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# RESISTANCE AND COMMUNITY-BUILDING IN LGBTQ+ ENGINEERING STUDENTS

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*Recent efforts to promote equity in science and engineering fields have exposed various ways that racial and gender minoritized groups are also marginalized in STEM. One key group that has been overlooked by many such programs is lesbian, gay, bisexual, trans*, queer, and gender-nonconforming (LGBTQ+) engineering students. Given their consistently negative experiences in engineering, such as homophobia and heteronormativity, there is a dearth of research on how LGBTQ+ engineering students may resist these challenges and create spaces in engineering in which they can thrive. We report a qualitative study of LGBTQ+ electrical and computer engineering students at a large public university in the southern United States. Four semi-structured focus groups (n = 9 participants) were conducted to capture the experiences of LGBTQ+ engineering students at the institution as well as explore the ways in which the participants navigated and created space for themselves in engineering. Our findings illuminate ways in which LGBTQ+ students resist dominant heteronormative engineering cultures within their personal contexts by creating space for themselves and building communities of marginalized students. We propose that engineering researchers, faculty, and staff listen to and amplify the grassroots solutions that LGBTQ+ students are already creating as they design new policies and programs toward equity.*

**KEY WORDS:** *resistance, equity, diversity, inclusion, LGBTQ+*

## 1. INTRODUCTION

Lesbian, gay, bisexual, trans*, queer, and gender-nonconforming (LGBTQ+) engineering students are a community that has recently gained increasing attention (Voss, 2015). The term "trans*" is used to refer to people who identify as transgender, gender-nonconforming, gender nonbinary, and genders outside of the man/woman binary. The asterisk replaces the more traditional term "transgender," which has been critiqued as being limited to the man/woman gender binary. According to several recent studies, many LGBTQ+ engineering students experience a chilly, heteronormative climate in engineering and use a variety of techniques, such as passing, covering, and compartmentalizing to navigate

 

their engineering lives (Cech and Rothwell, 2018; Cech and Waidzunas, 2011; Farrell, 2017; Hughes, 2017; Yoshino, 2006). For this paper, we define *heteronormativity* as the prevailing cultural assumptions that normalize heterosexuality and stabilize traditional notions of sex, gender, and sexuality. As a result of heteronormative cultures, LGBTQ+ engineering students consistently report feeling more anxious and stressed, which impacts their desire to engage with the engineering profession and their academic performance as well as their physical health (Cech and Waidzunas, 2011). While more recent studies show less expression of direct homophobia, a culture of silence still pervades the upper ranks of engineering education (Hughes, 2017), and policies and programs intended to serve LGBTQ+ students may reproduce existing inequalities (Marine and Nicolazzo, 2014; Yang et al., 2021a). In addition, LGBTQ+ STEM faculty experience similar chilly climates in academia and must confront deeply personal questions about coming out that may impact their professional lives (Bilimoria and Stewart, 2009; Cooper et al., 2019; Patridge et al., 2014). LGBTQ+ people continue to face an uphill battle in STEM spaces.

The growing number of studies describing LGBTQ+ STEM students' experiences in engineering spaces continues to focus on refining understandings about LGBTQ+ STEM students and their cultural contexts, hoping to motivate changes in STEM culture. While these studies are valuable to understand the structural forces that impact LGBTQ+ engineering students, they often miss the ways in which LGBTQ+ engineering students actively and dynamically resist these oppressive forces as they go through their engineering lives, seeking to create space and build communities for themselves and others like them in novel, generative ways. These mechanisms of grassroots resistance offer new student-centered, agentic perspectives on institutional policymaking that allow LGBTQ+ students to shape their own narratives in engineering.

Drawing on theories of queer and transformational resistance (Alimahomed, 2010; Cohen, 1997; Renn, 2005; Solórzano and Bernal, 2001), this study asks the question: "How do LGBTQ+ engineering students resist the heteronormative engineering climate?" Through in-depth focus groups with LGBTQ+ undergraduate electrical and computer engineering students at a large southern public university, we argue that LGBTQ+ engineering students resist the dominant narratives of engineering culture by creating new spaces of existence and support, gaining power in the engineering department, and finding and building communities of marginalized students, thereby becoming agents of change in their engineering spaces. LGBTQ+ engineering students' resistance techniques differed based on the intersections of their LGBTQ+ identities and other social identities. We propose a novel perspective through which engineering faculty, staff, and administrators can re-envision diversity/inclusion policies and programs that account for, support, and validate LGBTQ+ students.

Before proceeding further, it is important to note that the use of certain terms such as "LGBTQ+" and "queer" remain hotly contested and continuously evolving in the broader community of people with marginalized sexual and gender identities (Somerville, n. d.). While the authors acknowledge that the acronym "LGBTQ+" suggests the inclusion/exclusion of certain sexual and gender identities, some study participants objected to using "queer" or other terminology to describe them, whereas all participants

were onboard with the term "LGBTQ+". To respect these terms and the participant individuals, we choose to use the term "LGBTQ+" to represent people (students) with marginalized sexual and gender identities. In describing results and findings of other studies, we honor the terminology used in the original study.

## 2. LGBTQ+ ENGINEERING EXPERIENCES AND THEORIES OF (QUEER) RESISTANCE

Exploring LGBTQ+ students' experiences in engineering is a nascent but necessary research endeavor. LGBTQ+ engineering students bring a unique perspective that influences how they perceive the engineering environment. In this section, we present a concise theoretical framework for studying the experiences of LGBTQ+ engineering students drawing on prior literature on LGBTQ+ engineering students and theories of queer resistance.

Previous studies on LGBTQ+ engineering students have underscored the damaging effects of heteronormativity and engineering culture on LGBTQ+ engineering students (Cech and Rothwell, 2018; Cech and Waidzunas, 2011; Farrell, 2017; Hughes, 2017; Linley et al., 2018; Miller, 2015; Yang et al., 2021a,b). Cech and Waidzunas (2011) found that heteronormativity contributed to lower senses of belonging, higher stress levels, and feelings of marginalization for LGBTQ+ engineering students at their study site. LGBTQ+ students may be forced to pass as heterosexual, cover their LGBTQ+ identity, and compartmentalize their lives (Yoshino, 2006). The demands by engineering culture for LGBTQ+ engineering students to pass, cover, and compartmentalize, as Cech and Waidzunas argue, are products of heteronormativity in engineering culture, where the expectation for engineering students is that they are straight (2011). A similar study on gay men engineering students conducted by Hughes (2017) found similar pressures to conform to heteronormative standards; however, Hughes pointed out that LGBTQ+ engineering students also perceived a culture of silence around LGBTQ+ issues in engineering and often conducted environmental surveillance to determine to whom it was safe to come out. In Cech and Waidzunas (2011), Hughes (2017), and other follow-up studies (e.g., Cech and Rothwell, 2018), the pressures of heteronormativity, engineering culture, and the culture of silence had significant adverse effects on the academic, social, emotional, and mental well-being on LGBTQ+ engineering students. A large quantitative study by Cech and Rothwell (2018) found that LGBTQ+ engineering students were more likely to experience marginalization, less comfortable working with others, less likely to report that their engineering work is respected, and more likely to report anxiety and exhaustion. These effects of marginalization suggest that LGBTQ+ engineering students need to be further investigated and addressed as an underserved population in engineering education.

LGBTQ+ engineering students live at the intersection of their LGBTQ+ and engineering worlds and, as a result, require new frames of thought to fully explore their experiences. This intersection has given rise to recent developments in theoretical frameworks that seek to legitimize student agency and highlight processes of resistance in marginalized student communities. *Queering*, a notion from LGBTQ+ studies and queer theory, is the practice of critically examining institutions and power structures

to "call into question the stability of any such categories of identity based on sexual orientation…a *critique* of the tendency to organize political or theoretical questions around sexual orientation" (Somerville, n.d., p. 1). Within engineering education, queering engineering challenges us to view LGBTQ+ engineering students not as a monolithic group to be served with "LGBTQ+-specific" resources, but as a body of unique individuals bringing their experiences to engineering and engineering culture within the context of their LGBTQ+ and other identities to learn and become successful engineers. Renn (2005) highlights the numerous possibilities for research and practice that can be gained by queering higher education, including thinking rigorously about other critical issues of education, empirical studies on LGBTQ+ students, and reconsidering how educational institutions implement policies and programs that are intended to support LGBTQ+ people. Queering engineering education also affords theoretical and practical approaches to deconstructing existing power hierarchies in engineering education and reformulating discourse around diversity and inclusion to ensure that all voices—particularly student voices—are heard. While the most obvious impact is on LGBTQ+ engineers and LGBTQ+ engineering students, queer approaches to engineering education intend to engage in dialogue with all students at the bottom of the institutional hierarchy, especially underrepresented and marginalized student communities (Pawley, 2019; Slaton and Pawley, 2018). A queered engineering organization is not intended to be a single-issue campaign for LGBTQ+ engineering students so much as an advocate for all marginalized communities in engineering.

