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On the Importance of Spatiality and Intersectionality: Transgender and Gender Nonconforming Undergraduate Engineering Experiences Through Critical Collaborative Ethnographic Site Visits

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Abstract

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Engineering as a field is dominated by toxic masculinity, heteronormativity, whiteness, and cisnormativity. There is a dearth of research about transgender and gender nonconforming (TGNC) student experiences in engineering, and much of the available research on TGNC STEM student lives does not account for the nuanced intersections of marginalized identities that can affect a student's performance and sense of belonging in engineering or larger STEM environments. In addition, STEM-related research into marginalized populations' experiences is often done without the use of feminist, queer, trans, and anti-racist research methodologies that consider power imbalances between the researcher and the participant and the implications of conducting research on and with underrepresented populations. This study addresses these research gaps. We used critical collaborative ethnographic site visits to center TGNC positionality and community-centered research ethics. The four-day site visits presented here involved two mechanical engineering students at a prestigious private university on the East Coast of the United States. Activities included formal semi-structured interviews as well as less formal interactions with each participant, such as attending classes, visiting important campus and community spaces, and hanging out with the participants' friend/peer groups. The visiting researcher also explored the college campus and the broader community on his own to more deeply understand the politics and context of the local environment. As predicted by significant findings from previous phases of this research, the uniqueness of each student's identity, location, political worldview, and support system significantly impacted their educational paths in engineering. The two TGNC student participants, both with multiple intersecting marginalized identities, had incredibly different experiences in the same mechanical engineering program, leading one participant to resounding success and the other to leave STEM altogether. The findings from this critical collaborative ethnographic site visit suggest that barriers to success and a sense of belonging for TGNC students in engineering must be considered through the use of intersectional critical theories.

Introduction

In the 2023 legislative session, 413 anti-transgender bills were brought before the United States legislature by state representatives and senators in all 50 states [1]. This past year has seen more specifically anti-transgender bills than any other year, making this the most overtly anti-transgender legislative session in United States history. Legislative policy does not exist in a vacuum. Transgender people in the United States are facing administrative, social, and physical violence as a result of policy initiatives that seek to pathologize, vilify, and disparage transgender people. In 2023, transgender people in 24 states [2] have lost significant civil rights, including the right to change or have correct identity documentation, to access gender-affirming care, to access public bathrooms, to retain child custody, to secure health insurance, and to play sports. Non-discrimination protections have also been overturned. Other examples of legislative assault on transgender rights include drag performance bans, forced outings and misgendering, and curriculum restrictions that ban any mention of lesbian, gay, bisexual, transgender, queer,

intersex, or asexual (LGBTQIA+) identity. It follows, then, that transgender and gender non-conforming (TGNC) students are currently facing unique challenges to survival strategies, social acceptance, and a sense of belonging.

LGBQ students' experiences are well-documented in Engineering Education literature. TGNC students' experiences, on the other hand, are usually either outright excluded from empirical research or are discredited due to an assumed small population size [3]. Studies of the LGBTQIA+ population that do not include data from transgender or gender non-conforming students are limited in that they cannot draw inferences regarding experiences of inclusion, exclusion, or sense of belonging to members of the LGBTQIA+ community beyond those who identify as Lesbian, Gay, Bisexual, or Queer. In order to address this gap in the literature, the research team sought to document the experiences of TGNC students in engineering and computer science through critical collaborative ethnographic site visits. As queer-identifying researchers, we believe that it is essential to document the experiences of TGNC students in STEM as they are an underserved, and often ignored, part of our academic community. This paper directs attention to two engineering students who matriculated in the same engineering program at the same institution and seeks to highlight the importance and significance of place and space on transgender and gender non-conforming undergraduate engineering experiences, as well as the struggles that result from combating the depoliticization of engineering culture. The depoliticization of engineering culture and its negative impact on students with politicized identities have been documented [4], [5], [6]. One of the most significant findings from previous phases of this research is that each student's identity, location, political worldview, and support system influenced widely different experiences for TGNC students [7]. A primary objective of the site visits was to learn more about students' experiences through collaboration.

Background

As described in earlier work [8], the design of research with the TGNC community should center methodological approaches that do not reinforce harm. To address this need, our study included a research justice design and based analysis on feminist, trans, and queer methodologies to interrogate ideologies that shape engineering norms and practices. This important context is detailed more fully below.

