”Adversary or Ally”: Undergraduate Engineering Students’ Perceptions of Faculty

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Abstract

This research paper examines students’ perceptions of faculty and how it influences their identity trajectory. First-year students enter undergraduate engineering education with rich stories of how they came to choose engineering as a career pathway. Over time, the culture of engineering and network of peers, faculty members, and professionals shape students' stories and identity trajectories. How students “cast” faculty members in their story, often as helpful or hurtful actors, have implications for their identity trajectory, success, and, ultimately, retention in engineering. In this paper, we used two composite narratives constructed from longitudinal narrative interviews with 16 students to illustrate how students cast faculty into a role as either a support or an obstacle, based on their classroom experiences and interactions with them. This paper highlights the interactions that led these students to view faculty as helpful or harmful and explores the effects resulting: influence over student identity trajectory by fostering or hindering relationship building and networking, as well as influencing intellectual growth and personal ability beliefs.

Introduction

Engineering undergraduate curricula are designed to equip students with the knowledge, skills, abilities, and attitudes that are valued by the engineering profession. As students learn more about the field of engineering, they also develop conceptions of their own engineering identity and belonging. Prior work has shown that identity and belongingness are key factors influencing students’ pathways into, through, and potentially out of engineering [1—3]. Investigations into identity and belongingness can, therefore, inform efforts to recruit and retain a large, diverse body of engineers [4]. As faculty are at the forefront of students’ first experiences with the field of engineering, equipping them with the knowledge of their influence on students’ identity formation and belongingness is imperative.

Faculty members are a prominent source of influence on students’ perceptions of identity and belongingness. Course instructors act as gatekeepers, generally limiting participation in the engineering profession to those who have matriculated through an undergraduate engineering curriculum. Through the selection and communication of course topics, faculty members convey the ways of thinking, being, and knowing that are valued in engineering. Faculty may also directly influence a student’s self-perception of their abilities through recognition and judgments of students’ competence. These various forms of influences underscore the need to understand the different ways that students may perceive engineering faculty. In this paper, we take a narrative approach to express how undergraduate engineering students portray faculty members as either adversaries or allies. The process of “casting” faculty members in a particular way has implications for students’ generalizations about the role of all faculty members, which may influence how students engage with their engineering education.

An additional insight of this study is the ability to explore differences in faculty-student interactions based on institutional contexts. Briefly, this study focuses on the experiences of 16 undergraduate engineering students who attend programs across different institutional types. This

diversity of contexts allows us to access other forms of institutional influence beyond faculty-student interactions, such as class size and the priorities of the faculty member.

The primary goal of this study is to understand how latently diverse students, or students with various attitudes, beliefs, and mindsets informed by their prior experiences and backgrounds, perceive faculty in engineering. This work allows us to understand how students' identity trajectories are shaped by the culture of engineering through their interactions with faculty. We used narrative research methods to answer the following research questions:

1. What are students' perceptions of faculty in engineering?
2. How do students' perceptions of faculty as helpful or harmful influence identity trajectory?

Emergent from the students' stories was a characterization of specific or general faculty as adversaries or allies. When asked to recall significant interactions with faculty or staff at their institution, often participants would use language describing specific or general faculty as helpful or harmful. Participants saw some faculty as on their side and supportive, and others as making their course needlessly difficult—in some instances, perceiving faculty as being distracted, dismissive, or even abrasive. The findings from this study can assist in creating positive learning environments, wherein faculty can support students along their pathways as engineers.

Background

Interactions among faculty and students inside and outside of the classroom continue to emerge as a critical factor in supporting positive student outcomes in higher education [5]. While student outcomes and performance levels at an institution may have several different influences, several studies find faculty-student interactions (FSI) inside and outside of the classroom as having a significant effect on student performance, perceived gain, and effort [6—8]. Lundquist, Spalding, and Landrum [9] found that faculty attitudes and behaviors affect retention. Students are more likely to seek help from faculty members who they perceive to be open, accessible, and supportive of their academic needs. The quality (in-depth and positive) of faculty-student interactions can help foster student success and increase student engagement, especially among underrepresented populations, such as women, students of color, and first-generation college students [10]. While quality FSI within the classroom is important, interaction outside of the classroom can be just as effective, from casual conversation to working in a research lab or being invited to a professor's home. While positive interaction has been shown to have constructive effects on student success, negative interaction with faculty can also cause students to doubt their ability, and influence students to leave engineering [5, 6, 11—12].