Queering engineering education also enables us to consider how LGBTQ+ engineering students resist the marginalizing forces of engineering culture by engaging in broader frameworks of queer resistance across various disciplines. *Resistance* is a nebulous and loosely defined concept in sociology, but it is often used to describe the different ways, behaviors, and practices that challenge dominant ideas or discourses in society (Hollander and Einwohner, 2004). Solórzano and Bernal (2001) proposed a model outlining four types of resistance: reactionary behavior, self-defeating resistance, conformist resistance, and transformational resistance. Resistance, Solórzano and Bernal posit, is an action that reflects a critique of social oppression or is motivated by social justice. For example, an LGBTQ+ engineering student who critiques the heteronormativity of engineering may change majors, demonstrating *self-defeating resistance*. An LGBTQ+ engineering student who is motivated to change faculty perceptions of LGBTQ+ people may ask faculty to use gender-neutral pronouns in the classroom, but their actions only reinforce the power dynamic of the classroom rather than challenging it, demonstrating *conformist resistance*. *Transformational resistance* is an action that reflects a critique of social oppression and is motivated by social justice. For example, LGBTQ+ engineering students may participate in activist efforts to highlight non-inclusive policies. Acts of transformational resistance include the intentionality to resist as well as the act of resistance through engagement in activist efforts to challenge power structures. Solórzano and Bernal expound, with "a deeper level of understanding and a social justice orientation, transformational resistance offers the greatest possibility for social change" (2001, p. 319). Transformational resistance, in combination with critical and

queer theories, "allows one to look at resistance…that is political, collective, conscious, and motivated by a sense that individual and social change is possible" (Solórzano and Bernal, 2001, p. 320). In addition, Solórzano and Bernal highlight *resilient resistance,* a theory developed by previous resistance scholars, as a way to describe the resistance that marginalized communities use to survive in oppressive institutions (2001, p. 320). While resilient resistance may not be transformational or induce broader social change, resilient resistance is crucial for students from marginalized communities to create space for themselves in oppressive cultures and may lead to further collective transformational resistance (Solórzano and Bernal, 2001; Yosso, 2000). Resilient and transformational resistance both place student agency at the forefront of the conversation on diversity and inclusion and legitimize the power of marginalized students' voices in disrupting oppressive hierarchies in the engineering education institution.

While transformational resistance seems to imply that resistance must be visible and external, Solórzano and Bernal note that there are many forms of internal resistance that are also transformational. One example of internal resistance is an LGBTQ+ engineering student who wishes to go into academia to influence diversity and inclusion policy in engineering. While they may not be picketing in front of the engineering building, their desire for social justice and critique of social oppression drives them to gain power inside the institution in the hopes of eventually creating social change. Solórzano and Bernal argue that this form of resistance must not be neglected, especially as many researchers and activists alike venerate external resistance due to its visibility and potential immediate action, whereas internal resistance may not be as visible (2001, p. 324). Alimahomed (2010) reports on the power of internal resistance through non-visibility in her study on queer women of color. She found that queer women of color often felt marginalized in pre-existing spaces that were designed for only one of their identities, for example queer spaces or female empowerment spaces. As a result of their multiple marginalized identities, they were often made to be invisible in those spaces because they did not conform to dominant identities. They did not fit into the white, cisgender, gay, male image of queer spaces or the straight male person of color in spaces for non-white people, nor did they fit in the white straight woman image of feminist spaces. However, this form of marginalization, Alimahomed (2010) elicits, afforded them a political transience that created generative spaces for new mechanisms of resistance unique to queer women of color; the queer women of color in Alimahomed's work eventually began producing a zine (self-published, self-distributed magazine) devoted to their experiences as queer women of color. Alimahomed's study not only showcases how (non)visibility and internal resistance can lead to radical empowerment, but also the necessity of an intersectional approach when examining people with multiple (marginalized) identities. LGBTQ+ engineering students who identify as female, who are people of color, or who do not fit into homonormative ideals will most likely experience engineering culture and resist differently due to their multiple marginalized identities.

Few studies in the engineering or education literature have focused on the resistance tactics of minoritized students in engineering education. Jorgenson (2002) found that women engineers tended to position themselves as career-identified, organizationally

adept, non-feminist, a good mother, and/or a singular individual to maintain their positions in engineering. Hatmaker (2013) interviewed 52 women professional engineers about their experiences as women in engineering and found four identity negotiation tactics that they used to counter misogyny in the workplace: proving oneself as technically competent, projecting an image of a professional and gender-neutral engineer, blocking by verbally challenging the person who was marginalizing them, and rationalizing by convincing themselves that they were okay with it or it was part of the culture. Seron et al. (2018) highlight how women in engineering provide strong cultural critiques of the masculine culture of engineering but use conformist tactics to explain their marginality through meritocracy and individualism. Jorgenson (2002), Hatmaker (2013), and Seron et al. (2018) show how women in engineering resist a male-dominated, hypermasculine culture, primarily through conformist approaches. Revelo and Baber (2017) highlight how Latinx students sought to resist racial stereotypes by role modeling, community outreach, and collective activist resistance.

In addition to traditional notions of resistance, work on resistance from LGBTQ+, critical, and Black feminist scholarship has identified decidedly queer modes of resistance (Combahee River Collective, 1977). Queer resistance can be embodied as existence, as personal and political action, as a performance, and in many other ways. Much work on queer resistance centers on the notion of intersectionality and queer kinship. *Intersectionality* is the notion that a person's lived experiences are a product of all of their identities, not as the sum of each identity, and each person experiences marginalization differently as a result (Crenshaw, 1989). For example, a queer woman of color has different experiences of marginalization from a non-queer woman of color, from a queer white woman, and from a queer man of color. Intersectionality can be broadened to encompass social and professional identities as well (Yang et al., 2021a). For LGBTQ+ engineering students, intersectionality implies that their unique experiences in engineering are a product of being LGBTQ+, being in engineering, race/ethnicity, and other identities (Yang et al., 2021a). Queer intersectionality theorist Cathy Cohen ties intersectionality to queer resistance by arguing, "The reconceptualization of not only the content of identity categories, but the intersectional nature of the identities themselves, must become part of our political practice" (1997, p. 481). As seen in Alimahomed (2010) above, resistance tactics for the queer women of color in her study were unique to their experiences living in the margins of queer, feminist, and people-of-color spaces.

Queer resistance is fundamentally tied to how LGBTQ+ engineering students resist in engineering and education spaces. In Linley et al.'s (2018) study, LGBTQ+ engineering students leveraged their LGBTQ+ peer interactions inside and outside of engineering to build supportive and affirming communities for themselves. Nicolazzo et al. (2017) described novel ways that trans* students formed kinship networks to navigate gender-dichotomous college environments. These networks allowed them to be resilient in the face of heterosexism and resist systematic genderism that gave rise to gender binaries and stereotypes and highlight the ways that LGBTQ+ students create spaces and build community around themselves. In the education space, Miller (2015, 2017, 2018) explored the ways in which queerness and disability intersected in online forums,

university classrooms, and college life for queer disabled students, finding that online spaces often served as places of refuge as well as spaces for queer disabled students to amplify their voices through social networking sites, smartphone apps, and blogs. In his studies, Miller highlighted various ways in which multiple identities may intersect in particular contexts, whether to perform certain aspects of themselves or resist oppression. These complex, nuanced layers of space, performance, identity, and intersectionality often interact to generate unique pictures of queer resistance for each individual.

Given the multiple ways and contexts in which LGBTQ+ students resist, we define *creating space* as the practice of delineating (tangible or intangible) boundaries in which one can exist and enact change in their communities (Fine, 2012). For example, an LGBTQ+ student or ally may create space by challenging a person's homophobic comments, or a group of LGBTQ+ students and allies may create a student organization dedicated to LGBTQ+ issues. In addition, 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 (Spade, 2020). 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. These modes of resistance by LGBTQ+ college students point to the need for both examining resistance processes in LGBTQ+ engineering students and considering ways to legitimize and validate their agency.

