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

<table>
<thead>
<tr>
<th>Academic Advice</th>
<th>Academic Assistance</th>
<th>Academic Courses</th>
<th>Academic Navigations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Major Influences</td>
<td>Advice to Others</td>
<td>Pre-Professional Experiences</td>
<td>Career</td>
</tr>
<tr>
<td>College (Experience)</td>
<td>Concerns &amp; Priorities</td>
<td>Engineering Definitions</td>
<td>Faculty Interactions</td>
</tr>
<tr>
<td>High School</td>
<td>Identity</td>
<td>Interest &amp; Abilities</td>
<td>Professional Influences</td>
</tr>
<tr>
<td></td>
<td>Projects</td>
<td>Non-Curricular Activities</td>
<td></td>
</tr>
</tbody>
</table>
## Code Book

<table>
<thead>
<tr>
<th>Academic Advice</th>
<th>Academic Assistance</th>
<th>Academic Courses</th>
<th>Academic Navigations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Academic Major Influences</strong></td>
<td>Advice to Others</td>
<td>Pre-Professional Experiences</td>
<td>Career</td>
</tr>
<tr>
<td>College (Experience)</td>
<td>Concerns &amp; Priorities</td>
<td>Engineering Definitions</td>
<td>Faculty Interactions</td>
</tr>
<tr>
<td>High School</td>
<td>Identity</td>
<td>Interest &amp; Abilities</td>
<td>Professional Influences</td>
</tr>
<tr>
<td></td>
<td>Projects</td>
<td>Non-Curricular Activities</td>
<td></td>
</tr>
</tbody>
</table>
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 first-hand knowledge and experience (about & in engineering)

Exposure

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

Intention
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

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Coleman (n=15)</th>
<th>Mountain Tech (n=17)</th>
<th>Totals (n=32)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>10 (67%)</td>
<td>10 (59%)</td>
<td>20 (63%)</td>
</tr>
<tr>
<td>Moderate</td>
<td>1 (7%)</td>
<td>5 (28%)</td>
<td>6 (19%)</td>
</tr>
<tr>
<td>High</td>
<td>4 (53%)</td>
<td>2 (11%)</td>
<td>6 (19%)</td>
</tr>
</tbody>
</table>
Exposure Narratives

Low       Moderate       High
Exposure Narratives

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
Exposure Narratives

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
Exposure Narratives

Low  Moderate  High
Exposure Narratives

Low

Moderate

High

Emma, Coleman

• Excellled 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
Exposure Narratives

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
Exposure Narratives

Low  Moderate  High
Exposure Narratives

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
Exposure Narratives

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

<table>
<thead>
<tr>
<th>Intention</th>
<th>Coleman (n=15)</th>
<th>Mountain Tech (n=17)</th>
<th>Totals (n=32)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsure</td>
<td>3 (20%)</td>
<td>8 (47%)</td>
<td>11 (34%)</td>
</tr>
<tr>
<td>Mostly Sure</td>
<td>4 (27%)</td>
<td>2 (12%)</td>
<td>6 (19%)</td>
</tr>
<tr>
<td>Positive</td>
<td>8 (53%)</td>
<td>7 (41%)</td>
<td>15 (47%)</td>
</tr>
</tbody>
</table>
Intention Narratives

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 (Freshman)
Intention Narratives

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 (Freshman)
Intention Narratives

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)
Intention Narratives

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)
Intention Narratives

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)
Intention Narratives

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)
Intention Narratives

Unsure  Mostly Sure  Positive
Intention Narratives

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)
Intention Narratives

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)
Intention Narratives

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)
Intention Narratives

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)
Intention Narratives

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

**Key:**
- ☐ = Coleman Students
- ■ = Mountain Tech Students
- * = Students who have left either Coleman or Mountain Tech

---

2007 ASEE Annual Conference & Exposition Honolulu, Hawaii

June 25, 2007
<table>
<thead>
<tr>
<th>Unsure</th>
<th>Mostly Sure</th>
<th>Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lisa, Linguistics</td>
<td>Dana, Chemical</td>
<td>Alexis, Math &amp; Computation</td>
</tr>
<tr>
<td>Jaime, Human Biology</td>
<td>Kevin, Electrical</td>
<td>Paula, Civil</td>
</tr>
<tr>
<td>Leslie, Civil</td>
<td>Grace, Product Design</td>
<td>Sara, Electrical</td>
</tr>
<tr>
<td>Grace, Civil &amp; Mechanical</td>
<td></td>
<td>Todd, Civil</td>
</tr>
<tr>
<td>Jane, Physics</td>
<td></td>
<td>Zach, Mechanical</td>
</tr>
<tr>
<td>Robert, Mining</td>
<td></td>
<td>Michael, Electrical*</td>
</tr>
<tr>
<td>Anna, Mat'l &amp; Metallurgy</td>
<td></td>
<td>Kate, Mat'l &amp; Metallurgy</td>
</tr>
<tr>
<td>Mark, Meteorology*</td>
<td></td>
<td>George, Physics</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thomas, Petroleum</td>
</tr>
<tr>
<td>Emma, Civil</td>
<td>Christina, Electrical</td>
<td>Max, Petroleum</td>
</tr>
<tr>
<td>Bill, Mechanical</td>
<td>Marilyn, Environmental</td>
<td></td>
</tr>
<tr>
<td>Roger, Mechanical</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Steve, Physics</td>
<td>Nate, Chemical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oscar, Electrical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rudy, Undeclared*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hilary, Chemical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joe, Mat'l &amp; Metallurgy</td>
</tr>
</tbody>
</table>

**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.