A study aimed at understanding student and faculty perceptions of engagement in engineering showed many students noted interactions with faculty as a key factor in their definition of engagement in a course [13]. In another study, Briody, Wirtz, and Berger [14] found that many students wanted to be on good or friendly terms with the faculty at their institution. They also found that a major inhibitor to students seeking help was an underlying knowledge of status inequity and the fear of making a mistake. These studies emphasize the value of FSI in engineering as a support to student learning and development.

Smaller, primarily teaching institutions may be better suited for providing environments conducive to more numerous or impactful instances of FSI. However, the 2018 National Survey of Student Engagement highlighted how small institutions experience issues with faculty being available to students, and students taking advantage of opportunities to engage with their professors, such as visiting office hours [15]. While the quantity of FSI has been shown to increase positive outcomes for students, quality FSI has been shown as equally, if not more, important [16]. Our study aims to help describe a rich understanding of the effects of and responses to FSI by providing a composite story of the experiences of students at both research and teaching institutions.

Theoretical Framework: Identity Trajectory Theory

We use Identity Trajectory Theory to understand how FSI may inform student development as engineers. This theory was developed to explore how graduate students and early-career professionals develop their identities over time [17]. McAlpine and Amundsen [17] conceptualized identity trajectory with a longitudinal design focused on understanding how individuals' past, present, and imagined future influence their learning and development across multiple roles and aspects of their personal lives through three intertwining strands: intellectual, institutional, and networking. The strands in the original framework are rooted in understanding how the individual has contributed or intends to contribute to the discipline (intellectual), concerning institutional structures (i.e., roles and responsibilities) and interpersonal and intertextual networks to support their present work and future career pathways. McAlpine and Amundsen [18—19] emphasized the role agency plays in shaping their professional development within structural and personal constraints. Although this framework has been instrumental in understanding career transitions of engineering academics, social science doctoral students, and early career academics in a broad context of scholars, identity trajectory has limited understanding in the context of undergraduate engineering students [20—22].

We draw on an adapted framing of identity trajectory theory to understand how undergraduate engineering students develop their identities over time [23]. While the interwoven strands of identity trajectory theory are the same, the definitions and operationalization of these strands are different. The original descriptions were modified to characterize experiences that influence their pathway into engineering and development as engineers. The intellectual strand focuses on how students learn engineering knowledge in ways that enable students to contribute to engineering classrooms, team projects, and internship opportunities [23]. The institutional strand focuses on the "structures, resources, and responsibilities that influence students' identities within their academic institution and engineering as a career" [23, p. 2]. The networking strand focuses on how students build a relationship with peers, faculty, and professionals to support their development as an engineer [23]. In addition to identity trajectory theory, the constructs associated with engineering role identity (i.e., performance/competence beliefs, interest, and recognition) are embedded within the students' experiences and contribute to understanding how engineering students develop their identities. This framework is useful for understanding how students' perceptions of faculty influence their identity trajectory through their interactions inside and outside of the classroom [1].

Methods

This paper is based on a larger mixed-methods study focused on characterizing latent diversity in engineering. Godwin [24] defines latent diversity as the attitudes, mindsets, and beliefs that are not readily visible in the classroom that may enhance our understanding surrounding fostering innovation and inclusion in engineering [24]. The first stage of the larger project involved distributing a survey to 32-ABET accredited institutions to measure engineering students' incoming attitudes, beliefs, and mindsets. We used the resulting 3,711 valid responses to characterize response patterns across these measures resulting in six data progressions of latent diversity [25]. Students were asked for their contact information (i.e., email address) to participate in follow-up longitudinal, narrative interviews. We recruited three to five students from each data progression resulting in twenty-five participants. In this study, we focused on the narratives of 16 students who described interactions with faculty as important to their identity trajectory. Each student was asked to select a pseudonym to protect their anonymity (Table 1). Also, Table 1 lists the students who are aggregated into each composite character, gender identity, major, and institutional Carnegie classification.