## 3. METHODS

### 3.1 Setting and Sample

The setting was a large public research institution in the southwestern United States. At this institution, first-year students enter their majors directly; there is no common first-year engineering program. We recruited focus group participants from among electrical and computer engineering majors ($n$ = 1500) via a survey (results are reported in Yang et al., 2021b). Only undergraduate students enrolled in the electrical and computer engineering major were selected to take the survey. Based on a series of gender identity and sexual orientation items, 19% of the 854 respondents identified as moderately or strongly LGBTQ+, and the survey asked these respondents if they were willing to participate in focus groups. Nineteen students supplied contact information and were invited to participate, and nine ultimately participated in focus groups. Study participants were not reimbursed for their time. Table 1 lists pseudonyms, preferred pronouns, and salient social identities of the participants.

This research was approved by the site institutional review board. An informed consent form was distributed to participants electronically prior to the study, and all participants signed and returned a paper copy to the researchers before data collection began. During the analysis phase, the participants' names were maintained as part

**TABLE 1:** Focus group participants

| Pseudonym | Pronouns | Relevant Identities |
|---|---|---|
| Milan | He/him | White, cisgender, gay man |
| Tenzin | He/him | White, cisgender, gay man |
| Sam | She/her | South Asian, cisgender, lesbian woman |
| Aiden | He/him | White, cisgender, bisexual man |
| Ariel | He/him | South Asian, straight, gender non-binary person |
| Eden | They/them | White, gay, asexual, gender non-binary person |
| Kai | He/him | Asian-Hispanic, cisgender, gay man |
| Maya | She/her | Hispanic, queer, pansexual, cisgender woman |
| Zoe | She/her | White, pansexual, transgender woman |

of the integrity of the transcripts. To protect participants' identities, all participants were deidentified prior to the writing of this paper, and any identifying information not directly relevant to the paper's argument (such as year in school) was removed. In addition, specific events, people, and places were replaced with generic descriptive terms to ensure that participants cannot be identified from their participation in specific activities.

### 3.2 Data Collection

The first two authors conducted four one-hour semi-structured focus groups as part of a broader mixed-methods campus climate study on LGBTQ+ engineering students. Focus groups were chosen as the preferred qualitative method over interviews due to their ability to foster connections between participants, as LGBTQ+ students have reported feelings of isolation in previous work (Cech and Waidzunas, 2011; Hughes, 2017). Focus group questions were informed by the results of the survey, specifically sense of belonging, forms of discrimination experienced by LGBTQ+ engineering students, and the need to act differently in engineering spaces (Yang et al., 2021b). At the beginning of each focus group, participants were prompted to consider their multiple identities, personal and professional. Participants introduced themselves with their name, pronouns, and salient personal identities (Table 1). During the focus groups, the facilitators probed the participants on their described experiences and shared their own experiences to elicit rich, qualitative responses and co-create shared meaning with the participants (Holstein and Gubrium, 1995). Focus groups were audio-recorded and transcribed for analysis. Questions included:

1. How would you describe your overall experiences in [department]?
2. Tell us about a time when you felt like you belonged in [department].
3. Do you feel that your LGBTQ+ status, race/ethnicity, class, sex, etc., impacts your engineering work and participation in engineering activities or vice versa? How (not)?

4. How conscious are you of your LGBTQ+ status, race/ethnicity, class, sex, etc., when you are in engineering spaces and when you are in non-engineering spaces?
5. Do you feel like you have to act differently in class, office hours, or study groups because of your LGBTQ+ status, race/ethnicity, class, sex, etc.?
6. Can you discuss any instances of discrimination or harassment you've seen or experienced based on any of your identities (LGBTQ+, race/ethnicity, class, sex)?

### 3.3 Data Analysis

During initial analysis of the focus group data, resistance and community building emerged as an important lens for further analysis. First, the focus groups were coded using a two-step iterative process (Charmaz, 1996; Glaser and Strauss, 1967). The first author transcribed and annotated the transcripts by hand, creating initial codes using both inductive and deductive methods, i.e., from transcripts and from the literature. Analytical memos were created to document each step in the process. Then, the first author open-coded the focus groups. From the codes and analytical memo, they formed categories and generated new codes for axial coding. In this step, they identified resistance as one category of axial codes, and types of resistance seen in the open coding session were grouped into these axial codes. After axial coding, another analytical memo was written, and the first two authors consolidated categories into themes and verified them to be consistent with the survey data (Smagorinsky, 2008). In this paper, we discuss four axial codes that emerged from the focus groups: lack of community, challenging perceptions in interactional settings, gaining institutional status, communities of support. We also discuss intersectional perspectives that emerged from the data.

### 3.4 Trustworthiness and Credibility

In naturalistic and qualitative inquiry, trustworthiness is a key construct necessary to contextualize and interpret data through a critical lens (Creswell and Poth, 2017). We employed triangulation, member-checking, and reflexive bias-checking to assure credibility, or internal and external validity of the study (Carlson, 2010; Casey and Murphy, 2009; Creswell and Poth, 2017).

Triangulation is defined as utilizing "multiple and different sources, methods, investigators, and theories to provide corroborating evidence" to "shed light on a theme or perspective" (Creswell and Poth, 2017, p. 208). This can be done by collecting triangulation data using quantitative methods, which is called methodological triangulation (Curtin and Fossey, 2007). In our study, we used survey data from Yang et al. (2021b), extant literature on LGBTQ+ engineering students including those surveyed in the Relevant Literature section, and member-checking, which is discussed below (Creswell and Miller, 2000). In these processes, we identified key points of similarity as well as points of departure. After highlighting the salient points of triangulation, we utilized the member-checking process to refine our findings and discussion to highlight the narratives and experiences that our participants communicated to us.

Triangulation is also closely tied to member-checking. Member-checking "involves taking data, analyses, interpretations, and conclusions back to the participants so they can judge the accuracy and credibility of the account" (Creswell and Poth, 2017, p. 208; Creswell and Miller, 2000). We performed member-checking by sharing drafts of the manuscripts with the participants via email (Carlson, 2010). Participants were given one week to review the manuscript. In addition, the first author held informal discussions with the participants throughout the analysis and writing process, allowing him and participants to engage with the findings and check for misinformation introduced by both parties in the analysis process (Carlson, 2010; Creswell and Poth, 2017, p. 207). These member-checking techniques allowed us to iron out distortions and inconsistencies in our interpretation and reporting of our findings (Carlson, 2010).

Reflexivity and reflexive bias-checking has also emerged as a common trustworthiness step in qualitative studies (Creswell and Poth, 2017; Creswell and Miller, 2000). In this study, we implemented reflexive practices during the focus groups and the analysis phases. During the focus groups, the facilitators shared their own identities as well as reflections on their own experiences with the participants when appropriate to the conversation. These experiences often sparked new directions of thought for participants and facilitators, allowing participants to further engage with each other and the facilitators, creating a space in which all present were involved in the co-construction of meaning from experience (Holstein and Gubrium, 1995). This form of reflexivity during the focus groups enables participants to gain new knowledge about themselves and their lived experiences, thus giving them tools toward empowerment (McCabe and Holmes, 2009). The collaborative focus group setting enabled participants to forge connections with each other, something that individual interviews cannot do. Furthermore, during analysis and coding, we used analytical memos to reflect on our biases (Charmaz, 1996, 2006). Analytical memos aided in consolidating axial codes and forming interpretive connections that reflected participants' experiences as told through the transcripts. In addition, analytical memos allowed us to examine our own biases and ensure that we did not use positivist or restricting frameworks to interpret participants' experiences throughout the iterative coding process. The first two authors discussed the codes and analytical memos after each iteration of coding, and the third author carefully reviewed draft summaries of the findings.

### 3.5 Positionality

Positionality is the social and personal lens through which researchers interpret and make meaning from data, incorporating their identities into their methods and analyses (Day, 2012; Jacobson and Mustafa, 2019). In our study, positionality played a significant role in how we accessed participants, how we interpreted and coded the transcripts, and how we checked for trustworthiness in the findings. The first author identifies as a gay, cisgender, Asian man and undergraduate electrical engineering student at the study institution. As a member of the target study population, he leveraged his position as a student leader in the department to gain access to study participants via instructors and

facilitate the focus groups. This also allowed him to establish rapport with the focus group participants and bring site-specific contextual knowledge to the data analysis and framing, as well as maintain connections for member-checking.

The second author identifies as a gay cisgender white man and non-engineering graduate student at the institution. Both facilitated focus groups and discussed data analysis.

The third and fourth authors identify as heterosexual, cisgender, white women on the engineering faculty at the institution and advised about recruiting participants and publishing research.