Research justice

The design of our study was influenced by feminist, trans, and queer research methodologies that are centered on deconstructing power imbalances between the researcher and participant as a form of "research justice." Research justice is defined by Andrew Jolivette as "examin[ing] the relationships and intersections between research, knowledge construction, and political power/legitimacy in society [9]." We understand TGNC students to be experts on their own experiences and consider their input to be central to our study design and implementation.

Trans and queer space/place

Analyses of space and place are central to the findings of this study. We argue that it is vital to consider geographic location when attributing findings to data regarding transgender and gender non-conforming engineering students. Identity expression and concealment are directly related to the ability to safely express a marginalized identity without judgment or ostracization. The research team uses the concept of queer and trans geographies, which are understood to be the

"critical role of place and space in the production of sexual identities, practices, communities, subjectivities, and embodiments [10]" to address that each critical collaborative ethnographic site visit will likely yield different results based on factors such as geographic location, the political orientation of the students at each institution, progressiveness vs. conservatism in each department, and the presence of out LGBTQIA+ faculty and students.

E. Cram, a Communications and women, gender, and sexuality studies scholar, argues that space is a part of "social processes," and that "space matters. Space is alive, dynamic. Space is a medium of power [11]." Like Cram, we believe that cultural norms and values deeply inform spatiality and are strongly influenced by systems of oppression and domination. Experiences in engineering culture can be compounded by racism, sexism, cissexism, transphobia, ableism, and so on. Michel De Certeau argues that space is "a practiced place [12]." De Certeau argues that space is a product of human interaction with other humans or objects. Because space is constructed through action, De Certeau understands that "there are as many spaces as there are distinct spatial experiences. The perspective is determined by a phenomenology of existing in the world [12]." TGNC students interact with space with the understanding that they already occupy a marginalized space in society. Thus, their perception and sense of belonging in a space will not match that of cisgender and heterosexual students in the same engineering program.

Depoliticization in engineering culture

Research has documented the ways in which engineering culture endorses a separation of technical issues and social/political issues, with discussion of LGBTQIA+ inequality, or even LGBTQIA+ identity, being perceived as a threat to this depoliticization of the profession [13], [4], [5], [6]. Navigating this culture is particularly problematic for TGNC engineers, who are unwillingly categorized with a deeply politicized identity. Current attacks on transgender rights in the United States entrench TGNC students in social marginalization and contribute to the positioning of TGNC identities as taboo. Maloy, Kwapisz, and Hughes found that STEM promotes impartiality and depoliticization, stating that "this cultural value promotes the idea that if a STEM practitioner uses the best methods possible and isolates their bias from the research, they will produce the best science, regardless of the personal identity of the researcher. This commitment has informed a position that the identities of the person performing the science are thus irrelevant to their practice, meaning that TGNC identity should be irrelevant to the practice of science [14]." But to the contrary, engineering education and practice does not exist outside the boundaries of social relationships and politics. Further, Faulkner [13] and Hughes and Kothari [3] found that because depoliticization of identities is seen as crucial to preserving the objectivity and impartiality of STEM, "social aspects of STEM work undermine objectivity and threaten its legitimacy [13]. LGBQ people are politically visible, and in particular, trans identities are hyper-political, given the amount of legislation targeting trans people's access to public facilities [3]."

It follows, then, that TGNC people occupy a marginalized space within engineering culture, where their existence defies cultural "norms" within engineering spaces, leaving them little room to express themselves safely and without judgment. This creates a process known as environmental surveillance, defined by Yang et al. as "the ways in which LGBTQ+ people constantly assess their environment for potential stigmas associated with being visible." Environmental surveillance "informs LGBTQ+ people whether it is safe for them to exist in a

particular environment and impacts their sense of belonging [15].” Hughes and Watson argue that the introduction of politicized identities “spoils’ the ‘purity’ of the ‘objective’ STEM environment by introducing politics [16].” Students experience inhospitable STEM environments that cause them to engage in environmental surveillance practices such as “hiding or covering their sexual and gender identities when interacting with peers in STEM settings [16].”