Interviews

This study was based on two narrative interviews with each participant over a yearlong period. Most of the initial interviews were conducted during the fall of 2018, but in some cases, the interviews were held early spring of 2019 based on the student's availability. The first interview focused on understanding their background, pathway to engineering, pathway to their engineering major, and first-year engineering experiences. The second interview protocol elicited responses about their experiences throughout their second year of engineering. We also asked students about their classroom experiences (intellectual), resources, and connections that were related to their experiences (institutional), and interactions with faculty and staff in the college of engineering, peers in engineering, and professionals in their field (networking). Each interview was approximately 30 to 60 minutes in duration and conducted primarily by one researcher.

Analysis

The narrative interviews were transcribed verbatim and reviewed for accuracy. Below, we briefly describe narrative research methods and the process used to analyze each narrative. In this research, we chose to present the experiences of students who attend research-intensive and primarily teaching universities and colleges as composite narratives (see Table 1). These two joined narratives include the voices of the participants in a singular, cohesive story that represents the shared experiences of FSI these students have within each of their institutional contexts.

Narrative research studies human experiences by "allow[ing] people to tell the stories" they live every day [27]. Narrative research focuses on "chronology and context" and collaboratively explores phenomena with those providing the narrative accounts [27]. While there are multiple approaches for using narrative, in this study, we focused primarily on narrative methods that helped indicate similarities in the lived experiences of several participants. To do so, we condensed each interview into "restoryed" case narratives to help inform coding and thematic analysis. We then formulated the narratives into larger composite narratives, as a way to highlight the larger, cultural narrative each group of students was living through.

Table 1. Participant Information

Composite	Pseudonym	Major	Carnegie Classification*	Gender Identity
Charlie	Hilda	Health Data Science	R2	Female
Charlie	T-Chuck	Biomedical Engineering	R2	Male
Jordan	Briggs	Nuclear Engineering	M3	Male
Charlie	Lauren	Mechanical Engineering	R1	Female
Charlie	Jamie	Chemical Engineering	R2	Male
Charlie	Gary	Electrical Engineering	R1	Male
Jordan	Robert	Mechanical Engineering	D/PU	Male
Jordan	Frances	Biomedical Engineering	D/PU	Male
Jordan	Jennifer	Secondary Science Education	BCD	Female
Charlie	Thomas	Mechanical Engineering	R1	Male
Jordan	Adriana	Mathematics and Electrical & Computer Engineering	M1	Female
Jordan	Josh	Mechanical Engineering	M3	Male
Charlie	Joy	General Engineering (DC)	R1	Female
Jordan	Carrie	General Engineering (DC)	BCA	Female
Charlie	Anna	Electrical Engineering	R1	Female
Charlie	Robin	Engineering Science	R1	Female

*Carnegie Classifications abbreviated as follows: R1 (Very High Research Activity), R2 (High Research Activity), D/P (Doctoral/Professional University), M1 (Master's Colleges and Universities - Larger programs), M2 (Master's Colleges and Universities - Medium programs), M3 (Master's Colleges and Universities - Smaller programs), BCD (Baccalaureate College: Diverse Fields), BCA (Baccalaureate College: Arts and Sciences Focus) [26]

As narrative interviews rarely result in cohesive, storied events, our interviews included several instances of redundancy, as well as jumps in time and setting. To present our narrative in a manner that is more easily understood and read, each participant's interview was "smoothed" and constructed into a two to three-page restoryed case narrative [28—29]. Creswell [29] defined restorying as "the process in which the researcher gathers stories, analyzes them for key elements of the story (e.g., time, place, plot, and scene), and rewrites the story to place it in a chronological sequence" [p. 511]. Within each transcript, salient moments and experiences were found and linked together to preserve institutional, interpersonal, and intellectual experiences alongside story continuity and relevant situational characteristics. For example, there were many instances where a participant mentioned experiences or social interactions and then elaborated later on in the interview. We constructed the case narratives primarily with direct quotes and first-person view, retaining the voice of the participant [30]. There were instances where the researchers needed to provide additional text for clarity. The additional text is italicized to differentiate between the researcher's and the participant's voice and any personal identifiers were removed. The researcher

used the restoryed case narratives along with interview transcripts to determine which participants had significant interactions with faculty members that played a key role in their narrative. The restoryed narratives chosen helped indicate faculty interactions as a key element of several participants' experiences.