## 4. FINDINGS AND DISCUSSION

LGBTQ+ engineering students identified the lack of space and community for their identities that underscored their need to resist. LGBTQ+ engineering students demonstrated three main techniques of resistance: challenging perceptions in interactional settings, gaining institutional status through a peer mentoring or teaching assistant position, and crafting communities of support through personal relationships and student organizations. Each resistance technique allowed the participants to create space for themselves or build community with others who supported and validated their identities. In this section, we will discuss participants' descriptions of lack of community, then showcase each resistance technique, and finish with intersectional perspectives.

### 4.1 Lack of Community

The lack of an LGBTQ+ community in engineering, and resulting social isolation, was mentioned by all participants. For example, Tenzin and Sam explained that their social circles in engineering and non-engineering often did not overlap. Zoe knew one other transwoman in the department, and she felt that she did not "have an outlet to express that particular part of my identity here." Zoe's observation of the lack of other students like her made it difficult for her to be her authentic self within the department. In addition, Maya weighed in with her personal experiences involving engineering student organizations, where she felt her engineering participation and personal identities intersected: "I've gone to a lot of [various diversity-oriented student organizations'] events, and I've made a lot of friends through those who have shared my experiences, and not really having that from the queer identity is such a loss." While Maya observed, utilized, and participated in communities that reflected other portions of her identity, the lack of a similar community centered around queerness prevented her from connecting with her queer identity within the context of engineering. These experiences corroborate previous findings on LGBTQ+ engineering students' lack of community, as cited above (e.g., Cech and Waidzunas, 2011; Cech and Rothwell, 2018).

The lack of community extended beyond simply having supportive peers to socialize with. Participants noted a key distinction in their relationships with allies (in this case, non-LGBTQ+ students who support LGBTQ+ people and issues) and other LGBTQ+-identifying people. Maya stated, "It's very different to speak with an ally than

it is to speak with somebody who shares your identity." In this statement, Maya implied how people who were not LGBTQ+ had a certain dimension of connection missing that did not enable the same connection that she could make with another LGBTQ+ student. Eden concurred, "I only have a few LGBTQ people in engineering that I'm good friends with and most of them are low-key bisexuals, which is awesome and valid, but it's not the same as…. Gender and gender presentation is important to people." In Eden's case, while they were able to connect with a few LGBTQ+ engineering individuals, they also found those connections lacking. Eden's quote also highlighted the unique position of marginality for gender-nonconforming identities in the LGBTQ+ umbrella: trans*, non-binary, and gender-nonconforming identities occupy a particularly liminal space in the LGBTQ+ space, as they not only challenge sexual norms, but they also challenge gender norms set by cis-heteronormativity (Fassinger and Arsenau, 2007; Marine and Nicolazzo, 2014). Eden's gender-nonconforming identity made it difficult to fully connect with their LGBTQ+ engineering friends, whom they implied to be cisgender. These difficulties in connecting with others who did not share the same (LGBTQ+) identity created an environment of social isolation: students did not have someone who shared their identities to turn to when they needed it.

The lack of community was best exemplified by a dialogue between the focus group facilitator, Zoe, and Maya. Prior to this interaction, the facilitator had shared a result from the climate survey that estimated the LGBTQ+ student population in the engineering department. In reaction to this statistic and the observation that Zoe only knew one transwoman in the electrical and computer engineering (ECE) department, the following dialogue occurred:

*Maya: There's probably more than one transwoman in ECE, but….*

*Zoe: You said there were like 80 people who responded like very LGBT [on the survey]?*

*Maya: Where are they? I want to be friends with them!*

*Zoe: Some of them are probably not super public because of the-*

*Maya: Oh, yeah. Absolutely. And I don't want to put pressure on them to come out or anything, but… even if back when I was closeted, even if I had that opportunity to form a community, even if all the other people were closeted, it still meant more to have people who understood and who could talk about it.*

This dialogue showcases several aspects of the lack of community for LGBTQ+ engineering students. First, the evident surprise that Maya exhibited when she was reminded of the survey result, and the desire to connect with the "80 [LGBTQ+] people" in the survey, underscored how invisible the LGBTQ+ population was, even to each other. Second, Maya perceived that the lack of an LGBTQ+ community in engineering

directly impacted her ability to socially connect with other LGBTQ+ students and develop her own personal sense of belonging: simply having "people who understood and who could talk about it," she noted, would have been valuable to her as she navigated the engineering space.

As part of the chilly, heteronormative climate, the lack of community for LGBTQ+ engineering students within the department led to social isolation, both within the department and from each other, corroborating much of the previous work on LGBTQ+ engineering students (e.g., Cech and Waidzunas, 2011; Cech and Rothwell, 2018; Hughes, 2017; Linley et al., 2018; Miller, 2015; Yang et al., 2021a,b). Students trying to find community through shared identities sometimes simply could not find anyone in their circles, and those who wanted to express their LGBTQ+ identities in the engineering space perceived that they were not able to express themselves fully. These experiences of social isolation and want for an LGBTQ+ community, or at least, a community that served their needs, drove some participants to engage in resistance practices such as gaining institutional status and creating communities of support, as we will describe below.

### 4.2 Challenging Perceptions in Interactional Settings

While the lack of community weighed negatively on LGBTQ+ students' experiences in engineering, it allowed students to create space for themselves and build their own communities from the ground up. One technique they used was to challenge perceptions of heteronormativity that manifested in their interactions with their peers in engineering. Instances of challenging perceptions not only occurred in response to specific comments, but they also included sustained efforts by students to promote the visibility of LGBTQ+ issues among their peers. Primarily a form of interactional resistance, challenging perceptions allowed participants to actively and visibly reject homophobia or heteronormativity when it was displayed by others around them. Tenzin and Milan exemplified the use of this technique to promote LGBTQ+ issues in their interactions with other people in engineering.

When Tenzin was at a programming competition, he observed a student who was asked to write pronouns on their nametag attributing the request "to make sure you're not gay or something." In response to the other student's comment, Tenzin responded, "I don't think those things are related." In this brief interaction, Tenzin resisted the other student's homophobic comment by publicly negating the statement. While Tenzin's actions were likely more reactionary than transformational resistance in the context of Solórzano and Bernal's (2001) framework, Hatmaker (2013) describes a similar form of identity negotiation that she observed in her study of women professional engineers called blocking. Blocking "signal[ed] that they would not tolerate attention to being a woman" and "diverted the course of the interaction back to one in which their professional identity was in the foreground" (Hatmaker, 2013, p. 389). Tenzin, instead of reorienting the interaction to his professional identity, intended to highlight the non-inclusiveness of the interaction to the people around him and challenge the anti-inclusive

comment in the setting in which it occurred. Tenzin's comment in the passing instant was a defense of his (and others') space to express their gender identity.

On a more sustained scale, Milan also challenged the perceptions that his group project teammates had of LGBTQ+ people by leveraging his visibility. He perceived that while his project team was supportive of LGBTQ+ people, they seemed reticent to engage with him on topics that, as an LGBTQ+ person, he might have a different perspective on, such as relationships and nightlife. After coming out to them earlier in his engineering career, he felt comfortable enough to push their social boundaries. As he stated:

> *I personally try to make [LGBTQ+ topics] come up because I want to push my teammates to see how they react because now they know. The other day I mentioned to them, because they were all talking about like going out to [bar] and stuff and I said, 'Oh yeah, personally I prefer [gay-themed bar].' And then they were like, 'Oh yeah, [gay-themed bar]'s pretty cool.' Like I had to tell them, 'I'm not talking about like some of those like west-side, [non-gay-themed] bars, I'm talking about the one with the rainbow flags outside.' There's kind of like an ignorance I think that I want them to get over. Like I want them to feel comfortable talking about it with me. So maybe I'm being a little proactive in that way, but I don't think they'd bring it up on their own. They never have.*

By specifically mentioning parts of his LGBTQ+ experience to which his project teammates may not have been exposed, Milan sought to challenge their "ignorance" about the LGBTQ+ experience. Mentioning specific LGBTQ+ locations was a way for him to introduce the possibility for his straight teammates to engage with him on the LGBTQ+ scene in the city, challenging the traditional non-LGBTQ+-centered spaces his teammates typically frequent. In another instance, Milan mentioned how he used the initial survey through which focus group participants were recruited to get his teammates to think about different terms and identities that are part of the LGBTQ+ community. He related:

> *I thought the survey was a good experience. That was another one of those instances amongst my team where I was like, 'Ooh good, they're being challenged, they're reading the questions and they're like, 'What does that mean? Do I identify as a male?' They had no concept of a lot of this stuff. And I was like, 'Yeah, you identify as male. I'm answering this way and that way.' None of them were opposed to it. They were just like, 'Wow, this is new.' They'd never thought of it. So, actually I think that the survey for the sake of causing awareness was kind of a good one actually.*

Milan's persistent attempts to showcase LGBTQ+ culture and identities were emblematic of his resistance to the heteronormativity that he perceived in his project teammates. By challenging his teammates' reticence to bring up LGBTQ+ topics, Milan

sought to challenge heteronormative notions in his project teammates and make space for his LGBTQ+ identity in their team dynamic.