Identity concealment can take place for both personal safety reasons as well as adhering to cultural norms. Revealing a politicized identity could expose a person to social as well as professional ostracization. For visibly transgender and gender non-conforming people, identity concealment is not always possible, especially for those without cisgender “passing” privilege. Some TGNC people may choose to inhabit a “stealth” identity at school or in the workplace in STEM environments to maintain a level of invisibility. Living “stealth” means that a person does not disclose their transgender or gender non-conforming identity to people and often dresses and acts in such a way that aligns themselves with cisgender norms. Living stealth may be impossible without significant risks for those without cisgender passing privileges. Identity concealment can lead to a sense of estrangement from engineering culture. Hughes and Watson argue that the ability to have visible marginalized sexual and gender identities is “important because this openness offers a sense of authenticity that helps LGBTQ people experience congruence between their sense of who they are and the environments in which they interact with others. This sense of congruence signals to LGBTQ people that their valued aspects of who they are, such as their sexual and gender identities, are also validated by those around them within any given situation [16]. For TGNC people to feel safe to express their identities in engineering environments, a paradigm shift must occur in engineering culture, moving away from the depoliticization of engineering culture and towards a space that embraces diverse, whole selves.

Methods

The research team is comprised of scholars with expertise in women, gender, and sexuality studies, bioengineering, and engineering education. The interdisciplinary nature of our team is a valuable aspect of our research that enables our analyses to delve deeper into the lived realities of engineering students by matching students’ experiences with critical theories that support their understanding of their program environment. We understand systems of oppression to be deeply intertwined with the daily lives of marginalized students, and we believe engineering education professionals and engineering practitioners must move beyond a baseline understanding of intersectionality to understand the struggles that marginalized students face in engineering culture [17], [18].

Our approach is informed by critical and collaborative ethnographic research methodologies and emerging outcomes from prior study phases of this work. Critical ethnography as a method puts critical theories (critical race theory, queer theory, phenomenology, feminist theory) into action by integrating theory throughout the research process – rooting the experiences and observations in larger global justice frameworks at the intersections of race, gender, sexuality, class, culture, and disability [19]. Collaborative ethnography places the researcher with the subjects to co-create results from the fieldwork [20]. Collaborative ethnographies allow students to retain power in the relationship with the researcher and to exert some control over their portrayal in the research.

Recruitment and consent

Chain referrals were used to connect with potential participants from varied geographic regions in the U.S. (East North Central, East South Central, Mid-Atlantic, Mountain, New England, South Atlantic, Pacific West North Central, or West South Central). Briefly, we identified colleagues and other contacts across the US who we believed were positioned to connect with potential participants (TGNC undergraduate engineering or computer science students), to brief them on the study opportunity, and to pass along our study team's contact information. Informal, informational Zoom calls were made to students who contacted us and expressed interest in participating. During these calls, we discussed the general outline of activities associated with the site visit study, the timeline for completion of the site visit activities, and compensation for participant involvement. One or 2 participants were selected from 4 different geographical regions in a way that maximized the diversity of our overall participant pool (based on gender, race, and disability, among others). Each enrolled site-visit participant completed a written consent process approved by our institution's IRB.

The amount of compensation our participants received was informed by research justice, a movement to upend the unequal cost and benefit of research conducted on marginalized communities and to redress inequity through a restructuring of the research process (Jolivette, 2015). Surveys, interviews, and focus groups create great benefits for the institution and its research team (in the forms of grant funding, tenure, and graduate degrees, among others) often with little to no benefit for the subject community (which may or may not even receive compensation). Fair financial compensation that matches or exceeds the per-hour wages of the researchers is a way to strive for equal benefit for TGNC subject populations from a research justice perspective. Our participants were compensated at a comparable hourly rate as the researchers in order to reflect the unparalleled value of the unique expertise that they brought to the research project.

Site-visits

The site-visit activities were divided into three phases: 1) pre-visit preparation and logistics, 2) site visit, and 3) post-visit data review and feedback. The goal of pre-visit preparation and logistics was to assist in fostering a trusting, working relationship between the visiting researcher and the participant and to provide our team with a deeper understanding of the student's situational context. As part of this phase, the participant completed a "preparation package" that requested background information (university, major, description of living situation, etc.), possible dates for the visit, and the participant's expectations/hopes/concerns/needs about the visit. The package also asked the participant to provide input on topics to be covered, places and spaces to be visited, and activities to be engaged in. This allowed the site-visit experience to be co-created by the visiting researcher and the participant.

The collaborative site visit was conducted over four days. As a critical part of our method design, the research team included cisgender, transgender, and queer people, but the only point of contact between the participants and our team was a transgender and queer Ph.D. student in WGSS, who specializes in Critical Trans Legal Studies, Queer Studies, and Ethnic Studies (Johnson). This study design allowed for a more natural relationship between the participants and our team because Johnson and the participants formed bonds based on shared identities, making

it easier to find community with one another. In addition, Johnson was understood as holding professional knowledge about the administrative, social, and physical violence the TGNC community faces.

