

Black Faces, White Spaces: Understanding the Role of Counterspaces in the Black Engineering Graduate Student Experience

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So, as a Black woman, I feel as though my support system, you got to seek a support system, but when it's there, it's there for you. Especially the strong Black women around you. Like the little things that [the counterspace] has done for me to help me excel, in order for me to be this person that I am today. I'm forever indebted.

-Charisma

Introduction. Despite an increasing interest in diversity and inclusion in engineering, there has been a stagnant trend in the enrollment of Black graduate students while students from other racial minority groups have shown a steady increase over the last decade [1]. Where it might seem that more studies would seek to understand why this is the case for Black students, a recent review of the literature on broadening participation in engineering and computer science found Black graduate students to be the most understudied demographic [2]. Understanding how Black students transition from undergraduate studies and experience graduate studies in engineering could be particularly insightful in demystifying the enrollment and retention trends. The transition from undergraduate to graduate studies is a difficult adjustment for many students, often involving at least one of many challenges including matriculating to a new institutional culture, moving to and living in a different region, getting acquainted with greater autonomy and having to identify new support structures. These components of the transition have often been accompanied by additional stressors that can cause anxiety, depression, and loss of motivation to pursue higher education.

For this reason, many underrepresented students seek to identify communities, where their marginalized identities can be empowered, often referred to as counterspaces. According to Case and Hunter, counterspaces are “settings which promote positive self-concepts among marginalized individuals (e.g., racial and gender minorities, persons with disabilities, etc.) through challenging the deficit-oriented dominant cultural narratives and representations concerning these individuals” [3]. Counterspaces come in many different forms having explicit connections to the profession (i.e., American Society for Engineering Education (ASEE)), identity (i.e., Black Greek Letter Organizations (BGLOs), or both (i.e., National Society of Black Engineers (NSBE)) [3]. Martin, Revelo, Stefl, Garrett, and Adams investigated the impact of participating in ethnic professional organizations (NSBE and the Society of Hispanic Professional Engineers (SHPE)) at the undergraduate level [4]. However, the focus was solely on engineering related professional organizations and students who attended a predominantly White institution (PWI).

The purpose of this study is to identify counterspaces utilized by Black engineering students and the associated values of engaging in these spaces. This study stems from a larger National Science Foundation (NSF) funded study investigating the role of professional organizations (NSBE and BGLOs) in the success of Black engineering students. Professional organizations

have long served as spaces of support for the Black community. The larger project focused on these two specific types of entities to understand how organizations centered on the professional and civic commitment might differentially support engineers with a shared racial identity. However, there are many different types of spaces that students can engage in for support and community, this study was designed to uncover the various spaces the Black engineering students describe as counterspaces. This work sought to address the following research questions:

RQ1: Through their stories, what are identified as counterspaces for Black students pursuing studies in engineering?

RQ2: Through their stories, how do they describe any differences in those counterspaces in transitioning from the undergraduate level to the graduate level?

Counterspaces Identified. This study, like the larger study, sought to gain a comprehensive understanding of how students utilized counterspaces, beginning with a specific focus on two of the largest and well known counterspaces for Black engineering students – The National Society of Black Engineers (NSBE) and Black Greek Letter Organizations.

NSBE was founded in 1975 and serves as one of the largest student-governed professional societies in the world, having over 17,000 active members across varying professional and academic levels. NSBE’s mission “to increase the number of culturally responsible Black engineers, who excel academically, succeed professionally, and positively impact the community” is recognized through their national programming efforts that focus on strategic retention methods, opportunities for engineering experience and leadership, and purposeful integration within universities and corporate affiliations [5]. Akin to NSBE, Black Greek Letter Organizations were established as safe spaces to raise the Black community, offering a sense of community for Black students pursuing college education at a time when societal norms promoted racism, sexism, and segregation [6]. There are nine Black sororities and fraternities that provide academic, professional, and social support for Black students [6]. From the initial analysis of the data, there were a host of other counterspaces that were utilized during the participants’ journey through engineering, some of which were not originally considered by the

Table 1: Counterspaces Identified via participant experiences

Counterspaces Identified
Black Graduate Engineering Student Society (BGESS)
Black Greek Letter Organization (BGLO)
Black Graduate Student Association (BGSA)
Black Student Association (BSA)
Conferences
Friends/Peers/Roommates
Lab groups/Coworkers
Mentors/Advisors
Minority Engineering Program (MEP)
National Society of Black Engineers (NSBE)
Religious (Church, Faith, Bible study)
Social Media
Therapy/ Counseling
Volunteer Programs

research team prior to the inception of the study. A full list of counterspaces identified in this study can be found in Table 1.

