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Motivating Factors That Encourage Rural Students to Pursue Engineering

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Motivating factors that encourage rural students to pursue engineering

Introduction

This complete research paper describes a qualitative study conducted at a large midwestern university exploring the motivations rural students cite as reasons for pursuing engineering. According to the United States Department of Education, rural communities account for 32% of public elementary and secondary schools, serving 24% of students in the United States [1]. 27.1% of rural students continue their education by enrolling in a college or university by the time they turn 24; this is below the national average of 34.7% for all students 18-24 years old [2]. The number of rural students pursuing engineering degrees is unknown; however, case studies suggest that rural populations are underrepresented in engineering programs throughout the nation [3]. Other recent work has investigated the impact of rurality on engineering persistence and graduation rates, with one model showing that rural students are 7% less likely to graduate than students coming from a suburban area [4]. Although significant, these quantitative studies do not tell the whole story on the experiences of rural students who enter the engineering field

There are unique challenges rural students face when transitioning to institutions of higher learning [5]. Rural communities tend to be geographically isolated and regions of lower economic opportunity, which can lead to limited advanced math and science courses and fewer STEM outreach opportunities at the K-12 level [2], [3], [6]. This lack of STEM exposure may hinder students from entering the engineering pipeline. The culture of rural communities can also impact student's decisions to pursue higher education. Education is often not identified as a top priority for adults in rural communities. Many parents in rural areas have not attended college themselves, and therefore they are less likely to encourage their children to attend college [7]. This can result in a lack of mentorship and role models for prospective students. Many rural Americans tend to be committed to their communities and have little desire to leave their hometowns [7]. There is also evidence that rural students have lower expectations and confidence in their ability to succeed in an engineering course of study [8]. Finally, there has also been work that suggests that the reasons rural students pursue engineering are different from those of their urban and suburban peers [8]. By digging deeper into the experiences of rural students in their first year, we can learn more about these unique challenges and motivating factors that encourage them to pursue engineering. We hope that understanding rural students' experiences can promote the recruitment of more rural students into engineering and help educators better support rural students during the first-year transition.

This work is guided by one research question: *what factors motivate rural students to attend university and enroll in an engineering major?* The goal of this work is to describe the experience of rural students in their first year of study at a large university as they transition into an engineering course of study. This work will explore the factors that rural students consider when making decisions about post-high school education, engineering major choice, and choosing a college to attend. This work will also address students' perceptions of themselves and the personal motivation factors that contribute to their learning. Finally, this paper will address the relationship students have with their home community and their motivations behind the desire to return upon degree completion or move to a new location.

Background

Motivations are the reasons why people act or behave in a particular way. Modern theories of motivations focus on the relationship between one's beliefs, values, and goals [9]. Eccles and Wigfield group motivation theories into four major categories: theories focused on expectancies for success, theories focused on the reasons for engagement, theories integrating expectancy and value constructs, and theories integrating motivation and cognition [9].

Our work uses self-determination theory (SDT) to characterize the reasons rural students state for pursuing higher education, choosing and engineering, and determining their career goals. According to Eccles and Wigfield's categories, it is a theory focused on the reasons for engagement[9]. SDT asserts that actions are motivated by the desire to fulfill three basic human needs: competence, autonomy, and relatedness [10]. Competence is the knowledge and skills one must possess to succeed and feel effective in dealing with the environment. Perceived competence is often compared to self-efficacy, which is a person's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives [11]. Competence is built through providing optimal challenges, promoting task feedback, and freedom from demanding evaluations [12]. Autonomy is the ability for people to control their own choices and the freedom to proceed with choices unhindered. It is often cited that in an educational context, autonomy is the most salient SDT need that can be addressed [13]. Relatedness is the sense of community, belonging, or shared sense of purpose individuals have with one another to create close relationships. All three of these needs are interconnected and must be fulfilled for motivation to flourish.