Johnson traveled to the participant's campus to conduct the on-site interactions. The four-day visit was organized around the activities and conversation topics outlined in the pre-visit preparation and logistics package. Participation in the site visit required about 15 hours of the participant's time: each day included approximately one hour of semi-structured, audio-recorded interview/discussions with the researcher and an average of roughly 3 hours of other activities as determined through the pre-visit package. Outside of these contact hours with the participant, Johnson spent time alone on the college campus and the broader community.

Following the visit, our research team sorted and organized the site-visit data, including the transcriptions of the formal interviews, and then sent the data to the participants for review and feedback. This allowed participants to (1) clarify aspects of their specific experience or narrative, (2) reflect on the meaning of their site-visit-specific shared experiences and activities with the researcher, and (3) directly respond to the way they and their site-visit experiences have been characterized or noted by Johnson. Each participant chose a pseudonym to be used in the presentations of results. Note that Johnson was the primary researcher from our team who engaged in data analysis, as the meaning-making of the site-visit experience must necessarily come from those directly involved, and data analysis of TGNC experiences is best done by researchers who identify as TGNC. That is, the inferences drawn from the interview data come from embodied knowledge, where the researcher is able to understand the participants' experiences on a personal and professional level. Embodied knowledge, a concept that is best illustrated by Gloria Anzaldúa and Cherríe Moraga's "theories in the flesh" from *This Bridge Called My Back: Writings from Radical Women of Color,* is understood by Anzaldúa and Moraga to be theories that recognize that "the physical realities of our lives – our skin color, the land or concrete we grew up on, our sexual longings [which] all fuse to create a politic born out of necessity...we do this bridging by naming ourselves and by telling our stories in our own words [21]."

Results and Discussion

The site visits took place at a private university on the East Coast of the United States. Participant 1 (Gabe: non-binary, Asian American) was a 3rd-year undergraduate student in mechanical engineering, and Participant 2 (Buster: trans-masculine, white) was a 2nd-year student who recently transferred out of mechanical engineering to study classics. As previously mentioned, the activities were pre-determined by the participants and Johnson and included attending class or labs together, hanging out with the participants' friends, taking walks in the community, seeing the participants' living spaces, engaging in formal interviews, attending school-sponsored events, running errands, and having meals together at restaurants.

A unique feature of this study is that the visiting researcher (Johnson) was able to interpret the campus environment in ways that would be impossible for a cisgender and heterosexual researcher. That is, because Johnson identifies as transgender and queer, he was able to accurately witness what it is like to be a TGNC student on this campus. Johnson noted that the

university, as a whole, felt progressive. Pride flags were displayed around campus in main buildings such as the student center and dorms, signs promoting LGBTQIA+ events throughout campus, and visibly queer students were openly wearing pride-oriented clothing or publicly displaying affection. There were gender-neutral bathrooms in every building that Johnson toured. In the restrooms, signs were posted that asked students to consider that a person using the restroom with them may not outwardly appear to belong in that space and that the student should understand that it's a personal choice to use the restroom that person feels most safe in.

The university is located in a suburb of a major city. The town was a typical college town, with many businesses oriented around student life. Many students could be seen walking throughout the town and inside the businesses. There were pride flag stickers or physical flags inside or outside many of the businesses, signaling their commitment to helping maintain safe spaces for queer people. Pride flags were also seen flying outside of residences. Overall, the town seemed to be queer-friendly.

Having the opportunity to attend a course with each participant lent an insider perspective on the way the students interacted with their professors and peers. Johnson attended one mechanical engineering lab with Gabe and noticed that assumably straight, cisgender men dominated the classroom space. Prior to class, conversations among students focused on sports teams and girlfriends. Johnson noticed Gabe remained quiet. In contrast, Johnson attended an education course with Buster, and he appeared to be much more comfortable in class. There were many women and "out" queer people in the room, and Buster engaged with his peers openly. Buster later told Johnson that he loved that course because of the diversity of the students.