Theoretical Framework. Tinto’s Model of Student Retention suggests the academic and social integration a student is able to establish within their university to be a critical influence on their decision to persist [7]. Stated differently, students who connect to the university through individuals, clubs, or activities are more likely to persist. Experiences fostering academic and social integration can occur formally or informally within and/or outside of the traditional academic environments [8]. Many universities boast a variety of programs, organizations and support structures promoting academic and social integration among their student body; however, often these entities are focused on the undergraduate level and/or fail to prioritize the particular needs of students from underrepresented groups. This model is primarily intended for understanding undergraduate experiences. In this study it will be applied as a lens to understand what students identified as counterspaces as they reflected on both their undergraduate and graduate experiences.

Methods. This study adopted narrative interview methods to capture stories of the lived experience of Black graduate students in engineering. In order to be interviewed for this study, participants had to: (1) identify as Black; (2) be enrolled in a doctoral engineering program at an accredited engineering college; and (3) have engaged in either NSBE and/or BGLOs as an undergraduate student. As an initial recruitment effort, the research team deployed a demographic survey to targeted institutions through networks of Minority Engineering Program advocates and listservs associated with Black engineering organizations. More than 60 Black engineering graduate students completed the demographic survey as a result of the snowball sampling as students shared the study with their own professional networks and peers. A subset of 10 participants were chosen to participate in this study, composed of 5 men and 5 women. The descriptors of the participants and their counterspaces utilized are included in Table 2.

Table 2: Participant demographics

Pseudonym	Gender	Year	Counterspace Utilized	Engineering Major		Institution Type	
				Undergraduate	Graduate	Undergraduate	Graduate
Christian	M	1st	Church, Friendships	Electrical	Electrical	HBCU	HBCU
X	M	2nd	BGLO, BGSA	Mathematics	Industrial	HBCU	PWI
Melody	F	4th	NSBE, BGLO, MEP, BGSA	Nuclear	Bioengineering	HBCU	PWI
Celia	F	1st	NSBE, MEP	Bioengineering	Bioengineering	PWI	PWI
Dani	F	3rd	NSBE, BGLO, MEP, Church, BSA, BGSA	Mechanical	Mechanical	PWI	PWI
Joshua	M	1st	NSBE, BGSA	Chemical	Chemical	PWI	PWI
Tony	M	3rd	NSBE, BGSA, MEP, Student Council	Aerospace	Aerospace	PWI-D*	PWI-D*
Charisma	F	3rd	NSBE, MEP, BGSA	Mechanical	Mechanical	PWI-D*	PWI-D*
Martin	M	1st	NSBE, BGESS	Chemical	Chemical	PWI-D*	PWI
Shasha	F	1st	NSBE, MEP	Mechanical	Mechanical	PWI-D*	PWI**
*PWI serving a large number of underrepresented students							
**Institution located outside of the US							

Data Collection. Interviews were initiated with a prompt to stimulate participants to share their experiences navigating engineering through undergraduate and graduate school. Of specific interest to this study, participants discussed how perceived facets of their identity and

engagement with specific organizations impacted their experience. Following this narration, the interviewers used a semi-structured approach to follow up on specific points based on the stories shared by participants in what is known as the conversation phase. The conversation phase consisted of questions meant to delve deeper into the experiences shared. Interviews were audio-video recorded and transcribed. Interview transcripts were the primary source of data. To analyze the data, deductive codes were created based on the research questions as the first cycle of coding. Among the codes created, one specific code - support systems and impactful interactions with the child codes of counterspaces, mentorship, and personal relationships - was used to conduct pattern coding as second cycle analysis to identify what emerged as counterspaces and associated values in engaging in those spaces.

Positionality. The research team conducting the analysis consisted of two women and one man, all of which identify as Black. All members of the research team attended PWIs for both undergraduate and graduate studies. Because of this, their experiences provided additional insight to the shared experiences of being a Black graduate student in engineering. All interviews in this study were conducted by the graduate students of the research team. Because all parties involved shared similar identities (Black engineers navigating academia), rapport amongst the participants was more easily established and the conversational portion of the interview to be fluid. At least one member of the research team had previously interacted with each counterspace identified in this study, with some of which being utilized within the time period of data analysis. This also provided additional insight in the experiences of the participants in these counterspaces.

Findings. Professional and identity-related spaces were identified prior to the inception of this study, but through the stories of the participants, four salient classifications of counterspaces including familial and wellbeing came forth. It is key to note that many of the counterspaces straddle multiple classifications, affording students many potential benefits through engagement in one entity. This is depicted in Table 3. Within each of these counterspaces a host of values was described by the participants. These values were categorized as: career attainment; personal growth; mental health and wellness; purpose, responsibility, and obligation; agency and identity forming; and belonging and acceptance.