To fulfill these basic needs, Deci and Ryan postulate that multiple motivational orientations drive a person to act: extrinsic motivation, intrinsic motivation, autonomous motivation, and controlled motivation [12], [14]. Extrinsic motivation is derived from an external source. There is a separable outcome one is trying to obtain or avoid, such as a reward or punishment. Common external factors are grades or evaluations, which are metrics that have been constructed to "measure" a student's success and serve as motivation for improvement. Another type of external factor can be derived from another person, such as the opinion of a mentor, friend, or peer. Intrinsic motivation comes from internal drives and is defined as doing an activity for its inherent satisfaction [12]. These actions reflect ideas like core values, personal interests, and one's sense of morality. Intrinsic and extrinsic motivation are considered to be part of the "locus of causality," meaning they are the perceived sources of motivation.

The study of rural communities poses a unique challenge for researchers in engineering education. With no standard consensus, the United States has six different ways of defining "rural"[7]. Communities can be categorized depending on population, distance from a metropolitan center, geographical features, or level of economic and industrial development [7]. The lack of definition is further complicated by the individualized nature of an individual community. Rural communities have unique customs, values, and identities making generalizing between different communities a challenge [15]. Additionally, geographic isolation and low populations make access difficult. For these reasons, there is a general lack of research on the impact of rurality on the experience of engineering students. Most of the work in rural engineering education centers around K-12 outreach and recruitment of students into the STEM field.

Efforts have been made to determine the distribution of students from rural communities who enter and persist in engineering programs. A 2013 study looked at the geographic distribution of students enrolled in six Midwestern chemical engineering programs, discovered all six universities had rural student populations less than geographical proportional parity, meaning that the rural population was underrepresented in all departments [3]. Additionally, there was no rural student representation at three of the institutions. The authors propose that this may represent a leak in the STEM pipeline and efforts need to be made to increase rural recruitment to increase rural representation in engineering [3]. Other recent work has investigated the impact of rurality on engineering persistence and graduation rates. Using a regression model, it has been shown that rural students are 7% less likely to graduate than students coming from a suburban area [4].

This study seeks to expand upon the limited research on rural engineering education. By moving beyond recruitment and retention numbers, we are capturing the experiences rural students report and contextualizing them in the first year of undergraduate study. Our hope is that this work will illuminate the unique challenges rural students face and uncover the "why" behind the low recruitment and retention numbers reported in previous work.

Methods

Setting

This study was performed at a large public research institution in the Midwest. The campus is 40 miles from a large urban center and located in a mid-sized city with a population of 115,000. The college of engineering offers seventeen different engineering majors. First-year students are accepted into the college of engineering but are not admitted to a specific engineering department until their second year. There are approximately 7,000 undergraduate students enrolled in engineering. There is no information detailing the rurality of a student's home community available from the office of the registrar.

Participants

Students were recruited from a first-year general engineering course. All students were undeclared engineering majors and fit the following exclusion criteria:

- first-year undergraduate student
- enrolled in an engineering major (enrolled in either of the first-year engineering courses)
- self-identify as a student from a rural community
- be over the age of 18.

This study is part of a larger study on the relationship between students' engineering and rural identities. It has been proposed that rurality is a contributor to identity formation [16]. With multiple definitions and the "know-it-when-you-see-it" nature of rural communities, it was important to the team that students determine for themselves if they consider their hometowns as "rural." Therefore, the definition of "rural" was purposefully left vague when recruiting students. Students who self-identified as being from a rural community submitted the name of their hometown and high school. This information was categorized using the National Center for

Education Statistics School Locale Definition [17]. Students were invited to participate in interviews if both their hometown and high school fit into the category of “town” or “rural”.

Students were recruited by posting a call for participation on an online course message board and in-person solicitation. Fifteen students responded to the call initially. Three of the initial responders did not meet the criteria of their hometown or high school categorizing as "town" or "rural". Twelve students were invited to participate in interviews by email. A follow-up reminder was sent two weeks after the initial invitation. Seven students agreed to participate.