To retain constant validation of the ideas and social realities presented by the students through each stage of analysis, as much original text was kept as possible to preserve the voice of the student. Before the interview, we have students draw a journey map highlighting salient experiences they've had during the previous semester. Information from the interview transcripts and journey maps is placed into a conceptually clustered matrix and reviewed by multiple researchers for accuracy. Through the process we draw on multiple sources of data alongside constant comparison of findings between researchers to make sense of the students' experiences while retaining their social reality [31]. Alongside the use of first-person direct quotes, these efforts help retain ongoing communicative validation of each student's story, and a "co-construction of meaning" as we develop findings [32]. Through this process, both positive and negative interactions with faculty emerged as salient moments within students' retelling of their experiences. This led to the use of FSI as a main theoretical construct in exploring the similarities among participants' narratives.

Two cycles of coding were used to transform ideas from 16 participant transcripts into two composite narratives [31]. In the first cycle, the quotes highlighting FSI were extracted and coded based on the nature of the interaction. Once these sections were identified, multiple coded passes through these quotes led to emergent themes connecting individual student experience to broader concepts and were then pulled together to form themes indicative of the stories as a whole [33]. Emergent from the student experience were 12 themes (Table 2) that helped indicate broader student perceptions of faculty. In the second cycle, *composite narratives* were formed from the individual participant narratives to provide a more holistic view of the students' experiences, and from these composites, emerged two "roles" informed by literature that the participants perceived faculty filling in their narratives.

Composite Narrative

Wertz, Nosek, and Marlow [34] described the first-person composite narrative as a "reflective story," that creates an image formed by each of the participants' individual experiences. Furthermore, Wertz, Nosek, and Marlow expressed how the composite narrative is more than a "re-telling" of the participants' stories. Instead, the researcher brings their interpretation, "through knowledge of the literature regarding the phenomenon under [i]nquiry, through listening and hearing the stories told by the informants, and through her reflexivity during the process" [34, p. 5883]. To succinctly but accurately present the participants' stories, each narrative was placed into one of two composites based on their institution's focus on research (Charlie) or teaching (Jordan). Because the goals of faculty at research institutions and teaching institutions are inherently different, placing all participants into one composite have obscured the institutional context and on students' experiences. Each composite was formed with quotes directly from the participant's interviews, preserving individual context and experience, while also providing a more general view of the group as a whole [35]. Another benefit of using composite narratives to present the participants' narratives is anonymity. While we used pseudonyms, providing institutional research activity alongside specific accounts of interactions with faculty could potentially compromise

student privacy. By using composite narratives, while only extracting quotes, setting, and accounts directly from the interview transcripts, it becomes possible to retain vital contextual accounts, while keeping the participants fully anonymous [36].

Table 2. Composite Narrative Themes

Role	Themes	Charlie	Jordan
Ally	Available/accessible	3	3
	Recognition	2	5
	Advisor/Mentor	1	5
	Personal Relationship	0	5
	On my team	4	4
	Approachable	3	4
Adversary	Inaccessible/unavailable	0	1
	Busy/Distracted	2	0
	Inadequate teaching ability	2	0
	Impatient/Dismissive	2	4
	Unfair	0	1
	Makes course more difficult	3	2

While the composite narrative is a very useful tool, sorting participants at the researcher's discretion without explanation can seem opaque, vague, and unreliable to the reader. For this reason, Willis [36] encouraged transparency when reporting findings, to allow for a deeper understanding of where the composite narratives come from, and how they are rooted in participant experience:

1. As stated previously, all quotations, settings, and quotes come directly from interview transcripts.
2. Any grammatical change or clarification done by the researcher will be reported in *italics* and was done only to preserve narrative integrity.
3. Within the composite narrative themselves, any outside feelings, opinions, and judgments about the participants' experiences were avoided. Judgments and assumptions on the participants' motivations or feelings were also avoided.

These measures helped guide and link the process of creating these narratives to the stories told by the participants.

Results

This paper reports our findings regarding students' perceptions of faculty in engineering and how FSI influenced identity trajectory. Below, we describe the experiences with two composite narratives, Charlie and Jordan. Charlie is a composite of nine participant accounts from students who attended universities with high or very high research activity. Jordan is a composite of seven participant accounts from students who attended primarily teaching colleges and universities. Our findings highlight two perceptions of faculty in engineering: 1) Faculty as an Ally and 2) Faculty as an Adversary for each composite narrative.

Faculty as an Ally

The perception of faculty as an ally is highlighted below in the experiences of both Jordan and Charlie. These narratives describe establishing rapport with instructors while feeling their instructors had a genuine interest in their development as engineers.