Depoliticization of engineering identity

Through watching peer interactions in class and engineering spaces, Johnson witnessed firsthand the culture of depoliticization in engineering spaces at this university. This culture creates an environment where identity concealment or environmental surveillance is necessary for marginalized engineering students [15]. Both of the participants noted that it seemed unimportant to other engineers to discuss identity and that making marginalized identities visible may cause issues with fitting in. Living stealth, or making the conscious effort to not disclose a TGNC identity, was a strategy used by both participants at this university. For Gabe, the idea of self-disclosing a non-binary and queer identity felt stressful.

> "Some friends I have, I haven't really told them. Some of my friends here, are really straight, and I love our friendships...but it's, either like, I don't think it's that important to tell them, or I didn't want to go through the headache of figuring stuff out and working through things with them. I keep my lives pretty separate. I don't want to do that, but it's hard when people are not out here being like, 'What pronouns do you use?' Stuff like that. Engineers are very like, 'I'm studying engineering.'"

When asked about whether concepts surrounding gender, race, class, or sexuality were ever addressed in class, Gabe remarked,

> "Not really. I have talked to professors, even ones who care about this, and they are like we have a lot of coursework to get through, and it's math. Disability does come up a good amount. Race, gender, and sexuality are kind of in the background. It's kind of like, everyone can be an engineer…we don't see that."

Buster noted that his hesitancy towards being out in engineering was partially a personal choice due to the stressful nature of self-disclosure in an unwelcoming environment, but it was also due to STEM culture as a whole.

> "It's something that I didn't really bring up to my professors or classmates. Part of that is personal, like, I don't want this to be a thing, and part of that is the STEM community…recognizing that I wouldn't fit in and not wanting that to be another thing to deal with."

Both participants understood sexism in engineering spaces contributed to the marginalization of TGNC students within engineering culture. Buster, felt that because he did not have cisgender passing privilege, he was perceived as a woman in STEM. Buster noted that this university had almost a 50/50 male/female ratio in engineering, but that ratio did not combat the cisgender male domination that happens in STEM spaces. When asked about how he felt he fit in with engineering spaces at this university, he said,

> "It was definitely weird and strange. It kind of felt like I really didn't fit in. One of the reasons I chose [university name redacted] was because they have a 50/50-ish gender ratio in engineering. I was like, okay, this is something I need no matter how I identify, I don't want to be in an all-male space. It did feel like there was space to be a woman in STEM, less so space to be queer in STEM, even less so space to be trans in STEM, and that was more of like...it wasn't talked about, wasn't assumed to be an option unless you went out of your way to come out. It did feel like...you have to make this space for yourself…especially being trans."

Later, Buster pointed to the sexist dynamics present in engineering spaces at this university, noting that it was difficult for him to carve out a space for himself socially.

> "At first, it was like, oh my god, I don't know how to break into this space. It was very much like, there is a norm that I know I don't fit into…how do I either make myself fit into that or accept that I don't fit in? One thing that I've noticed…and this plays into women in STEM, is that you have to aggressively make space for yourself. If you don't belong, you have to make an effort to call attention to that. You have to be a certain amount of confident in your identity even if you aren't actually that confident. You have to accept it so strongly that you won't be pushed around. Mechanical engineers are so irritating. That's part of it. I was like, I cannot be like these people. It was partly because of how I was treated because of my trans identity. You know, like, a lot of assumptions being made in terms of 'I know what you are unless you say something else.' Or, like people making it a big deal when that isn't necessarily happening in classics. I do think being in STEM, and then in humanities gives me a lot of perspective on contrasting them. I would so consistently get spoken over [in engineering spaces], like I wasn't out and trans, because I very much don't pass. And I do think I would just so consistently realize, I can tell you're not listening to my idea."

Ultimately, Buster left engineering altogether for the humanities due to his general unhappiness with engineering culture and the hostility he faced. Buster's experience is not uncommon. TehQuin D. Forbes' states that "there is evidence that science, technology, engineering, and math (STEM) fields have a particularly hard time retaining queer students. For example, a longitudinal study found that despite their higher reported participation in undergraduate research than their straight peers, queer students were about seven percentage points less likely

to stay in STEM majors throughout four years of undergraduate studies [22].” It is well-established that there are significant connections between students’ sense of belonging, establishing an engineering identity, and persistence in engineering programs [23], [24], [25].

Identity concealment in engineering spaces

Gabe remarked that transitioning publicly would draw unwanted attention and that sexism in engineering spaces at this university had also been an issue in the past. Gabe highlighted that because they were not out in engineering spaces, their perceived gender acted as a protective factor, however, they noticed that despite the insulation from harm that their perceived gender provided, white dominance in these spaces was an issue.