Table 1 contains the demographic information for the seven participants. Students were deidentified and assigned a pseudonym A-G. All students are considered “in-state” and lived on campus at the time of the interview. All seven participants were 18-24 years old and single, never married. None of the participants had religious affiliations. There was one female participant and six male. Student B identified as Asian-American and the other six participants identified as Caucasian. None of the seven participants were first-generation college students. All of the students had two parents with bachelor's degrees or higher and reported a household income of over $40,000.

Table 1: Demographic information for the seven study participants

Name	High School Distance from Campus	High School Class Size	Age	Martical Status	Gender	Ethnicity	Religious Afflitation	Mother's Education	Father's Education	High School GPA	Annual Household Income
A	29 miles	68	18-24 years old	Single, never Married	Male	White	No Religious Affiliation	Bachelor's Degree	Bachelor's Degree	4.0 or above	More than $80,000
B	166 miles	100	18-24 years old	single, never Married	Male	Asian or Pacific Islander	No Religious Affiliation	Master's Degree or above	Master's Degree or above	3.5-3.99	$60,000-$79,999
C	185 miles	150	18-24 years old	Single, never Married	Male	White	No Religious Affiliation	Master's Degree or above	Bachelor's Degree	3.5-3.99	More than $80,000
D	135 miles	100	18-24 years old	Single, never Married	Male	White	No Religious Affiliation	Master's Degree or above	Bachelor's Degree	4.0 or above	$60,000-$79,999
E	422 miles	160	18-24 years old	Single, never Married	Female	White	No Religious Affiliation	Master's Degree or above	Master's Degree or above	4.0 or above	Unknown
F	164 miles	96	18-24 years old	Single, never Married	Male	White	No Religious Affiliation	Master's Degree or above	Bachelor's Degree	4.0 or above	More than $80,000
G	35 miles	93	18-24 years old	Single, never Married	Male	White	No Religious Affiliation	Bachelor's Degree	Bachelor's Degree	4.0 or above	$40,000-$59,999

Data Collection

The study was granted IRB approval in the fall of 2019. Data was collected during the participants' first semester at the university through one-on-one, semi-structured, in-person interviews. The interviews were held in a study room on the college's engineering campus. Ninety minutes were allotted for each interview. Participants were compensated with a $20 gift card. Students filled out a paper demographic questionnaire (Table 1) at the start of the interview. The interview questions were personalized based on the students' questionnaire responses. For example, Student E identified as a female engineering student, so her interview

included questions on the role that gender played in her experiences in engineering. Interview questions were specifically adapted for engineering students from the thesis of Karen M. Ast [18].

This study was developed using a lived experience framework and narrative inquire. Narrative inquiry makes meaning out of an individual's experiences by accounting for temporality, sociality, and place dimensions in which they occur [19]. In this study, these three dimensions were relevant as the student participants were drawing on their past rural high school experiences to describe their current transitional experiences entering engineering school. Narrative inquiry allowed the researcher to illuminate the influences that rural culture has on students' perception of the challenges they are currently or have previously faced. Interview questions were developed to be open-ended and allow students to share their experiences in their own words.

This work is part of a larger study exploring the experiences of rural engineering students. In addition to investigating the motivations behind rural students' decisions to pursue engineering, the study explored the formation of engineering identity and barriers rural students face while entering an engineering community of practice [20]. A sample of the questions developed to specifically probe the research question of this paper is as follows:

- Why did you choose to attend college?
- Why did you choose this university?
- Why did you choose an engineering major?
- What motivates you?
- After graduation, do you plan to return to your rural community? Why or why not?