Charlie: Usually the professors are pretty good to talk to. They're always willing to help and want to talk about engineering. Like hearing different views about what you're learning. If you thought of something a different way to do a problem and you're trying to explain how you thought you were supposed to do it. Hearing different points of view of how they always, like they enjoy hearing how and trying to figure out how—maybe they'll see you did it a different way. That still will work. You're just missing something little. I went into *one of my professor's* office like twice a week because it was a very difficult class. The hardest class I have ever taken. It was my first 400-level, which is like a senior-level class. I was the only sophomore in the class. It was tough, but my professor was there to help me through stuff. He's not one of those teachers that says, "Uh, I don't know, read the textbook" because that's always frustrating. Part of it is just he's a really nice dude, and he gets really excited. I don't know about you, but my favorite thing in the world is not how fast does water flow through the pipe in the sewer system, but he made it sound really interesting, and something that was worth learning. He's like my favorite teacher this semester. He makes everything so hard, but I'm enjoying the class. Everyone who hasn't quit has learned a whole bunch. He was just so casual and so upfront with you. "Do you think this is helpful? Am I just doing this because I am told to or do you guys actually enjoy this and need this?" And, I thought that was the most helpful thing about a teacher, actually asking what we thought about what he was teaching. He was my professor for that class, but then also he gave me advice for other things and helped me plan out my schedule for everything. So, he's actually one of—he's the reason why I ended up going to Rome, because I told him that I wanted to study abroad in Italy and he's like, "Oh." And, he pulled out this folder was like, "Yeah, we have this program." And I was like, "Yeah!" But last fall he was great and answered questions. I actually took an elective not in an engineering class. I think I had the best professor I've ever had. This guy, you could tell he loved teaching. He loves teaching, and he was very open to feedback. He asked at the beginning of the term like, "How do you guys learn? What should I do?" and stuff like that. I remember thinking, and I even said to him, "I wish my engineering professors were more like you."

Jordan: I feel like having that more personal relationship, seeing your professor more as a person, rather than just a figurehead who's just above you, spewing information, I feel like it's more valuable when it comes to learning. That's part of the reason why I chose a small school. The idea of having a really good connection with my professors really drew me in. It makes me feel important and helps me feel more comfortable with the material. They're always willing to help you—always willing to take time for you. Because the student body isn't huge, it feels more personal. They're willing to interact with you personally and they get to know you. Go out for a meal, whatever. I think that's one of the big things is it just makes it more one-on-one and stuff and personal. You're able to go to them for different things and it's not weird or anything but it's just—you're able to be at least friends with them. So the professor, she was so helpful in me becoming an ECE, oh my goodness. She suggested, actually no she didn't suggest, she realized that I was doing really well in this class, and she made an appointment for me with the head of the software engineering program, because she's like, "You need to be in this major." She's fantastic, she's helped me a lot. I went and I talked to the software engineering person, and she was great

too, they're all wonderful people. I just got to learn a little bit more about what software engineers do, and that it's still creating, but it's creating in a little bit of a different way. He helps me pretty much pick all my classes and layout what my four years are going to look like. So I'm very close to him and I feel very comfortable, enough to just go into his office pretty much whenever I need to whenever he's there. And, we just talk about what potential career options I want to explore. Let's talk about grad school. Let's talk about which classes I should take next semester. I think I utilize him a lot, and that's one thing that's been really helpful is just having a staff member who knows me, knows my schedule, knows who I am as a student. I feel like I know a lot of the science professors really well, but this one, in particular, is really helpful and actually is involved in not just being my professor. He's actually shaping my four years here. I think he's really pushed me to decide what I wanted to do. He's forced my hand a few times to either cross off or look into certain decisions, which I think is needed every once in a while. My Linear Algebra class, it was a pretty big class, for my school anyway. I think there were about 20 of us. But, it wasn't too difficult. He kind of like walks us through step by step all of the different equations that we might have. Then, he really prepares us for the exams and doesn't really try to trip us up or trick us. It was kind of a team effort to get through that class, between the professor and us. He and his wife invite students over for what they call breakfast once a month and so you just get to talk if you have any questions. You're adults that were just sort of, you moved out of your house and now you don't know or moved out of your parents' house and now you're in college, and if you have any questions about anything really, or just want to relax and get off campus because many times we don't get off-campus. They like to get to know us better as well. It's not just for our benefit. They enjoy getting to know students. It's, again, a small school so they are not here for the pay. They are here to help us. That's why they're here.

