So How Did That Go For You? Early Career Engineers' Success in Meeting Goals set as Undergraduate Seniors

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Abstract –The purpose of this study is to explore how early career professionals perceive their success in achieving the goals they set as advanced undergraduates and what factors have contributed to this success. We frame our study in Social Cognitive Career Theory and utilize case study methods. The 20 participants earned engineering bachelor's degrees in 2007 or 2008. This analysis utilizes interviews and surveys from participants' junior and senior years of undergraduate work as well as interviews and surveys from 2011. Many participants have been successful in following their intended path. However, several participants have been unable to find work in their desired field, experienced job losses, or found they do not enjoy working in a particular environment. Others have modified their career goals because of family concerns. Findings from this study will enable faculty and administrators to better understand factors that influence their graduates as they enter the workforce.

Keywords: Recent Graduates, Goals, Career Transition

INTRODUCTION

The engineering profession continues to struggle with recruiting and retaining students [1, 2] and practicing engineers [3]. One survey found that 44 percent of senior engineering students were unsure if they wanted to pursue a career in engineering, and 14 percent were definitely not intending to pursue an engineering career [4]. A study by the Society of Women Engineers found that about 71 percent of men and 61 percent of women with engineering degrees were still employed as engineers three years after graduation, and only about one-third of women and half of men were in engineering jobs 18 to 20 years after earning their engineering degrees [3]. To improve retention among engineering students and professionals, many calls have been issued to change the nature of engineering education[5, 6]. Yet few reports or research studies consider the perspectives of students facing graduation or early career engineers to understand how they make choices to persist in or leave engineering careers.

In general, little is known about the experiences of early career engineers. We do know they face new challenges with unstructured, real world applications for which they may not have been prepared [7-9]. They must navigate unfamiliar systems to access the resources they need, encountering diverse supports and barriers [10]. At the same time, early career engineers may be still figuring out their identities and goals for their careers [4, 11, 12]. Therefore, it is vitally important to understand the experiences of these early career engineers in order to help new engineers prepare for and successfully transition to the workplace, and therefore improve retention within the engineering practice.

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Based on this need, our research question is: How do early career professionals perceive their success in achieving the goals they set as graduating seniors and what factors have contributed to this success?

THEORETICAL FRAMEWORK

We frame our study in Social Cognitive Career Theory (SCCT), as this framework specifically addresses factors contributing to relationships between career goals and actions. SCCT asserts that career choice is a function of self-efficacy, outcome expectations, goals, and contextual supports and barriers, as shown in Figure 1 [13]. In other words, the choice of an engineering career is located in the individual's belief that he or she has 1) the skills and knowledge to be an engineer, 2) expectations of the rewards of an engineering career, 3) commitment to do the kinds of things that engineers do, and 4) an amenable climate for making career decisions. Early Career Professionals (ECPs) enter the workforce with career goals grounded in their undergraduate experiences. These goals are based on the knowledge and skills that these recent graduates have learned as well as their beliefs about their abilities and their expectations for future career success. The work environment challenges graduates' skills, as well as their beliefs about their skills and expectations for future career success. This, in turn, can influence interests, goal intentions and/or goal-directed activities [13].
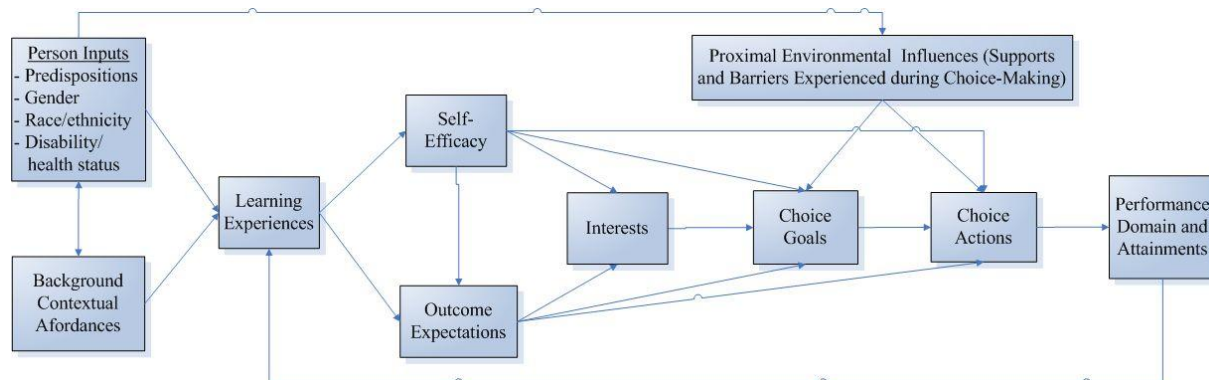