Data Analysis

Interviews were recorded and transcribed by a transcription service. The transcripts were read multiple times to gain an understanding of the individual experience of each student as well as the collective experiences the participants shared as rural students. The researcher then used open-ended coding to note emergent themes from each transcript. The open-ended codes were categorized based on four orientations (extrinsic, intrinsic, autonomous, and controlled) and the fulfillment of the three basic needs (competence, autonomy, and relatedness) based on self-determination theory (SDT) [10]. Summary reports were written to capture collective themes, assist with coding, and allow for sharing of information between the research team. This iterative process allowed for emergent themes to be grouped and categorized.

Researcher Background

The first author of this paper is an engineer from a rural community and has an interest in learning about the experiences of other rural students in the engineering education system. After graduating from a small, rural high school, she attended large research universities for both her undergrad and graduate education. She has first-hand experiences of how the culture, economy, and educational resources of individuals from rural communities might influence their transition into and motivation to pursue engineering. She is interested in learning how the experiences students had in rural communities shape their identity as an engineer.

The desire and curiosity to explore rural student's experiences were sparked by the first author's path from a rural community to academia. She acknowledges that these experiences could bias

her interpterion of the results however, also argues that her background allows her to view the study with "theoretical sensitivity" [21]. She can build rapport with the participants by sharing her own personal and professional experiences. Having had many of the same experiences that the students report, she also has an enhanced ability to analyze the data and give meaning to the experiences of this population.

Results and Discussion

This analysis is guided by the research question of *what factors motivate rural students to attend university and enroll in an engineering major?* Table 2 details the themes that emerged from analyzing the interview transcripts in terms of considering student internal and external motivations based on SDT. These themes have been organized into five main classifications: motivations to pursue higher education, motivation to pursue engineering, motivation to attend a large research institution, and motivations to leave or return to their home communities. There is significant overlap between the five categories, as several motivation factors can impact more than one area of a student's decisions. Although these motivating factors may influence all students starting at any university, these interviews uncover ways that rural first-year students uniquely navigate the decisions necessary to enter an engineering community of practice.

Table 2: Emergent themes

Motivations to attend college	**Motivations to pursue an engineering degree**	**Motivations to attend [large midwestern research institution]**	**Motivations to leave or return home**
Seeking new opportunities	Having an aptitude for math and science	Family tradition	Relationships
Wanting to experience diversity	Person in their life suggested they pursue engineering	Location – in-state tuition	Availability of jobs
Desire to leave home community	Financial incentive and risk aversion	Prestige	Attitude of home community
Expectations from family and community	Contributing to the greater good	Availability of resources	Perceived lack of value in home community

Motivations to attend college

The first theme explored in this analysis was the motivations students cited for attending college. Several of the students explicitly stated their internal *desire to leave their home community* was a large motivation to attend college. Student F explicitly wanted to leave his hometown: *"I don't wanna live in [my hometown]…. If I didn't get an education that allowed me to get a job that I could move somewhere else I just- I don't- It wasn't really- I didn't really see a way out of that other than going in the military, which would have worked too, you know."*

Student G also expressed military as an option he considered instead of attending college. Ultimately Student G decided he would consider the military after completing his degree:

> *I know I always wanted, I always thought about joining the military. I was gonna do that after high school. And then, I don't know, I always was convinced, go to college and try it out but, I think after college, I might try going for Air Force and becoming a pilot through there, but-... I don't know, that's a long way-*

One of the prominent external motivation students cited for attending college were *expectations from family and community.* Student E noted that the majority of her motivation came from people in her life and not wanting to disappoint them:

> *Definitely, all of the people that I know have been encouraging me throughout the way. I don't want to disappoint them. And I know that even if I decide to not take this path anymore, they'll still be encouraging, but I wanna prove to myself and to everybody else that I can do this, and that it, it may be challenging along the way but I can get through it and I can follow these paths that I've set for myself.*

Student D also noted that his motivation to attend school came primarily from his parents.

> *I think a lot of it was influenced from my parents because they were the generation where it's like, "You go to college or, like, you're not going to go anywhere." and stuff. That was my primary motivation because my mom, when she was little she wanted to be a veterinarian and so she went to college to try and be a veterinarian and she did.*

He went on to note that although this motivation was initially external, he was able to internalize it and reframe his motivation in terms of his own goals for the future.