Faculty as an Adversary

The perception of faculty as an adversary is highlighted below in the experiences of both Jordan and Charlie. These narratives describe frustration towards pedagogical methods, inattentiveness, and tension between the instructor and themselves.

Charlie: A lot of engineering professors, especially tenured professors, I mean this last quarter I had—the first quarter this year I had a professor for my circuits class. The professor didn't really explain any of the concepts. But would just kind of assume that we knew how to do them, and wouldn't slow down, and was just more concerned with, "Oh. Here's what I know how to do." I don't know how to describe what I'm saying. He was an old guy, and he was just such a dick. Such a dick to everybody. If you asked him a question he's always be like, "Guys, nobody has any questions?" But if you asked him a question, he'd make you feel like a fucking idiot. He did get really frustrated if you didn't understand it the first time he said it. It almost seemed like he hated his students, which is not ideal. I mean, half the class failed this final, I mean the midterm. I feel like the midterm average was like a 45. This guy is just like—I hate when professors are like, "Oh, half the class got a 45. It must be their fault." Dude, what the fuck are you thinking? Obviously something is wrong here, and you're teaching to students who don't know anything. What makes you think you can just speak to them on a level as if they already have a graduate degree in engineering? It seemed that they were all really incredible at the subjects that they were teaching, but they weren't teachers. You know? They're professors. They're not teachers. But they didn't have the kind of teaching skills that I thought were necessary. I don't know a lot about what the Ph.D. program is like. I don't know if they have teaching classes that they have to take. But

teachers, you think, yes they learn the subject that they're teaching. But they're also learning skills to convey information to you. I don't know necessarily that some professors have those skill sets. Like I said, they're incredible at the subject that they're teaching, and it's very obvious that they know exactly what they're talking about all the time. But they don't necessarily know how to convey that information to students, I've noticed. A lot of my engineering professors are just not responsive to what their students need, and I don't like that. It's just, they have this attitude of being up on a high horse and, "I'm better than you." It makes me not want to pursue a further non-academic relationship with them, but I really wish that I could, and I wanted to.

Did not enjoy the fluid mechanics lectures as much and I don't think that *my institution* does a very good job teaching their physics classes, so, for the most part, I had to learn the things on my own by reading the book. And then, physics professors were less so. They definitely seemed like they would rather be doing something else. At *my institution*, it seems like they're more focused on their research and then they just teach to get money and stuff, which makes sense. Physics was definitely a more on your own kind of figure it out. The meticulousness is what made that class difficult, not the content. A few times, I'd go up to him after class and ask him questions. He always seemed like he was very distracted by other things. He was obviously smart enough to answer the questions, but sometimes he'd—once or twice I would ask him something and I looked it up later and what he said didn't quite line up.

Jordan: The professor I have for my math methods class does not grade consistently at all. Even throughout the same—there was one test where one person got a question wrong, they got three points off. Another person got it wrong and got only two points off, but they had the same answer. It's been a little interesting getting used to how he grades because he doesn't grade consistently. At first, it was mostly because we had turned in one thing, he gave it a really good grade, and then the next week we'll turn in something and get a really bad grade, but, like, the work and what was wrong was similar. Well, I mean we do work on homework together, so when we find out that we get similar answers and just get completely different grades we're just like, "What's going on here?" She is very rude and short at times, when you ask questions, and it almost seems like she doesn't want to help or that she feels that the questions I'm asking, I shouldn't be asking. But in my mindset, its, well, I could not ask questions and not understand or I could be taking time out of my day to come ask you questions so that I do understand. So she tells me to go back and look through things that I've already looked over, and I tell her and I say I don't understand. She's like, "well you should know how to do that." And, it's like, if I don't know how to do that and you're not going to tell me how to do that, we're just going to be stuck in this continuous loop. And another example is I walked into class for an exam last week, and I think I asked her a single question before the exam started. And, she said, "yeah, you were definitely at my office enough asking questions." And I didn't say anything, but it made me feel bad for going to her office and asking questions when I feel that kind of behavior should be encouraged. So it's frustrating when faculty members treat you like a child and act like you're dumb for asking questions on things they think you should know when they're the one with a doctorate and you're the one going to school. Which doesn't really make sense to me.