Figure 1: Lent, Brown, and Hackett's SCCT model [13], used with permission.

Promising research results have developed in using SCCT to understand the career choices of engineering students and particularly underrepresented populations [14, 15]. Therefore, extending application of the model of SCCT to early career professionals in engineering is a reasonable and appropriate approach. However, with the exception of Fouad et al. [16] which used SCCT to look at women's persistence in engineering careers, little research has leveraged SCCT in this way.

METHODS

The 20 participants in this study are a sub-set of those initially recruited from multiple institutions as traditional-aged college freshmen in 2003 as part of the Academic Pathways Study (APS). In APS, participants were studied via interviews and surveys over four undergraduate years. Most earned their bachelor's degrees in engineering in 2007, although some graduated in 2008. Atman et al. [17] provide greater detail on the research design and goals of APS.

In 2011, the Engineering Pathways Study (EPS) followed up on a subset of APS participants with interviews and surveys to understand transitions to the workforce. Although EPS participants come from three universities, only two are used in this analysis: TPub, a technical public institution, and LPub, a large public institution. This limitation in participants is consistent with case study methods which suggest having enough cases to represent diversity [18, 19]. Future research would expand this analysis and test findings using the third site, SPri, a suburban private institution. This analysis uses data from participants' junior and senior years of undergraduate work as well as post-graduation data. As part of EPS, participants completed phone interviews that averaged between 30 and 45 minutes in length. Interviewers followed a semi-structured interview protocol to ensure consistency across

interviews but also allow researchers to probe participants for greater detail when needed Following case study methods as described by Yin [19], interviews were recorded, transcribed verbatim, and coded along with free-response questions from surveys.

Participants

Because APS originally oversampled for women and minorities [20], our sample is diverse. Our 20 participants include:

- 12 from TPub and 8 from LPub
- 11 Men and 9 Women
- 14 White/Caucasian, 3 Asian/Asian American, 1 Mexican American/Chicano, and 2 Multiple Ethnicities
- Majors included Mechanical Engineering (5), Chemical Engineering (4), Petroleum Engineering (3), Engineering Physics (2), and one participant each from Aeronautical Engineering, Bioengineering, Civil and Environmental Engineering, Computer Science and Engineering, Environmental Engineering, and Metallurgical and Materials Engineering.

Data Analysis

We analyzed the data in several ways starting when data collection was still in progress. First, we identified a set of initial themes present in the data, both a priori from APS outcomes and SCCT constructs as well as inductively from the interviews [21], through triangulation conversations among the interview team members and interview data sheets and summary vignettes. This provided a solid overview of data across all participants. More specific to this study, the lead author prepared case reports to answer the research question individually for each participant, utilizing all of the available data sources for the participant, and then compared data across cases. This approach is consistent with Yin's [19] suggestions for case studies and ensures that each participant's experiences are understood. We documented examples of the themes and sub themes from the interviews so that side-by-side comparisons of examples (by school and participant) were possible.

We formalized coding of the interview transcripts using MAXQDA software, using the themes developed from the first phase as initial codes as well as additional sub-codes that emerged. Through all phases of analysis we have used researcher triangulation [22, 23] as our primary strategy for increasing the trustworthiness of the data analysis. Members of the research team engage in regular conversations about data analysis and findings.