> *Largely I think my motivation, originally was just, like, I don't want to disappoint my parents and stuff, but eventually, they will stop[ed]. They just didn't really have any expectations for me anymore and so all my motivation is just from thinking about my future and- how I want my life to be like after college and stuff. And I want to work towards that, and just keep at it. Yeah, a lot of it's just looking forward for me. -Student D*

Motivations to pursue engineering

One of the most prominent intrinsic motivations students give for pursuing engineering is an *aptitude for math and science*. As noted by student G, when you are good at math and science, people in your life encourage you to think about engineering: *"I mean, I've heard everyone say just typical, uh, you're good at math and science, you should be an engineer..."* Student A had a similar experience saying: *"I guess I've been set on engineering since freshman year I feel like, just 'cause, you know, when you say you're interested in math and science, like, people say 'Oh, engineering that's for you.'"*

Although being good at math and science may be an internal motivator to explore engineering as a career choice, all seven participants noted that a *person in their life suggested they pursue engineering* because of their aptitude for math and science. This person may have been a teacher, like in the case of student E:

> *Yeah, my AP Chem teacher- ... and then my calc teacher, they both were like, "[Student E] you like math, you like science, you're good at these things. You should definitely look into*

a job in this field because you'd be able to prosper," and they were very encouraging in all of my studies. And once I told them that I had decided to be an, to go into engineering, they were really happy and excited to support me throughout my journey.

Student F had a teacher he was very fond of, who was an engineer before he became a calculus teacher. Student F was able to see the similarities between himself and this teacher, which served as inspiration:

> *My calc teacher, he's worked as an engineer for a large portion of his life before he started teaching and he's really cool, and I like a lot of how he ... Like I see similarities in how he thought about stuff to how I think about stuff, and just, yeah, it was like if, if he likes these things, and he was an engineer and he got to do these things, then that would be really cool. So, yeah he kind of … He talked about engineering more often, and, so it kinda gave me a look into the role of engineering from someone who had previously been an engineer and was now teaching calculus, so.*

In addition to teachers, Student G noted that his high school guidance counselor also played a role in helping him pick out a college major. When asked who told him he was good at math and science he responded: *Teachers would be the main thing, [and] like a school counselor when I talked to her about, like possible majors, where I'd go to college.* Student B noted that he was motivated to consider engineering after seeing a family member pursue a degree in mechanical engineering:

> *I mean, I had one cousin who was a mechanical engineer. I did spend a lot of time with them 'cause, my cousin and her boyfriend was [also an] engineer. And I spent a lot of time with them just 'cause they were really close friends of mine. So I felt like you're spending a lot of time with them also like interested me in engineering because I remember why I went, and this was not really little. I went to stay with my cousin and her boyfriend at his college, Purdue. And he was just showing me all this stuff he was working on and it was really interesting. And I remember I was like nine and he described to me, natural selection and it blew my mind. I was blown away. He also explained to me the very basic derivatives. And I was like, "This is so cool." But, even though I didn't know, like really understand it, it just, it was very fascinating to me at the time.*

Finally, many students noted their robotics coach as a mentor who inspired them to go into engineering. Student D noted having a coach with a similar background to him: *"But we had a really good mentor who's kids went to [High School] or whatever and he grew up in, like, a rural area, but he works, he's, uh, a chief engineering working for GM."*

Another common external motivation students cited for wanting to pursue engineering is the *financial incentive*. This was particularly important for student F when asked why he wanted to attend college and pursue engineering he responded:

> *Um, (laughs) because I wanna be financially secure, and have a degree that allows me to get a job with… I don't wanna be wildly wealthy by any means, I just want to have enough money where I don't have to worry. Growing up in the recession of 2008 has shown me*