Milan's interactions in his group project team exemplified a more cogent form of transformational resistance that had direct effects on the intended audience. Mentioning how he wanted to "push [his] teammates" to "get over" their "ignorance" about LGBTQ+ topics, Milan sought to bring up aspects of his LGBTQ+ life outside of engineering to challenge their perceptions of being gay. Milan's purposeful way of drawing attention to his visibility gave intentionality to his actions that challenged his teammates' perceptions. Motivated by wanting to increase his teammates' responsiveness and openness to LGBTQ+ issues and critiquing the dominant culture of heteronormativity emblematized by silence around such issues, Milan demonstrated a specific form of transformational resistance in which he attempted not just to challenge, but to change his group project teammates' perceptions of LGBTQ+ people. While Milan did not challenge broader existing social structures in the same way that Solórzano and Bernal's (2001) transformational resistance discusses, he actively sought to disrupt his group project team's perspectives on LGBTQ+ people, exerting his influence to create space for himself and LGBTQ+ issues within his group of colleagues.

Tenzin and Milan demonstrated the possibilities of interactional transformational resistance, in which they sought to challenge perceptions of the people around them to promote LGBTQ+ visibility within their circles of friends and colleagues. As open white cisgender gay men, they were able to use this form of resistance due to their non-marginalized identities, which afforded them a specific voice among their peers that other focus group participants may not have felt they had or felt comfortable exercising as a result of their non-dominant identities. In the first block quote above, Milan references this privilege by highlighting the fact that "now they [his teammates] know" about his LGBTQ+ identity. Since challenging perceptions requires potentially harmful or confronting interactions between people who may or may not necessarily support LGBTQ+ issues, LGBTQ+ students who may not feel that they have the same power or privilege to interact in this way without retribution may simply ignore the instance or do nothing (Schilt, 2011). Challenging perceptions was also predicated on visibility in these instances; even though Tenzin and Milan leveraged their visibility to resist, in theory, anyone who is LGBTQ+ or an LGBTQ+ ally may resist by challenging perceptions. For example, LGBTQ+ engineering students with multiple marginalized identities may not feel comfortable being visible in homophobic contexts and simply remove themselves from the situation. Thus, challenging perceptions, as a resistance tactic, was afforded to, and only enacted by, gender and racial majority students who were comfortable being "out and proud" in engineering.

### 4.3 Gaining Institutional Status

Gaining institutional status was another resistance tactic, utilized by Aiden and Ariel. Gaining institutional status referred to participating in a program, such as a teaching assistantship or peer mentorship, in which they were employed by the department in a

position to work with other students and often came with increased access to resources such as more personal interactions with faculty. The power that institutional status afforded to these students enabled them to leverage institutional resources in serving as role models and touchpoints of inclusion for their peers.

While Aiden's personal beliefs prevented him from being openly visible in the department, he acknowledged how becoming a teaching assistant could be a powerful and generative space for representation if he chose to become visible. Aiden, who was a teaching assistant at the time of the focus groups, stated:

> *I'm currently working as a TA, and it's made me realize that it's important for me to be open about who I am, so that other people who may not be as comfortable being surrounded by peers who aren't LGBTQ+, who aren't people of color, who aren't the same identity as them that it's important for me to be about be open about who I am so that they can see it's okay for me to be who I am.*

Aiden's description of the potential of his position to make change signified his acknowledgement of his role in the department. As a touchpoint for his students, he felt being visible in the engineering space as a teaching assistant would enable others to see that "it's okay for me to be who I am." While he did not describe an instance in which he acted on this power, Aiden recognized its utility in promoting inclusion. For Aiden, being out was a deterrent in using his position to represent the LGBTQ+ community.

Ariel also described his experiences as a peer mentor in the department. As a first-year student, Ariel participated in a university-wide first-year learning community with thirty other engineering students, a faculty mentor, and an undergraduate peer mentor. In subsequent years, he returned to the program as a peer mentor, a paid position, for a group of first-year students of color. Of his experience of and intentions for participating as a peer mentor, he stated:

> *I noticed how there just aren't that many women to begin with in engineering and it seemed almost like a meaningless struggle to fight against that. At times it's felt that way because it's kind of crazy to look around and see just how many men there are in all of our classes. [Peer mentoring was] really interesting because I feel like a lot of students of color are the ones that tend to feel, especially women and LGBTQ+ students, tend to feel the most ostracized and the least able to access resources. It was really nice to have everyone together so that I and other educators and facilitators could easily tell them everything that they need to know and make them feel like they have some sort of cohesion in ECE because it's really easy to not have that when you're a student of color and LGBTQ+.*

Ariel's experiences in the diversity-oriented program for first-year students was a key motivator for encouraging him to become active in diversity/inclusion efforts. Realizing the issues that he and others like him faced, he returned to the program to mentor

subsequent first-year students with marginalized identities in the same program. Becoming an undergraduate peer mentor was not only fruitful for him personally, but also a way for him to reach out and connect with other students whom he perceived needed a role model in the department. As he stated later, "I felt like being a mentor was my way to encourage freshmen to stick with it and show them that if I can do it given no prior experience to engineering whatsoever before I started, then you can also do it." Ariel's engagement with the program as a peer mentor in his second and third years, in addition to Aiden's position as a teaching assistant, were clear examples of how two LGBTQ+ engineering students resisted dominant forces of marginalization by gaining institutional status in the department. With their status, they were in positions to foster more inclusive environments and communities for younger generations of engineering students.

While both Aiden and Ariel used institutional status to resist the lack of diversity and inclusion in the student body, Ariel provided a richer picture of how he leveraged institutional status as a mechanism of resistance. Ariel's critique of the difficulty for the department to communicate resources to students of color and his motivation to use his leadership abilities to set himself as a role model for other students is a prime example of using his (earned) institutional status to engage in resilient resistance (Solórzano and Bernal, 2001). By enabling access to resources and advising other students, Ariel enabled others to navigate within the institutional system established by the engineering department to survive and be successful in the engineering profession. In addition, he made space for other students to exist and feel comfortable in engineering by setting himself as a role model who "did not know anything about coding….but if I can do it given no prior experience in engineering, then you also can do it." This role modeling exemplified his act of transformational resistance: by gaining institutional status, he directly changed the face of the institution to underrepresented students, particularly the ones he mentored in the first-year program.

Gaining institutional status was one mode of resistance in which creating space and community building could intersect. Ariel, as a peer mentor, could provide access to resources and sources of community for underrepresented engineering students, and Maya, a student who participated in a similar program in her first year and recognized it as a significant part of her undergraduate experience, showcased the effect of peer mentoring as a mechanism of building community. Role modeling, for both Aiden and Ariel, showcased how existence and success as an LGBTQ+ student was possible in engineering, and they actively fostered physical and social spaces in which marginalized students could gain access to resources and knowledge in the department. At the same time, Ariel's institutional status as a peer mentor allowed him to bring new marginalized students into the engineering community and connect them to extant marginalized communities. Peer mentoring has been shown to significantly impact both peer mentors and mentees by creating spaces for peer mentors and mentees through which peer mentors can "give back" and "pay it forward" to the community and mentees can be socialized into the community (Jackson et al., 2013; Trujillo et al., 2015; Wilson et al., 2012). By becoming a peer mentor, Ariel actively influenced the individual experiences of each of his students, the broader communities that his students inhabit, and the institution that

his students were embedded in, thereby creating space for, and building, communities to resist the pressures of a cis-heteronormative, competitive environment.

Despite the power that institutional status afforded LGBTQ+ students to resist from within the institution, gaining institutional status reflected the stability of the institution as a dominant force governing LGBTQ+ engineering students' lives. Both Aiden and Ariel sought to challenge institutional forces by helping to improve other students' experiences in engineering, and both had strong critiques of the structures of inequality in the department; however, as noted above, their approaches required being out and working within the institution to transform it. This places potential barriers for some LGBTQ+ students who may want to resist but do not want to lend legitimacy to a system of oppression or have had too many negative experiences within the institution to want to work within it. In addition, having the positions they had often meant that Aiden and Ariel could be constantly in contact with a large number of people that may have different belief systems from their own, which some students may not be comfortable with. Their positions also often required remaining politically neutral according to university policy, potentially placing limits on the forms and practices of resistance that they could feasibly do. The constraints that came with working for (and therefore within) the institution selected for a specific subset of LGBTQ+ engineering students who were able and willing to work under the auspices of existing structures of oppression.

