freshman)

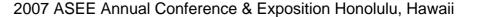
Unsure

### **Mostly Sure**

Positive

"I think we're all for the most part pretty serious about school, and we're pretty sure we want to be engineers."

Christina, Mountain Tech (Majored in Electrical)



Unsure

Mostly Sure

**Positive** 



Unsure

Mostly Sure

**Positive** 

"I'm rather odd in that I already am pretty sure what I want to do, cause everyone else seems to not be so sure....I think it's very standard to wait until like the end of your sophomore before you declare, [but] I'm almost 99 percent sure that I want to do it, so I figure I might as well just do it [declare the major] now."

Rudy, Coleman (Freshman)



Unsure

Mostly Sure

**Positive** 

"I'm rather odd in that I already am pretty sure what I want to do, cause everyone else seems to not be so sure....I think it's very standard to wait until like the end of your sophomore before you declare, [but] I'm almost 99 percent sure that I want to do it, so I figure I might as well just do it [declare the major] now."

Rudy, Coleman (Freshman)



Unsure

Mostly Sure

**Positive** 

"I'm rather odd in that I already am pretty sure what I want to do, cause everyone else seems to not be so sure....I think it's very standard to wait until like the end of your sophomore before you declare, [but] I'm almost 99 percent sure that I want to do it, so I figure I might as well just do it [declare the major] now."

Rudy, Coleman (Undeclared - Computer Science)

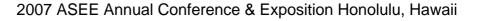
### Intention

# Exposure

_			
	Unsure	Mostly Sure	Positive
	Lisa, Linguistics  Jaime, Human Biology  Leslie, Civil  Grace, Civil & Mechanical  Jane, Physics  Robert, Mining  Anna, Mat'l & Metallurgy  Mark, Meteorology*	□ Dana, Chemical □ Kevin, Electrical □ Grace, Product Design	☐ Alexis, Math & Computation ☐ Paula, Civil ☐ Sara, Electrical ☐ Todd, Civil ☐ Zach, Mechanical ☑ Michael, Electrical* ☑ Kate, Mat'l & Metallurgy ☑ George, Physics ☑ Thomas, Petroleum
	□ Emma, Civil ■ Bill, Mechanical ■ Roger, Mechanical	<ul><li>■ Christina, Electrical</li><li>■ Marilyn, Environmental</li></ul>	■ Max, Petroleum
		□ Steve, Physics	<ul> <li>Nate, Chemical</li> <li>Oscar, Electrical</li> <li>Rudy, Undeclared*</li> <li>Hilary, Chemical</li> <li>Joe, Mat'l &amp; Metallurgy</li> </ul>

**Key:** ☐ = Coleman Students ■ = Mountain Tech Students

\* = Students who have left either Coleman or Mountain Tech



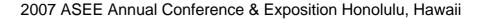
### Intention

# Exposure

Unsure	Mostly Sure	Positive		
☐ Lisa, Linguistics ☐ Jaime, Human Biology ■ Leslie, Civil ■ Grace, Civil & Mechanical ■ Jane, Physics ■ Robert, Mining ■ Anna, Mat'l & Metallurgy ■ Mark, Meteorology*	☐ Dana, Chemical ☐ Kevin, Electrical ☐ Grace, Product Design	☐ Alexis, Math & Computation ☐ Paula, Civil ☐ Sara, Electrical ☐ Todd, Civil ☐ Zach, Mechanical ☐ Michael, Electrical* ☐ Kate, Mat'l & Metallurgy ☐ George, Physics ☐ Thomas, Petroleum		
☐ Emma, Civil ■ Bill, Mechanical ■ Roger, Mechanical	■ Christina, Electrical ■ Marilyn, Environmental	■ Max, Petroleum		
	☐ Steve, Physics	<ul> <li>Nate, Chemical</li> <li>Oscar, Electrical</li> <li>Rudy, Undeclared*</li> <li>Hilary, Chemical</li> <li>Joe, Mat'l &amp; Metallurgy</li> </ul>		

**Key:** ☐ = Coleman Students ■ = Mountain Tech Students

\* = Students who have left either Coleman or Mountain Tech



# Implications for Engineering Education

- Description of initial pathways into engineering
- Description of the range of exposure and commitment of engineering majors
- Students at both institutions had low exposure to engineering and varying strength of intention to pursue engineering
- Exposure based on formal, structured experiences beyond coursework
- Future analysis contrast informal, unstructured experiences



# Acknowledgements

This material is based on work supported by the National Science Foundation under Grant No. ESI-0227558, which funds the Center for the Advancement of Engineering Education (CAEE). CAEE is a collaboration of five partner universities: Colorado School of Mines, Howard University, Stanford University, University of Minnesota, and University of Washington.