Table 3: A summary of the different counterspaces and the categories they fall under

Counterspaces	Identity	Professional	Familial	Wellbeing
Black Graduate Engineering Student Society (BGESS)	•	•		
Black Greek Letter Organization (BGLO)	•		•	
Black Graduate Student Association (BGSA)	•			
Black Student Association (BSA)	•			
Conferences	•	•		
Friends/Peers/Roommates	•		•	
Lab groups/Coworkers		•		
Mentors/Advisors		•		
Minority Engineering Program (MEP)	•	•	•	
National Society of Black Engineers (NSBE)	•	•	•	
Religious (Church, Faith, Bible study)			•	•
Social Media			•	
Therapy/ Counseling				•
Volunteer Programs	•	•		

Professional. Professional organizations are spaces that are utilized in a manner that supports the development of a professional engineering identity. This support comes in many different forms including but not limited to academic support, leadership opportunities, and networking. In majoritarian contexts, these sorts of organizations are leveraged by students in order to gain opportunities or develop skills to make themselves more marketable; however, professional counterspaces for Black graduate students have the added effect of also affirming their unique identities within engineering, falling under the value category of agency and identity formation. One example of this was provided by Shasha, a first year engineering PhD student studying at a university outside of the US. She began her engineering career at a PWI-D University that supported underrepresented engineering students through their minority engineering program (MEP). During her first year, she became involved with NSBE and eventually became her chapter's president.

So apart from the [MEP] and all the amazing people there NSBE also became a really good part of my time in my undergrad. I joined as a freshman, and I didn't really know a whole lot about the organization, and then my sophomore year, I decided that I would run for a small like committee position, and I just started to really love the organization. The next year, my third year, I became chapter president, which absolutely terrified me, but it was a role that I like grew to love because I really love being able to find ways to make the experience of the fellow people of color and even just the people in general at my university and in my department feel better or more included, or finding ways to just integrate them better.

In two just years, Shasha ascended from first finding out about the organization to being in the highest possible NSBE position at her institution. Though it was a frightening

transition, Shasha overcame her fears while she continuously developed her leadership skills as she moved from general body member, to a member of the executive board, and finally to the president. Leadership positions are great resume boosters, contributing to her overall career attainment; however, the true value for Shasha was the personal growth that was gained through her participation in NSBE. As president she found a sense of purpose and responsibility to her “fellow people of color,” motivating her to bring about changes in the way minorities communicate with the majority.

I realized there were lots of conversations that weren't happening and there were lots of areas where the relationship between the minority students at my school could be improved, and I was able to like actually make waves in doing that when I was serving on like the NSBE board, which was like ... I don't know. It was so rewarding for me.

Spurred by her initial success as a chapter president, Shasha decided to take on more responsibility within the organization, ascending to the regional level. With that, came the same sense of duty to support the NSBE membership though on a much larger scale.

My last year of college, I decided to run for a NSBE regional board position, so I became the [Regional Board member], which was so much fun. It was absolutely so much fun. I got to run or help with the running of 50 chapters in our region, and I got to attend like all the conferences. We were running all the conferences, so planning which events we have and really thinking critically about what will make students get the most out of this experience, and that was honestly just so rewarding, being able to like have such a direct impact on students in such a high-level way.

Shasha's participation in NSBE paid dividends by helping her grow both professionally, via conferences and other resources, and as a person through her time and responsibility as a leader. NSBE played a large role in Shasha's ability to navigate engineering spaces comfortably due to the large support system she had built around herself at her undergraduate institution; however, as she progressed from the undergraduate to the graduate level, she was presented with a challenge of finding a similar counterspace within her professional environment, that supports her in a comparable way.

So, I feel like I haven't been as productive in my PhD research here just because the environment is not that conducive to like, I don't know, me being here. Like people don't talk to me. People act like I'm invisible. Like all this kind of stuff, and I don't have like the support group that I have back home and like ... I think it's all just been like really difficult, and I feel like I could have been a lot more productive in an environment that like had something more similar to what I had back home with NSBE, or cared about race, or something like where they at least like willing to talk about it in a productive way. Like I haven't been able to find it yet here, and

I'm not sure that I will just because the numbers just aren't here, and the culture is just very different and does not want to talk about race like they're very against talking about that because they think they don't have a problem, but they have a big problem.

The transition from undergraduate school to graduate school is a stressful experience for most people and is often intensified being a part of an underrepresented group, due to additional barriers. Shasha's personal experience is further exacerbated because she is attending a school outside of the US. While Shasha was accustomed to having a counterspace in her undergraduate journey, the lack of it has made her transition into graduate school even more difficult. Here, the abrupt removal of this counterspace during her transition put a large cognitive and emotional load on Shasha, affecting her ability to properly integrate both her academic and social identities into her new institution. Moving forward, she hoped to find new ways to be actively involved with NSBE, her well acquainted undergraduate counterspace, through their international programming, in an effort to tap into her past support system and alleviate the pressure of facing a new challenge in a new space alone.