## 4.4 Communities of Support

While challenging perceptions and gaining institutional status were some ways that LGBTQ+ engineering students resisted the heteronormative engineering climate, the main mechanism of resistance practiced by almost all the focus group participants was building communities of support. Communities of support were groups of students with whom participants surrounded themselves that legitimized their identities and their experiences in engineering and supported them in their engineering endeavors. Participants actively crafted communities of support to improve their experiences in engineering, drawing on a variety of sources, including friends, significant others, and student organizations. Some communities of support were interactional, where students drew from their friend networks for support, while others were part of more formal structures, such as diversity-oriented student organizations and events.

### *4.4.1 Interactional Communities of Support*

Interactional communities of support focused on significant others, friends, and people that LGBTQ+ engineering students encountered in their daily lives. Participants had a wide range of sources for creating interactional communities of support. For example, Ariel and Aiden mentioned that in classes, they often gravitated toward women and people of color, and many of their friends had marginalized identities. Eden mentioned that they mainly associated with LGBTQ+ friends in computer science because they had found more LGBTQ+ peers in that department than the engineering department. Zoe de-

scribed how her roommates were one of her primary on-campus support systems as she transitioned physically and figuratively into the college environment. Maya in particular leveraged the community of support that her significant other afforded her to overcome many of the struggles from a hostile engineering climate:

> *I actually met my boyfriend as a freshman on Reddit…and through him, I found a lot of my friends. He's someone who is very supportive and accepting and knowledgeable about [LGBTQ+ identities], and I found that most of his social circle was also knowledgeable and supportive, all of those positive adjectives. And then from there it was just absorption of other people's friends. I'm not particularly good at making and keeping friends, but being able to have a network that already exists and then making your way among it and picking people out of that is the way that I've really made my way through here.*

Maya's use of her support network was crucial to her navigation through the engineering space. As she noted, her significant other provided both support as well as connections through which she was able to find a community that made her experiences in engineering more tolerable. Compared to her "awful" academic experiences, the communities that she fostered around herself were what drove her to continue in the program. As she stated, "I've made myself comfortable with professors because I've been here so long. I was so nervous my freshman year. I didn't want to talk. Now I'm almost done it's like, eh, whatever. I'll sit here and heckle for all I want to do." By building a community of support around herself, she was able to resist the dominant engineering climate and create spaces in which she felt safe and supported by her peers and faculty.

### *4.4.2 Student Organizations*

Student organizations presented a unique site for resistance and fostering communities of support, as they provided a space for students to network, build relationships with their peers, and motivate various initiatives in engineering. Sam, Ariel, and Maya recognized the need for diversity and inclusion in the engineering profession and wanted to contribute their time and effort to push the field to become more diverse and inclusive, illuminating how they sought to resist in ways that challenged institutional norms. Student organizations provided a space and enabled LGBTQ+ engineering students, particularly those of color, to engage in social justice work and amplify their voices with other like-minded people with similar identities. While the LGBTQ+ engineering students in this study were unlikely to have large-scale impact in the institution, their work with student organizations was an attempt to position themselves in a more collective, student-led narrative calling for more diversity and inclusion efforts in engineering.

Sam, Eden, and Maya participated in the women in engineering organization, often also participating in outreach activities related to women and marginalized identities. Ariel participated in campus-wide student organizations at the university's multicultural center. These experiences often reflected positively on the students and gave them ways

to promote diversity and inclusion causes while creating communities. Of the multicultural center space, Ariel mentioned:

> *I was an officer in one of the organizations [in the multicultural center] and I've been in that space a lot. Almost everybody was LGBTQ+, and almost everybody was a person of color. I think that space was used not only as a place to promote social justice, but also to provide a sanctuary for LGBTQ+ people to just be and not be judged.*

By participating in the multicultural engagement center, Ariel demonstrated how LGBTQ+ engineering students could also engage in broader university and community efforts to resist cultural stigmas around diversity and inclusion. For Maya, student organizations were her safe spaces where she could be visible and find others like her:

> *I get really excited when I'm able to go to rainbow activities because I never had that opportunity. I keep thinking about the other women and Hispanics and my [first-year peer mentoring group] was a [diversity-based first-year group], so I found out about all these [diversity-oriented student organizations] through them. They were all affiliated with that, so you learn about these things because they provide you those resources, but there's nothing equivalent to that [for the LGBTQ+ engineering community].*

Maya illuminated the value and impact that an LGBTQ+ community could have had on her experiences in engineering and how she leveraged her membership in other diversity-oriented student organizations to get similar support and find people who had similar marginalized identities. Later in the focus group, she volunteered to be on the initial forming committee for a new LGBTQ+ engineering student organization at the university. She eventually became the inaugural president of the new LGBTQ+-centered engineering organization, along with several other focus group participants serving as officers.

Student organizations have been well-studied as co-curricular activities in which students gain valuable resources, peer interactions, mentoring, professional development, and other support that the department does not necessarily provide, serving to significantly augment the engineering experience for those who participate in them (Baker, 2008). For students from marginalized backgrounds, diversity-oriented student organizations provide social support, social integration into broader professional cultures, and access to a collective of resources (Guiffrida, 2003; Harper and Quaye, 2007; Lin, 2006; Park and Kim, 2013). These social support systems also contribute to a sense of belonging in the campus culture and a more positive college experience for marginalized people (Montelongo, 2002). Of the nine focus group participants in the study, at least five participated in diversity-oriented student organizations, and several actively sought opportunities to engage in organized resistance as part of their organization's activities. From the authors' [J.A.Y.] personal communications with the participants outside

the study, they were also able to build their own interactional communities of support through peer connections inside and outside the formal boundaries of the student organization. Student organizations, as one of the few components of a college of engineering that celebrates resistance and grassroots student activism, thus can form a key component in enabling significant transformational resistance among students.

The power of LGBTQ+-specific student organizations for LGBTQ+ college students goes beyond social support and increased sense of belonging. As physical, online, and social spaces for LGBTQ+ students to gather, student organizations can significantly impact LGBTQ+ students' meaning-making processes of their institutional environments (Nguyen et al., 2018; Pitcher et al., 2018). Pitcher et al. (2018) described how LGBTQ+ student organizations uniquely served the needs of LGBTQ+ students by providing them a safe, comfortable, nonjudgmental environment to have their voices heard and connecting them with other LGBTQ+ peers. These communities of support were often instrumental in creating uniquely individual and positive experiences for participants within the vicissitudes of college life. Pitcher et al. relate, "if not for the LGBTQ+ student organizations and the connections made there, some LGBTQ+ students may not stay at their institutions and might have left higher education altogether" (2018, p. 124). LGBTQ+ student organizations therefore serve a unique role in shaping the process of meaning-making for individual LGBTQ+ students who participated in the space.

For LGBTQ+ students and (more broadly) students with marginalized identities, the unique ability to foster collective meaning-making enables student organizations to serve as counterspaces for political and organizational resistance (Case and Hunter, 2012; McConnell et al., 2016; Ong et al., 2017; Renn, 2007; Revilla, 2009, 2010; Solórzano et al., 2000; Thomas et al., 2021). Counterspaces are defined by Solórzano et al.: "sites where deficit notions of people of color can be challenged and where a positive collegiate racial climate can be established and maintained" (2000, p. 70). Viewing student organizations as counterspaces illuminates the roles and agencies of LGBTQ+/queer student leaders within student organizations. With additional status in the organization, queer student leaders have additional reach to draw other queer students into the organization and foster queer families within the space, significantly impacting their identity development (Renn and Bilodeau, 2005). Furthermore, queer and LGBTQ+ student leaders have been reported to undergo what Renn (2007) calls an "involvement-identification cycle" in which higher involvement for queer and LGBTQ+ student leaders led to stronger identification with their identities, which led to stronger desire to pursue social change and therefore even higher involvement in the organization. By being active participants in these communities of support, LGBTQ+ student leaders influenced and were influenced by peer interactions, refining their processes of meaning-making for themselves and others. As a result of the collective meaning-making within these counterspaces, they gained deeper understandings of their identities and what social change they desired and were able to enact initiatives for transformational queer resistance (Renn, 2007).