RESULTS

Our results show that many participants have been successful in following the path they intended as advanced undergraduates (juniors or seniors). However, several participants have been unable to find work in their desired field, experienced job losses, or discovered that they do not enjoy working in a particular environment or field. Other participants have modified their career goals because of family concerns, such as prioritizing a spouse's education or caring for an elderly grandparent. We classified participants across a spectrum representing the degree to which goals have been met. These categories include: Meeting Goals, Clarified Goals, Large Detours but Back on Track, Unexpected Goal Changes, Unsure of Goals, and Not Meeting Goals. Each of these groupings of participants is described in the following sections with at least one exemplar case and quote.

Meeting Goals (n=8)

Many participants are doing what they hoped they would be doing after graduation. As a case example, Beth had an internship as an undergraduate with a government agency and decided she wanted to go into regulatory environmental work. After earning her master's degree and despite geographically limiting her job search so she could care for her elderly grandmother, Beth obtained a position as a regulatory trainee with a similar government agency.

> "After working for the [government agency] I really liked working with the federal government. And um, you know, when I graduated with my masters this other trainee program opened up and I applied for it and there you go. …Am I doing something I thought I'd be doing when I was graduating? Yeah." [Beth, TPub, EPS Interview]

Other participants had even more direct pathways. Michael wanted to earn a PhD and enter academia; he is currently enrolled as a PhD student and still planning to become a professor. Josh wanted to be a petroleum engineer, so he secured a position with a major company and is completely happy after four years with the firm. These participants set goals as undergraduates and have been able to achieve them.

Clarified Goals (n=4)

Other participants were not sure what they wanted to do when they graduated, but believe that their choices are consistent with their somewhat vague ideas at graduation. We call this grouping "Clarified Goals" because their goals are more focused but along the same general path they initially described. Joe and Kara provide representative case examples. Joe is very happy with his job. He did not originally intend to go to graduate school, telling a researcher just three weeks before his bachelor's graduation that he was searching for a job. His job search was unsuccessful so he accepted a research opportunity to stay at TPub for a master's degree with one of his professors. Later, Joe was able to get a very desirable job through his professor's contacts, so to him the time spent in graduate school was a success. When asked if he was currently doing what he thought he would be doing, he told the researcher:

> "I'm doing what I hoped I would be doing, let me put it that way….I was kind of expecting uh, more of just a general plant metallurgist position or something more in a production environment…not a science R&D position." [Joe, TPub, EPS Interview]

Similarly, Kara was not originally planning on pursuing a PhD, but found academic work more interesting than the available jobs.

> "I really wanted to work in the R & D field and I was looking at positions and didn't really see anything that um, was interesting to me that I could get with the background in education that I had at that point. So, I thought, well I'll stay." [Kara, LPub, EPS Interview]

She stayed for a master's degree to try to find an interesting job, and then stayed for a PhD because graduate work was again more appealing than available jobs. Now she hopes to work for a national lab after graduation.

In general, participants in this category see their current work as a logical extension of their undergraduate goals, even if they did not explicitly plan to be doing what they are currently doing.

Large Detours, but Back on Track (n=2)

Participants in this grouping had a goal, then detoured from that goal, but are now pursuing it again. For example, David wanted to work in the energy industry. After working in heating and air conditioning for a year and a half, he left that job to try to find something more in line with his interests. He held multiple jobs and ended up pursuing a master's degree in renewable energy full-time.

> "I really wanted to work in the renewable energy field, I'm not quite there yet, but I think I'm heading the right direction with this degree."[David, TPub, EPS Interview]

Jesse's path was even more varied. As a senior, he wanted to:

> "Work at an internship for a short amount of time, then decide if I want to continue being an engineer in the field. Either way I will travel and try to use my skills as an engineer for development work in the world." [Jesse, LPub, Senior Survey]

In the four years since graduation, he has worked as an engineer for a large firm, then volunteered full time, then worked varying service positions, and is now working as an engineer for a non-profit organization in a developing country. He reported that he is now doing what he envisioned at the end of his undergraduate studies.

These two cases illustrate that some goals remain salient over time, even if unexpected circumstances or opportunities cause early career engineering professionals to deviate from direct paths for a time.

Unexpected Goal Changes (n=2)

Two study participants have changed their goals from what they originally wanted to do but are happy in their new paths. Laura, a chemical engineer, wanted to work in a certain specialty but was also geographically constrained by her husband's career. She changed specialties and enjoys her work.