> *how important it is to be financially secure... It's really hard to get a well-paying job without having a degree in today's world, you know, and, so that's why I, that's part of my motivation-for growing up, but- Oh, [engineering] that's because it pays well and it's cool. Like I said, I really like this sort of stuff, and the pay was also just nice. It was like oh, engineers can make a lotta money sometimes, you know, if you get good jobs, or like just like the average is like enough- like starting salaries are great and stuff.*

Student G was more hesitant to cite money as a motivating factor to pursue engineering: *"I mean, I guess money but, that's not really too big for me, I know, every time I tell someone, "Oh, I'm going to engineering,' they're like, 'Oh man. You're set. You know, you've got, you're going to make a lot' but, I'm not really thinking about that right now. That's not like a big deal for me..."*

Although not the same as *a financial incentive*, many students indicated that they chose engineering because it was the least "risky" option between career paths they considered. Student F talked at length about his love of music and considered majoring in performance before reconsidering after evaluating the financial risk:

> *...so, like music is extremely, extremely important to me. And I was going to be a performing musician, like get a degree in performance, but I was like that's a lotta money to spend for a very high-risk venture I would say, you know? Because you have to be really good and wanted as a performer to make money that would kind of I guess recoup the cost of getting the education in the first place.*

Student A mentioned that he felt the pressure to consider "risk" into his career choice based on his family perceptions. When asked if his family supported his decision to choose engineering, he responded: *"Yeah, absolutely. They've always been supportive, they would support whatever I do, but I think it's nice to have a steady, I guess not very risky [choice of major], I guess, in some cases ... Yes, it's difficult, but they're also supportive and they know I can do it, so that's very helpful to have."*

Finally, the most often cited internal motivation to pursue engineering was wanting to contribute to a bigger picture in society.

> *I want to make some kind of, like, I want to make something that, like, will help something else or whatever it's like, a person or a company or something. I just want to contribute to a bigger picture. That's, kind of, what I felt like engineering would allow me to do. - Student D*
>
> *I knew that I wanted to do something with my life that I felt could have a great impact on everybody in the world. I started looking into engineering because I was pretty good at math and I enjoyed the classes, and science was very interesting to me. – Student E*
>
> *I just wanna make something cool that hopefully helps out humanity. – Student C*
>
> *Like I do want to help people more, I wanna do engineering for the good of society versus making money. – Student B*

Motivation to attend the large midwestern research institution
The most often cited reason for students to attend the large Midwestern research intuition where the study took place was the location. Many students noted that being able to travel between home and school was a priority. Student A noted: *"I guess a mix of the location, like I live, you know, a half-hour away from home, I can see my parents every other weekend, or every day if I wanted. You know, in-state tuition, I guess all the (laughs) little factors that go into it, it's a great school."* Students B and F, also noted that the in-state tuition was a major factor they considered important. Student B commented: *"Like one of the biggest factors for me is in state, so it's really, really cheap."* Student F emphasized this factor further, noting that staying in state has a significant impact on most of the students from his hometown: *"A lot of my friends have gone off to other colleges and most, actually all of them in state… you know, just, just the general in state schools."*

Student E was the only student to mention attending this university was a family tradition: *"My mom and dad and my grandpas and one of my great-grandpas all went here, and my brother goes here currently, so it was kinda in the family already. I've been coming here for a while for football games, and so it just felt right to continue the tradition and go here."*

One emergent theme evident in students' responses to the questions "why this specific university" was the *availability of resources*. As mentioned in an earlier study on barriers using this same data [20], rural students often spoke of college as an opportunity to take advantage of abundant resources after completing a high school with scarce resources. Student D noted that it was important to him to have resources that could help with his course work:

> *The first time I learned about it was during the central campus tour and, they showed it off, but it was only kind of a cliff note basically. And at orientation when they gave us a lot more tours around they were like, "Yeah, this will help you out a lot." It was always like, they kept really emphasizing, "We have resources for you. If you wanted them you can find stuff and help for this. Like, there's a tutoring room or blah-blah-blah, science civic center." I'm like, "Oh, science civic center, that sounds really important to me and I think that will help me out a lot." That was before I even got here I was like, "I'm planning on joining this, whenever, the release date drops for this, sign up."*