> “Transitioning, people are going to be paying a lot of attention to you. I don’t think I could do that. I think I would crack under that pressure. In the machine shops and stuff like that, having cis-passing, male-passing privilege is a boon. Because people expect me to be there. One of the machine shops had an old director who was not very cool. He got fired for sexism. There’s a new director, and they’re trying to make it better. One thing I do feel is that those spaces are very white.”

The TGNC participants at this university concealed their identity and this served as a protective factor between themselves and their peers. Both participants expressed anxiety surrounding being out as TGNC in engineering. Thus, the participants found the majority of their social support outside engineering spaces. Cech and Waidzunas bring attention to the ways in which engineering students often live “compartmentalized lives,” which function through “the maintenance of boundaries between their engineering work and their social lives. This compartmentalization is not necessarily required of straight engineering students, whose classmates often form the core of their friend groups and who are able to pass seamlessly between their personal lives and professional lives while on campus [4].”

Finding social support outside of engineering

Finding community for TGNC students can be difficult, depending on the level of “outness” the student is able to inhabit. Building on work by Spade [26], Yang et al. note that building community centered around LGBTQIA+ identities is a survival tactic that ensures group safety and can challenge the institution’s heteronormativity [and, we would argue, also cisnormativity.] Yang et al. state, “We define building community as the practice of creating spaces, fostering interpersonal networks and relationships, and uniting around an identity or cause that makes way for individual personal growth, group survival, and/or collective political action. These definitions of creating space and community-building operationalize specific techniques of resistance used by marginalized peoples to challenge dominant social and cultural forces that define an oppressive institution [27].”

Gabe, found most of their social support in an Asian American student organization on campus and was able to be open about their non-binary identity with their friends.

> “What’s really, really important to me always, and right now especially, is my Asian American identity. I do a lot of work here with [club name redacted]. That’s the very noticeable identity that I do get discriminated against. It means a lot to me to work with the club.”

Gabe mentioned that in this student organization, many students had TGNC identities, and the ones who did not were educated about TGNC people.

> "My friends here, I'm really lucky, one, because [university name redacted] is like, very queer, so even if people are not gender non-conforming, they are exposed to LGBT people. In the activist circles, especially. [Student organization name redacted,] where I work, I have a lot of my close friends come from [there.] They are all very good at understanding and using they/them. You know, I'm sure at some liberal arts colleges, people are just like, oh, they/them, that's a thing now. And the classes they do, and then they get on board. In [student organization name redacted] especially, they have a lot of non-binary people. I met my girlfriend in [student organization name redacted,] she's very supportive."

Both participants were able to find queer community, but for Gabe, this process was more easily done with people who shared their racial identity. Gabe mentioned that they had never intentionally sought out community with other queer students in LGBTQIA+-oriented spaces because white people often dominated those spaces at this university.

> "The LGBT center, I have actually never been. The space is very white. The white queers dominate that space. There's such a divide between white enbies (non-binary people) and enbies of color. The experiences don't line up."

Contrastingly, Buster did not feel his racial identity precluded him from belonging to queer-oriented spaces on campus and that he could find community relatively easily outside of engineering spaces. When asked about LGBT-inclusive spaces on campus, Buster mentioned that he did not spend much time at the LGBT center because it was not close to his dorm but that he felt the entire campus was welcoming to queer people.

> "I was going to say the entire campus. [Laughs]. There's the LGBT center. There are a couple houses for various different identities. It's a nice space. People just go and hang out there and study there. I don't really go there because it's far from me. But, it's good vibes."

Buster noted that finding community was certainly harder than it would be for cisgender and heterosexual students, but that he felt that he found community easily.

> "I do think a lot of my friends... I have found in the queer community, and I think that's like having something in common and having the same understanding has been something that has brought me together with people. I think my experience would be very different if I was cis/het. I think the way I would be set up to interact in the world would already be different. I think I'd find a community anywhere... I do think it was very easy."

However, Buster mentioned that before leaving engineering, he struggled to find community in engineering classes.

> "I do think it's easy to make friends among the queer community. It's hard to make friends in engineering classes. It's really easy to make friends in my education class. Easier to make friends in my Roman history and Latin class."