In addition, by providing a unique structure for marginalized students, counterspaces can do more than just provide social support and connection: they can also foster connections between student organizations that legitimize intersectional experiences of

students with multiple marginalized identities and contribute to larger efforts of political activism beyond the microcosm of a single individual or group of individuals (McConnell et al., 2016; Ong et al., 2017). These intersectional collaborations can enable greater modes of truly queer resistance, as issues of race, gender/sexuality, power, privilege, and marginalization are brought to the same table (Cohen, 1997; Crenshaw, 1989). As seen in this study, having an LGBTQ+ engineering student organization at the study site to cater to the unique needs of the LGBTQ+ engineering student population and serve as a counterspace within the heteronormative, white-dominated institution was desired by several of the participants. Indeed, after the focus groups concluded, study participants eventually created an LGBTQ+ engineering organization to focus on serving the needs of the LGBTQ+ engineering student population.

Student organizations could also be hostile, however, to those with multiple marginalized identities, as reported in Yang et al. (2021a). As Maya stated, she felt that she had to prioritize certain identities when she went to various diversity-oriented student organizations, noting that she felt that she had to determine which identities mattered to her most and therefore attend the organizations that matched those identities. She also mentioned how she felt that "if I go to a [women-in-engineering] thing, then it's not really the time to talk about my experience as a Latina," indicating both how she internalized messages of racial erasure in gender settings as well as how her intersectional identity and structural inequalities forced her to negotiate between her identities. Ariel mentioned how he perceived a "tug-of-war" between his identities, where he felt too "nonconforming" to exist in engineering spaces, but too "normal" to exist in the extremely diverse space that was the multicultural center. Not only do these experiences indicate how student organizations could marginalize certain subsets of their target population (Yang et al., 2021a), but they also demonstrate the invisibility and political transience of LGBTQ+ students with multiple marginalized identities in broader social movements (Alimahomed, 2010). Moving from inclusive space to inclusive space without feeling like they really belonged was characteristic of both Maya and Ariel's experience and suggest that LGBTQ+ students with multiple marginalized identities could remain placeless without people who welcomed them on the basis of their multiple marginalized identities (Alimahomed, 2010; Banda and Flowers, 2016).

### 4.5 Intersectional Perspectives

The relationship between resistance techniques, race and gender highlight nuanced intersections of identity, the layers of power and privilege associated with identities, and the inclinations toward certain resistance tactics. Milan and Tenzin, both cisgender white gay men, were able to leverage their comfort with being visible to simply speak up in support of LGBTQ+ issues when necessary or desired, potentially due to their privileged status as cisgender white men. Sam and Maya, both women of color, mentioned that their desire to not be visible in engineering spaces hindered their ability to directly counter homophobia, as they did not want to become "that person" who was ostracized for being "politically correct." This fear of backlash led them to instead use more re-

lational and/or department-sanctioned means of resistance Instead, they primarily used student organizations to find communities of support and gain certain opportunities that were not afforded to them elsewhere. Sam mentioned that she leveraged her participation in local women in engineering student organizations to attend conferences and recruiting events that were specifically geared toward improving the status of women in engineering. Ariel, a man of color, and Aiden, a bisexual man, who both indicated that they "didn't care about what people think of" them but also expressed a desire to be non-visible in engineering spaces, took the approach of gaining status in the department, as either a peer mentor or a teaching assistant. These differential approaches to resistance based on (non)visibility, race/ethnicity, and gender identity highlight how marginalized groups may desire to be less visible than their white counterparts, and more importantly, draw on either institutional status or community to back their resistance efforts. The resistance patterns of students with multiple marginalized identities are still fraught with tensions in ways that those of students with only one marginalized identity are not.

Unlike challenging perceptions and institutional status, communities of support and student organizations were accessible to all participants in the study, making them the most accessible form of resistance. Whereas challenging perceptions rested upon students' individual notions of (non)visibility as well as social status among peers, and gaining institutional status was predicated upon external institutional gatekeepers (e.g., faculty) to give status to select students, interactional and formal communities of support were accessible to all participants. Each indicated that they had at least one friend group in engineering in which they felt welcome, and all participated in at least one student organization: professional (such as the local IEEE chapter), social (such as a board game club), or diversity-oriented (such as the National Society of Black Engineers [NSBE] and Society of Hispanic Professional Engineers [SHPE]). The low barrier to access student organizations allowed participants to join existing spaces as well as craft their own interactional communities of support (friendship groups) as they moved from space to space.

It is also important to note that LGBTQ+ engineering students may use some combination of the techniques, or different techniques from the ones described here. For example, Ariel used his leadership status in student organizations and worked as a peer mentor for first-year marginalized engineering students, illustrating how he leveraged both institutional status and student organizations in his resistance. Similarly, Maya used student organizations to identify potential people who would fit in with her group of friends and build her interactional community of support. Illuminating these multifaceted approaches as well as the intersectional dynamics of resistance also leads to key implications for supporting LGBTQ+ engineering students.

## 4.6 Summary

This study finds that LGBTQ+ engineering students actively, purposefully, and dynamically resist the heteronormativity of the engineering climate, showcasing their personal and political agency and desire to make change in the department. They created space

for themselves and built formal and informal communities of other LGBTQ+ students, allies, friends, and significant others to not just survive in the engineering world, but also contribute to changing the environments that they inhabit to be more diverse and inclusive. As one of the first studies focused on the resistance of marginalized students in engineering education, this study highlights several techniques in which they may resist dominant cultural narratives about them in engineering and seek to reclaim their space in powerful ways. In fact, Revelo and Baber (2017) describe similar resistance processes in Latino/a students, with their study identifying role modeling, community outreach, and collective resistance as the techniques that Latino/a students used to become engineering resistors. This study corroborates their work and suggests that similar techniques are used by students from various marginalized groups to assert their presence in engineering. In addition, the modes of resistance identified by both this study and Revelo and Baber (2017) exemplify how small actions could have large effects within peer circles. As we discuss in the next section, this study highlights the need for, and value of, centering student agency on marginalized students as a primary focus of institutional diversity and inclusion efforts. We provide new directions for research and practice focused on legitimizing student agency and amplifying student voices in institutional policy.

## 5. IMPLICATIONS

The resistance tactics of LGBTQ+ engineering students highlight their agency in engineering spaces to challenge heteronormativity and instigate change. However, these tactics must be legitimized, supported, and validated by researchers, practitioners, and stakeholders in engineering alike. We highlight various ways that researchers, practitioners, and students can and must work together to create a more inclusive engineering education experience for all.

### 5.1 Implications for Research

Research is a significant part of higher education institutions, and it informs much of engineering education practice today. Much of the previous literature on LGBTQ+ engineering students has been exploratory or focused on their marginalization, meaning-making, resilience, and persistence in engineering disciplines, and there are few studies that explicitly focus on the agentic resistance practices that these students enact in their daily lives (Cech and Waidzunas, 2011; Cech and Rothwell, 2018; Hughes, 2017; Linley et al., 2018; Jennings et al., 2020). These resistance practices are often ephemeral and/or embedded within the structures and cultures of the institution, making them difficult to separate from other lived experiences. Our study provides a first in-depth look at LGBTQ+ engineering students' experiences from the perspective of student agency, elucidating intricate, complex practices whose scope and nuances—and impact on them and how they learn in engineering spaces—must be understood further.

More importantly, this paper lays the groundwork for more critical and community-involved work exploring how these students go about being resistors, doing engineer-

ing, and changing the institution. Drawing on Solorzano and Bernal (2001), we provide a starting point from which we can move toward thinking about student empowerment and transformational resistance in unique ways. To this end, the study showcases the need for not only more critical, sociological, feminist, queer, and intersectional perspectives in engineering education, but also the interrogation of current institutional programs and practices that reproduce the marginalization of marginalized students. In addition, we must allow students themselves to write their own narratives of their experiences in engineering education (Secules et al., 2018). This legitimacy of student voices with novel methodologies can drive future research in centering students' experiences as the epistemological root of policies and practice. Recent work by Nicolazzo (2016) employ novel critical approaches to exploring LGBTQ+ engineering students, including new inclusive theoretical frameworks, study designs, and analysis techniques that "work *alongside* participants rather than conducting research *on* or *about* them (emphasis original)" (Bhattacharya, 2008, as cited in Nicolazzo, 2016). These collaborative and emancipatory methodological perspectives offer new directions on how both qualitative and quantitative approaches can be queered to not only capture and understand LGBTQ+ engineering students' experiences but also provide generative spaces for inclusive policy development that also uplift student voices.