Student E noted that the opportunities she was drawn to the focused on the campus community and an inclusive environment:

> *From my experiences visiting other engineering schools, from what I can tell, [this university] has been really pushing towards making everybody feel like they can succeed and giving all [of] us these opportunities that some of, a lot of the other places don't have these opportunities for us to make these smaller communities and feel more inclusive so that's been really nice here.*

The facilities specific to engineering were what motivated student D to choose this university:

> *I knew I wanted to go engineering when I started my college tours and stuff and I would look up the best engineering programs in the U.S. I was like, "Okay, all these schools are really cool, I should probably tour them." And that basically what really sold me on [this*

university] was the engineering tour here, because I saw all these facilities, all these different buildings on [the engineering] campus and I was like, "Oh my gosh, there is, like, so many resources for me to do things here."

Motivations to leave or return home

When asked about plans after college, all seven students noted that they did not plan to return to their home community. The motivations behind this plan were mixed, with some students having no desire to return, others feeling it necessary to leave to find economic opportunity, and a few actively seeking a new life elsewhere.

The availability of engineering jobs was a common external factor that motivated students to want to leave their home community. Student A noted that he did not especially want to return to his home community, and would not be able to because of his job choice. When asked if he planned to return to his rural town after completing his degree he answered:

> *Probably not, because, I mean I guess it does depend on what I go into, engineering-wise, but I feel like I was fortunate growing up to be able to travel, so I've seen a lot, you know, different places in the US that I would possibly wanna live. So I don't have a specific plan in mind, but I really would like to go to a more modern community, like, a bigger community, probably. Maybe, you know, in Colorado or California or somewhere, I guess wherever my field kinda takes me. Because if I do some sort of naval architecture I'll be along the coast, or, like, you know, if I do aerospace I might be in Washington, or certain things like that, so ... oh, yeah, well, I guess kinda like the opportunities thing. Like, yes, this is a small town, and I'm lucky to have it growing up, but I felt like, you know, there's points in life where you have to move on, sort of.*

Student E had a similar response, noting that there were no jobs that were of interest in her hometown: *"I probably won't be able to return home for a permanent amount of time because there's not many opportunities as a chemical engineer there except for, like, paper mill. I don't really wanna do that. I don't really wanna work at the paper mill."* She goes on to talk about the economic instability in the region and her desire to have more stable employment:

> *Our paper mill has been struggling lately, and so we know that there's a very strong possibility that it's gonna close soon. So I am looking for a more permanent career field that I, I'm able to change my position in that company no matter what changes are happening in my life. I probably won't go back to my town. Possibly for vacations and stuff, but I'll probably have to move elsewhere and I'm okay with that. I knew going into this field that there aren't that many jobs as an engineer in small towns in the Upper Peninsula [of Michigan].*

Student G shared that although he wouldn't mind returning to his hometown, his career plans did not align with him being able to stay in the area:

> *Like I said, I love [my hometown]. I really enjoyed being there but obviously, if I joined the Air Force I'm not gonna live there. I'm gonna, be away for probably like tenish years. And then, after that aerospace jobs, there's not a lot, and I guess the Midwest I'd be happy*

> *if I would, but I don't think it's like a deal-breaker. Like living there, or not living there, that's not a big deal either way.*

Student B talked about the external pressure he felt from expectations from his home community. These external pressures intersected with his internal motivation to grow and develop. When asked if he plans to return to his hometown after completing his degree he responded:

> *No, definitely not. I feel like growing up there it was definitely slightly inhibiting. Everybody there expects you to work at one of like three companies that work in our town. They expect you to stay there. They expect you to have your family there. They expect you to put your kids there, they expect you to do all this stuff. That's just a giant loop. They don't expect you to grow as a person or stuff like that. And it's very, I feel like it was a trap…. I definitely have no plans to return there.*