Discussion

The purpose of the paper was to understand how students' perceived faculty members in engineering and how their interactions influence their identity trajectory. This study resulted in

two distinct roles for faculty—ally or adversary. Students perceive faculty as an ally when they feel they have established rapport with faculty, including positive attitudes towards teaching and learning, demonstrating their genuine interest in their development as an engineer beyond the classroom. Moreover, students perceive faculty as an adversary when they feel a tension forming between the professor and themselves, as opposed to experiencing difficulty with the material itself, including negative attitudes towards teaching and learning. Below, we discuss in further detail how students perceive faculty in engineering and how their perceptions influence their identity trajectories.

What are students' perceptions of faculty in engineering?
While the composites *Jordan* and *Charlie* were presented separately to preserve the experiences of students within different academic climates, the students' view of daily interactions with faculty overlapped. Students from both institutional contexts characterized faculty as helpful according to their willingness to help learn difficult material and provide guidance for their immediate or imagined future. Students who attended the larger, research-focused institutions described how faculty not only guided students through the course material but also provided advice on co-curricular opportunities that contributed to their identity development such as studying abroad, undergraduate research, and internship opportunities. Likewise, students who attended smaller, teaching-focused colleges described how they perceived faculty at smaller institutions as more personable, which influenced their decision to pursue engineering as a major. Previous research is consistent with four specific characteristics identified in the experiences of the students in our study: (1) faculty as approachable or personable; (2) faculty as passionate or enthusiastic about their work; (3) faculty as caring about students personally; and (4) faculty as role models, mentors, or advisors [16].

On the other hand, students characterized faculty as adversaries when they were perceived to be busy, distracted, inaccessible, impatient, or dismissive. While there were not as many overlapping characteristics of negative interactions with faculty between Jordan and Charlie, one common theme was instances of impatience or faculty being dismissive of difficulty students were having with course content or coursework.

How do students' perceptions of faculty as helpful or harmful influence identity trajectory?
As did Briody, Wertz, and Berger [3], we found that participants felt that professors operated at a "higher level" when explaining the concepts due to their extensive experience with the content. Students felt that they could not communicate with faculty because they were unable to explain complex concepts in ways they could understand and perceived that their lack of understanding positioned them as "dumb." In these cases, some faculty responded with impatience or even dismissed students, leading participants to be more reluctant when asking for help in the future. These instances could be harmful to engineering identity development, as participants mentioned that these interactions led them to feel less competent and disempowered ("like a child"), which influenced their attitudes about their ability to learn and apply engineering knowledge. Similarly, negative interactions with faculty-led to some students feeling unable or unwilling to foster personal relationships with their professors, challenging students' ability to build a network with engineering faculty members who can support their engineering identity. These findings illustrate how negative interactions with faculty influenced their ability to recognize themselves as competent, which in turn influenced their learning and development as an engineer. More

importantly, these experiences have consequences for certain strands within their identity trajectory, demonstrating how students' inability to see themselves as engineers is not only reflected by the lack of recognition. Instead, these negative interactions result in thinning their identity over time due to an inability to rely on faculty as a resource for their intellectual development as engineers and incurs a lapse in interpersonal networking.

Charlie directly referred to engineering and physics faculty as negatively influencing their student experience more than the other faculty they interacted with at their institution. These interactions influenced Charlie's development as an engineer, as they felt unable to create interpersonal relationships with some of their engineering professors. Marra and colleagues [2] emphasized the importance of classroom climate, the difficulty level of STEM curriculum, and teaching and advising for student retention and success. Students' inability to build connections with their faculty resemble classroom environments that are classified as "chilly" based on its adversarial impact on student success [2, p. 8].

While perspectives and experiences were similar between Jordan and Charlie, the roles of adversary and ally did vary across institutional types. When describing faculty as allies, Jordan described appreciation for the personal relationships they were able to form with the faculty members at their institution. These relationships led Jordan to feel recognized and important, as Jordan described their faculty mentors as truly caring about them and shaping their undergraduate career and experience. Jordan felt as though they could be friends with their instructors, able to reach out to them in a non-academic way, as they would often invite students to their houses. When describing faculty as allies, Charlie did recall having faculty advisors and mentors. However, whether they were helping with coursework or helping plan a trip abroad, Charlie mainly described faculty relationships and assistance through an institutional lens. When describing faculty as adversaries, Charlie described how some faculty seemed distracted when they asked them for help or were not available outside of class. Some students in this context felt that faculty viewed teaching as lesser than research or other activities, which led students to rely less on help from their instructors, often feeling they had to navigate the course content on their own.