Lisa's case was much more dramatic. She described her initial decision to stay at TPub for a graduate degree

"wasn't the masters so much as being able to use up the rest of my eligibility to um, for [specific sport] in NCAA" [Lisa, TPub, EPS Interview].

She then went to work as an engineer, but did not have a positive experience.

"It was a tough economy and they were the only ones that were hiring so I didn't really have much of a choice….I should have just never done that and just searched for a company that I actually would have liked and enjoyed working with." [Lisa, TPub, EPS Interview].

Because of her negative experiences, Lisa has now gone back to school for a degree in a health-related profession. She believes that she will be able to leverage her athletic experience and engineering skills to build her own health practice.

These cases illustrate that participants may not meet their initial goals, but can change their goals and be quite happy.

Not Meeting Goals (n=1)

At the end of the spectrum is Will. His job does not have the hands-on component that he craves, and he has been unable to find a different job. He describes his mobility being limited by financial obligations related to being a husband and parent. As time passes, he is becoming less optimistic about being able to achieve his goals.

"And since I'm in my current job I'm worried that those skills that I learned in school are just becoming more and more stale, that the longer I stay here the harder it is to find a job in the career I want." [Will, TPub, EPS Interview]

Will intends to continue attempting to change jobs.

Unsure of Goals (n=3)

At the time of their EPS interviews, three participants were not able to articulate their goals to the researchers. Emily worked part-time for her firm during her senior year and started full-time after graduation. Due to the economic downturn, her hours and benefits were severely cut. She feels that her managers are unconcerned and is finding the little work available unfulfilling. So, she is trying to change jobs but her job search has not been fruitful. She told her interviewer:

"I'm just worried I'm not going to be able to figure out what I do want to do if I, if it's not engineering, you know?" [Emily, LPub, EPS Interview]

The other two participants are reasonably contented in their current roles, but are not certain where they want to go in the future.

DISCUSSION

The purpose of this study was to explore how early career professionals' success in achieving the goals they set as graduating seniors and what factors have contributed to this success. We found that we could categorize participants' success across a spectrum. In addition to directly achieving goals, this spectrum illuminates pathways that are indirect and emergent after graduation. As such, the findings from this study will enable faculty and administrators to better understand factors that influence their graduates as they enter the workforce, and therefore better prepare graduating engineers to meet their goals.

First, faculty should help students recognize that a variety of external factors may impact their success in achieving their career goals. For example, a changing economy can result in a very different job climate than even one or two years previously. As a result, several of our participants accepted jobs that they would not have originally considered, yet were able to adapt and were quite satisfied with their choices in the end. Faculty could help students think about the many ways that their engineering skills could be useful across a variety of jobs so they are better prepared to market themselves.

Second, faculty should also talk to students about the process of accepting jobs. For example, graduates should fully investigate a position before accepting it and may need help knowing what questions to ask. Our data show multiple participants who regretted accepting jobs without understanding the type of work they would be doing or the office environment.

Finally, faculty should understand, while mentoring students that family, concerns play a very large role in early career engineering professionals' career choices. For example, both men and women experience geographic restraints because of their partner's wishes, and both men and women worry about balancing work with family life. This is a topic seldom considered in engineering classrooms. It is seldom addressed implicitly or explicitly in classroom activities, yet is an important factor to many early career engineers. Graduates need to know it is OK to talk about and ask about how family concerns fit with a job search.

So, why do we put this burden on faculty when many schools have career centers that could be doing these very activities? Because classes are mandatory for graduation and career centers are often optional activities. We have a responsibility to educate students not only with technical skills but to know how to use those skills within the larger societal and global context. Research suggests we may not currently be meeting this need. For example, even among senior engineering students, there is confusion about what engineers do and what engineering is [12]. Faculty are the primary group of people on campus with whom students interact and are therefore positioned to make significant differences. Faculty who are hesitant to provide advice because they have little industry experience or extensive academic careers can partner with their campus career centers to ensure that they are up to date on current industry conditions and hiring practices. In a sense, faculty would be helping students to leverage their technical skills but learning how to find an employment opportunity where they could be most successful.

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