## 5.2 Implications for Practice

In addition to research, this work has significant implications for practice. In many cases, inclusive policy development has focused on a "top-down" approach in which faculty, staff, and administrators implement policies that they think will impact students and improve diversity and inclusion in the department. However, these approaches are not always inclusive and can be mired in some of the oppressive cultural logics that they seek to disrupt (Marine and Nicolazzo, 2014; Yang et al., 2021a). By taking student agency to heart, we can envision several novel approaches to inclusive policy. First, engineering education stakeholders must recognize, validate, and uplift the grassroots movements that LGBTQ+ and other marginalized engineering students are already participating in to spark institutional and social change. The political and institutional activism that students can generate beyond the formal policies and structures of the institution can create powerful waves of transformation by challenging dominant elements of engineering culture. Student-driven initiatives and student organization-sponsored events allowed several of the LGBTQ+ focus group participants to participate in empowering acts: Sam and Maya participated in different diversity-oriented engineering student organizations that hosted several events promoting diversity and inclusion throughout the school year, and Ariel participated in events hosted by the multicultural center on campus. These sites for empowerment and empowering acts must be recognized and validated by the institution through visibility and resource allocation. By supporting and providing resources for the activism that marginalized students undertake, and in some cases, already are undertaking, institutional agents validate student voices to catalyze social change from the ground up.

Faculty, advisors, and other staff also play pivotal roles in shaping LGBTQ+ students' daily experiences in STEM. As the primary institutional agents with whom students interact, they can take several steps to improve the campus climate. First, faculty and staff should educate themselves on key issues of diversity, equity, and inclusion that affect their campus. Many college campuses have diversity outreach centers or programs that often craft such programming targeted to their immediate environments. In addition, the American Society of Engineering Education provides nationwide safe zone training workshops and a virtual community of practice focused on LGBTQ+ engineering students. Second, engaging with students on a personal level in informal settings helps establish deeper relationships with students and enables faculty and staff to gain insight into how students navigate their environment and how best to support students' resistance efforts. Third, working with an equity orientation toward meeting students' needs (as opposed to enforcing a bureaucracy of policies) empowers faculty and staff to ensure that each student accesses the resources necessary to succeed in their environment and circumstances. Policies often serve to enforce particular institutional norms and narrow definitions of success, limiting students to particular paths through the university which may not fit with students' personal and career goals. In the case of the LGBTQ+ engineering students in this study, while the students identified many institutional and cultural factors that shaped their marginalization, they were unable to identify clear paths toward transforming existing institutional structures. They appeared to not have access to higher levels of administration and were not able to participate in conversations about diversity and inclusion that occurred at a policy level. As a result, their ability to promote change from within the institution was limited to what they could do either individually or collectively to gain power within the institutional structure. These findings highlight the need for faculty and administrators to make space for students to participate in and contribute to key discussions and decisions about programs and policies. Having a voice at the table enables students to express their concerns and, as a result, more effectively tailor the college of engineering toward their needs. Furthermore, for marginalized students and their allies, having student voices in power at the institutional level affords them crucial space in making policy regarding diversity and inclusion issues, as such policies directly impact them and potentially dictate how they experience engineering. Their unique and potentially critical perspectives as marginalized students in engineering gives them unparalleled insight into what it means to exist in engineering and the effects of current and potential institutional policy on the department, generating important reflexive conversations about institutional practices. When asked about what engineering administrators could do to help improve the experiences of LGBTQ+ engineering students at the study site, focus group participants offered and debated different ways of community-building and whether they would work for the particular department based on their personal experiences. It is obvious that these students already had nuanced ideas about institutional changes that could be made to support them; their ideas just need to be brought to the institutional table. It is not unreasonable for students to approach leadership in their own department to request student membership (or at least input) on important committees. Thus, validating and amplifying student voices

as part of research and institutional practice enables students to become agents in institutional discourses about them, pushing the engineering education institution toward a more student-centered, inclusive site for meaningful dialogue.

## 6. LIMITATIONS AND FUTURE WORK

We acknowledge limitations to this work. First, among the nine people in our study, we do not represent several groups in the LGBTQ+ community, including Black and African American students, indigenous and Native American students, and trans* men. While it may be difficult to recruit these populations due to their small population sizes, future work must consider purposeful recruitment measures to ensure these groups are represented in LGBTQ+ engineering student research. Second, while we use the "LGBTQ+" umbrella term to describe these students, terms such as "LGBTQ" and "queer" remain hotly contested within the LGBTQ+ community. Some people may choose to use different terms to describe themselves and would not have been captured by the study. Future work may seek to complicate and/or explore nuances amongst the various sub-communities under the LGBTQ+ umbrella, such as trans* engineering students or queer people of color, who may have uniquely different and intersectional perspectives as a result of their identities (Jennings et al., 2020). Future research may also explore different mechanisms of resistance, what forms of resistance are available to whom, and what meaning-making practices influence specific avenues of resistance that students may pursue, particularly in light of the intersectional experiences of students with multiple marginalized identities. Third, the focus group participants for this study centered primarily on undergraduate electrical and computer engineering students due to the method of recruitment. Future work should expand the study population across STEM disciplines and may also focus on various differences between graduate and undergraduate students. Fourth, one particular space that was mentioned in the focus groups but not explored in this paper was the unique experiences of LGBTQ+ engineering first-year students transitioning from high school into college. Because a college student's first year can significantly shape their experiences in subsequent years, it is both interesting and necessary to study how LGBTQ+ STEM students navigate the transitional period into college. This transitional period may yield interesting findings related to coming out, developing LGBTQ+ and other identities, navigating different political climates, and/or experiencing new spaces that inform best practices for creating diverse and inclusive first-year experiences in engineering.

## 7. CONCLUSION

The unique position of LGBTQ+ engineering students at the intersection of their LGBTQ+, other personal, and professional engineering lives affords them a distinct conscience from which new theories and narratives of resistance can coalesce. Extending beyond the prevailing literature on meaning-making, resilience, and persistence of marginalized students, we center the active, agentic act of resistance as the counter-

narrative to the hegemonic, dominant narrative of oppression. By employing perspectives from frameworks of queer and transformational resistance to intersectionality theory, we embrace student agency as a core premise of our study and showcase how LGBTQ+ engineering students were able to exert significant influence within their spheres of influence to resist heteronormativity. Taking stock of their individual identities and how they make meaning from their identities, each individual participant in our study resisted in unique ways that reflected how they saw themselves in relation to their identities and their position within their social and institutional contexts. While some resistance tactics were not necessarily "queer" or "transformational" in that participants did not (or were not able to) directly challenge the institution or deconstruct hegemonic, marginalizing cultural norms on a large scale, they were cognizant of the social justice issues endemic in the department and able to transform their immediate social networks and peer interactions into spaces in which their existence was legitimized, connections through which they disseminated and received resources and support, and communities and counterspaces for broader collective sociopolitical activism. Each student was able to impact at least some portion of their peer networks to resist heteronormative narratives, substituting their own counternarratives in their place. They were able to challenge perceptions within their peer groups, gain institutional status as role models for other marginalized students, and craft interactional communities of support through their personal friendship groups. These mechanisms of small-scale resistance reflected the unique, individual ways that the participants made meaning of their identities and their intersections as well as their position within their social networks, creating unique tales of resistance for each individual and a broader argument toward the intersectional nature of truly transformational and queer resistance.

From the perspective of institutions, these resistance mechanisms may often be overlooked because either they occur at such a small scale that it would not be noticed or they occur outside the eyes of the institution (such as weekend study sessions or peer get-togethers). Indeed, some resistance practices served to stabilize institutional values and norms, as some participants leveraged institutional status and resources to resist. However, it is within these grassroots networks that pockets of resistance emerge and coalesce into broader movements for social change. As Cohen (1997) describes, queer resistance cannot be done entirely alone: the most powerful forms of queer resistance come from organized collectives and communities that work together to uplift everyone. LGBTQ+ engineering students found and founded collective communities of support through student organizations, which enabled them to participate in physical and non-physical counterspaces of transformational resistance. These sites of counterspaces and counternarratives enable individuals to combine resistance efforts into larger-scale collective grassroots political action and can be locales for intersectional transformational resistance.

By applying theories of transformational and queer resistance and centering student agency at the heart of our study, we shine a new light on the resistance practices and counternarratives of LGBTQ+ engineering students. LGBTQ+ engineering stu-

dents resisted within their academic and social worlds by creating space for themselves and others and building communities with people who supported and validated their identities. Through challenging perceptions of LGBTQ+ people, gaining institutional status, crafting communities of support, and participating in student organizations, LGBTQ+ engineering students demonstrated significant student agency in crafting their engineering environments to not only survive and exist, but resist and motivate social change. While they did not (or were not) able to cause significant broader institutional change, their resistance practices transformed the various circles that they inhabited and came together in potential counterspaces such as student organizations. From split-second, momentary interactions with peers to large-scale organized activism by groups of student organizations, these forms of resistance and student agency must be acknowledged, validated, and celebrated by engineering researchers, faculty, staff, and administrators in creating new policies and research methods to foster diversity and inclusion in engineering.

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