When students perceived faculty as allies, it led to the belief that their instructor was "on their side," supporting them in their learning of the course content. While some participants described their courses as difficult, students often separated the course difficulty from the instructor of the course. From this viewpoint, students described faculty as key support during their engineering education experience and the difficulties they faced. Also, students felt comfortable approaching these instructors with questions and using them as a resource. Kezar and Maxey [37] found that validation and recognition of students and student responses encouraged participation and engagement in the classroom. This finding emphasizes the importance of the links between the intellectual and networking strand of identity trajectory as the relationships built with faculty influence students' ability to learn engineering knowledge and contribute in a classroom setting.

In recalling negative interactions with faculty, students reversed the professor's role in the struggle against the content of the course, positioning faculty as an obstacle rather than a support. Participants described their instructors as *making* their courses difficult, meticulous, or unfair. In certain circumstances, students simply described their instructors as being bad teachers. For example, Charlie described how the faculty who were adversaries were professors, not teachers.

This finding reflects the tension faculty experience between research and teaching, as Alpaya and Verschoorb identified how teaching accomplishments are not perceived as high as other aspects of their role as faculty such as research and the need for a "stronger teaching culture" [38, p. 374]. Developing a teaching culture among engineering faculty has led to research focused on the professional development of engineering faculty. Our research echoes the need for faculty to value lifelong learning, constantly adapting to the changing student profile and growth in expectations of what it means to be an engineer.

Implications for Practice

Several students voiced how they valued professors who listened when they expressed difficulties with the course material, appreciated professors who were open to feedback about their pedagogy and accommodated their learning styles. For example, when professors asked students "how do you learn" and "is this helpful" students positively perceived their instructors. Similarly, verbal recognition from instructors helped students generate confidence and a sense of belonging. Affirming a student's effort within a class, or more broadly recognizing characteristics a student has that embody what it means to be an engineer can foster confidence moving forward. Generally, faculty can position themselves as allies by being mindful about their discourse and actions through limiting negative language, communicating openly with students about course content at a level they can understand, being present within the classroom, encouraging feedback, and giving verbal recognition of effort. These together can assist in supplying students with a positive learning environment on their pathways to becoming engineers.

However, we acknowledge there are structural limitations that hinder faculty from implementing inclusive practices in the classroom and at scale, considering the vast difference in courses offered in engineering, directly related to variables such as institutional type and class size. Moreover, these findings highlight persistent issues embedded in the culture of engineering that manifests in the classroom, continuously limiting the ways of being and thinking that are recognized, in turn, influencing students' identity trajectory. Furthermore, this work asserts how there is a broader systemic issue that must be addressed to improve engineering education by establishing inclusive practices as a norm in engineering, instead of relying on historical structural and cultural constraints as a justification for inadequate and exclusive educational practices.

Conclusion

Engineering student identity formation is heavily influenced by the "gatekeepers" of the field—faculty. Increasing the quantity of FSI is important but monitoring and increasing the quality of interactions is equally, if not more, important [16]. From this research, we have noted that faculty attitudes towards students have an impact on student engagement, identity trajectory, and feelings of belonging. Student perception of faculty as helpful or harmful directly influenced students' identity trajectory intellectually, interpersonally, and in some cases institutionally. While there are many reasons why a student's pathway may lead to or away from engineering, both institutions and faculty individually play a key role in preserving retention in engineering through academic (difficulty, teaching/advising) and non-academic (fostering belonging in engineering) factors [2]. Increasing quantity and quality of faculty-student-interactions can be key in preserving a diverse body of engineers.

Understanding what qualities commonly lead students to characterize faculty as "adversaries" or "allies" can provide insight into the ways faculty can lead and support their students, as well as assist in understanding the complexity of engineering identity formation. To better understand the effects of engineering faculty on student identity trajectory, future work will include a more comprehensive look into student interaction with faculty over time, as the participants in this study achieve seniority at their institutions and proceed into the field of engineering.

Acknowledgments

This work was supported through funding by the National Science Foundation CAREER Grant No. 1554057. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation. The authors wish to thank the STRIDE team and interview participants for their participation in the study.

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