Unlike Buster, Gabe did find friends in engineering courses but was not out as non-binary to these friends. Buster, who was more visibly gender non-conforming, did not find community in engineering spaces. Buster mentioned that the majority of their friendships came from outside of engineering. "I think a lot of my engineering friends weren't from engineering classes, they are people I know who are engineers."

Both participants found support in their partners, who were also TGNC. When asked about their most important social relationships, Gabe mentioned their girlfriend, who identifies as non-binary and uses she/they pronouns.

> "She/They do a lot of very affirming things. She is one of the few people I can talk about my dysphoria with. Who really, like, understands it. I don't think their dysphoria is, like, as strong as mine, but like, I think that there is still a connection there. And maybe that's why we connected in the first place too. They are from [the Midwest] and are visibly queer and have been called the F slur whenever they go back home. I'm like, I've never been called the F slur, but I know what it's like to be scared and angry and hope for a better world in this specific way. And also, we are both Asian, and East Asian, and we have a lot of things in common, like, our parents, so there's a lot of connection there. She's really great."

Buster, also identified their partner, who is a transmasculine person, as a significant source of social support.

> "I think I'm closest with my partner… We met during frisbee, the women's team. I played on the men's team for a semester, it was very different. I do think that there's a lot they understand because they are also trans, and there's a lot I can talk about and feel like they either get it or get understanding it. They are very dependable. I know that if I need something, I can go to them. A lot of the stability in my life is coming from them."

The importance of space and intersectionality

Cech and Rothwell conducted a recent study exploring LGBTQ inequality in engineering education across a wide variation of institutions (e.g., large public schools to small, religiously affiliated private schools). Their results indicate a common baseline anti-LGBTQ bias "is not only a manifestation of the climate of individual programs but part of the culture of engineering education more broadly, embedded in its taken-for-granted practices and ideologies [28]." This also seemed to be true in our data set; however, how this bias played out in our participants' lives was significantly impacted by each person's specific social locations. We found that TGNC students' experiences are tied to TGNC students' specific institutions because TGNC identities intersect with one or more other marginalized identities. Because Johnson was able to experience these environments side by side with the participants, unique observations were made about the cultural spaces of the engineering environment at this institution. Johnson's identity as a queer and transgender doctoral student enabled him to make inferences about the safety of the community and school environment, and he was welcomed into the participant's social networks as a community member rather than an outsider.

Additionally, geographic location plays a significant role in the safety of TGNC students and their overall happiness and sense of safety. As anti-trans legislation surges through the United States legislature, trans people are actively watching their rights legislated away. This university is located in a "blue" state that has not passed any anti-trans legislation this year. As previously mentioned, the university and the surrounding town openly supported LGBTQIA+ people. However, it is problematic to assume a universal trans experience for any given institution of higher education. TGNC people often have other marginalized social locations that contribute experiences of safety, belonging, and happiness at any given institution. This was evident in the data of our study, where two students at the same institution shared one identity but had different

experiences based on their differing racial identity and their differing levels of cisgender passing privilege.

Conclusion

Transgender and gender nonconforming identity, a highly politicized identity, is positioned as incompatible with a supposed depoliticized engineering culture. Both participants understood engineering spaces, believing they were depoliticized spaces. Thus, they felt unsafe being out in engineering and felt that engineering spaces were unwelcoming to TGNC people.

Forbes brings attention to the dearth of TGNC-oriented materials and resources offered by educators and also addresses the fact that many are unprepared to educate students on these topics [22]. This should not be interpreted as a suggestion to fill that gap in knowledge with diversity, equity, and inclusion (DEI) training only. DEI training can be the foundation upon which further knowledge is gained. We encourage faculty to educate themselves about the politicization of TGNC identities and to include activities and coursework that address gender and sexuality in engineering. This would raise the visibility of LGBTQIA+ advocacy efforts and may promote sustaining connections between LGBTQIA+ students and professionals [29], [28]. Our research participants indicated that they felt as if the engineering faculty at their university were not doing enough to advocate for TGNC people on campus. While both acknowledged that most professors were supportive of TGNC identities, they expressed that topics surrounding race, gender, or sexuality were not introduced in their engineering courses because such topics were viewed as irrelevant or simply that technical topics were given priority in the curriculum. Faculty "moral support" of TGNC students without action, however, actively contributes to the marginalization of TGNC students. We support Cech and Rothwell's [28] call for engineering faculty and program leaders to seriously commit to shifting institutional and professional culture towards one that is affirming to LGBTQIA+ students.

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