Another very common theme among respondents was the internal feeling that they did not "fit" in their community. Student A put it quite plainly saying: "*So yeah, I'm very appreciative of the community, but I also feel like I didn't really fit, um, completely in the community. Like I did, but I feel like I belong somewhere else, sort of."* Student F elaborated, citing a Ted Talk by Chimamanda Ngozi Adichie titled "The Danger of a Single Story"[22]. A "single story" is an oversimplified generalization that describes an individual, group, or culture. The single-story narrative is perpetuated by power, which is not only the ability to tell another's story but to make it the definitive story of that person [22]. Student F said that it often felt like his community had a "single story" and he was not a participant:

> *A single-story is basically you believe one thing about something, black and white, this is, this ... You generalize a population or a situation, and that's because you don't have the education on it that would allow you to see it from a different perspective, or you don't have any firsthand experience with it, and I think there's a lot of single stories [in my hometown] I guess. People that think the world is this way, and they don't really wanna see their view change because they're so entrenched in it- you know? Like when someone has been raised to have a certain view, and then they just believe that their whole life, and then something comes in to try and change that like maybe this isn't exactly how it is, and it's so hard to change their mind- and does those things, and those things are not bad, but there's kind of a culture around it like if you don't do that you're excluded and you're weird, you know? I personally don't hunt or fish, I prefer to do other things. It's just if you don't fit in with the group of people. There's kinda like a core group of people I guess that kinda hold the town together, and if you don't ... It's really hard to get into that group if you're not raised there...*

The notion of "fit" was most pronounced in Student B's account of dealing with racism in his hometown:

> *Outside my family, it's very close-minded. Everybody thinks alike. It's not always the greatest thing, because I was adopted into a family. So, even though grew up in a white family, I was never treated like every other person. It wasn't the greatest time. I was one*

of maybe 10, minority students in the school. It was very interesting and it was very, like a common thing that would happen there is like racism was like, it wasn't like very, uh, does imply, but it wasn't- like, you know if you noticed it, you noticed it…. But if somebody said a racial slur, nobody cares. But it just happens. Uh, I think it passed up for a lot of opportunities 'cause I was Asian, or at least that's what I've been told. But it could've been for other things, but it was definitely something that you felt if you were like a minority student. Um, but everybody was really nonchalant about like discrimination and stuff like that.

The desire of these students to leave their home community to seek economic opportunity is a common characteristic of the phenomenon of brain drain. Originally used to describe migration patterns in the developing world, brain drain is the transfer of resources in the form of human capital, typically highly educated individuals moving from developing to developed countries [23]. Recently, brain drain has been studied in rural communities in the United States. Vazzana and Rudi-Polloshka found that a higher perceived likelihood of finding an interesting job with attributes such as a good salary and advancement opportunities is by far the most important factor influencing students' intentions to stay in Appalachia [24]. This can result in a "hollowing out" of rural communities, with the best and brightest students leaving an area at the same time that agriculture and industry in the regions have changed, leaving rural communities with the inability to move their economies forward [25], [26]. Our study provides a more detailed context for the external and internal reasons why students desire to leave their hometowns. In addition to developing economic opportunities, rural areas should consider the culture of the community and how to ensure young educated individuals find belonging if they were to return.

Conclusions and future work

This study explored the lived experiences of seven first-year students from rural communities to probe factors that motivated them to attend university and enroll in an engineering major. Using narrative inquire and SDT, we identified internal and external motivations pertaining to students' desire to attend university, pursue engineering, enroll at a large midwestern research institution, and reasons for wanting to leave or return home following the completion of their degree.

The motivations described in this work help illuminate areas that educators, community members, and industrial partners can inspire more students from rural communities to pursue engineering. By understanding the factors that motivate rural students, educators can help them better navigate the educational system and find their place in an engineering community of practice.

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