Identity. Identity-related organizations focus on cultivating the specific identity of their members in the appropriate contexts. An identity counterspace within the context of engineering is one where non-majoritarian identities are affirmed, abutting the existing cultural norms of engineering. These counterspaces work to promote connections between members, establish safe spaces for the discussion of controversial viewpoints and create communities that affirm and enhance underrepresented identities. This can lead to elevated levels of agency and identity development as well as a greater sense of belonging and acceptance. It was also found through the stories of these students that these identity-focused organizations will often fulfill multiple classifications of counterspaces just as NSBE ties together a professional and identity related space, being a support system for Black engineering students.

Identity-related counterspaces come through many different channels, and one that emerged as a highly utilized identity counterspace among participants was that of minority engineering programs (MEP). Charisma was a third year engineering PhD student studying at a PWI with a large number of underrepresented students after having attended a similar institution for her undergraduate degree as well. At both institutions the MEP offices provided a counterspace where she was able to express her identity as a Black woman in engineering. At the undergraduate level she described her experience at her institution as being "very diverse". Because of the nature of the minority engineering program, Charisma never "felt as though [her] identity as a Black woman really hindered [her] from doing anything" even though she was still a clear minority based on classroom demographics. Looking around one of her classes, she sees very few other students that look like her, though for the four or five Black women present she attributes to the that of the MEP, stating "*if it wasn't for [MEP], we wouldn't be here*". In a class of over 200 people, being one of four people representing an identity can be a challenging and isolating feeling. Having the MEP as a place where Black students can congregate becomes a

vital factor in validating their non-majoritarian identities within the space of engineering. When Charisma transitioned to her graduate institution, the MEP is one of the first spaces that she chose to interact with, based on her experiences with her undergraduate institution. The representation of Black women through the graduate MEP office instilled in her a sense of pride to be a Black woman in engineering in pursuit of a PhD, and gave her a plethora of great role models and supporters who shared aspects of her identity in spite of not having many shared identity peers in the PhD program.

My biggest support system is the [Graduate MEP] office, and that started when I got to [Graduate PWI-D] and we put out a document to recruit at NSBE and the [MEP] office coordinates it. That started to get me going to the [MEP] office, because the [MEP] office brings us to NSBE every year through the [College of Engineering], but the people there are just amazing. Like [Dr. Luis Patton], [Dr. Alice], [Ms. Mable]. Like all three of them. You got [Dr. Luis Patton], she got her degree, and now she's the director of [MEP], but she is [an inspiration], you see, I aspire to be like you. Now I see it's possible. And she recently gave a talk to us about don't let your setback be your set up. And she talked about all the things that set her back in life, but now she's here, and she's thriving. So, don't be afraid to overcome those burdens and those challenges, so Dr. [Luis Patton], she was an instrumental part in me being a Black woman in engineering. And Dr. [Alice], she was our, well she still is the BGSA advisor. She was our advisor at the time, but she has a psych degree, but she got her doctorate recently. She did it doing full-time. But that was an integral part of me, like it's just inspiration. You see all these wonderful Black women doing great things. Then [Ms. Mabel], she's always there for you. That's like your mama. She's there. I've cried in her office but having this support system outside of my labs and stuff like that, having the support system makes you feel as though, that you can do it. I feel as though I have a family that no matter what, where I'm at, they want me to win.

The MEP office served as Charisma's "home away from home" and gave her the support that she needed to bolster her social identity within a space not traditionally accepting of non-majoritarian identities. This counterspace recognized and empowered Charisma, solidifying her confidence as a Black woman in engineering. This allowed her to not only internalize her own identity within that space, but also reach out and give back to her community. As she progressed within her PhD program, her research interests shifted to that of engineering education, because of her obligation to give back, instilled in her through her interaction with so many powerful Black women. She fulfilled this by working as a teacher for a summer engineering program for high school students.

We had four teams this year, so it was three pathways, four teams each, four people on each team, so I had 16 kids. I was scared. Like, I was scared. I don't think they knew that. I just know that they knew that I was a laid-back teacher, and everything

like that. I just didn't realize the impact I made on them. They always used to call me the best pathway. And so, it worked out pretty well, but at the end. They were like, "Charisma, we ain't had a Black woman in four years. We never had a Black woman in four years, so can you do [the summer program]?" I was like, "Geez, this is a lot of pressure." But I mean, they wouldn't steer me wrong, because it was through the [MEP] office. They would not steer me wrong, so I trusted that. And so, I did [the summer program], and I was a Black woman who did it. So, I had kids, and they had a lot of young Black ladies there, too. And some of them latched onto me, and they acknowledged me. And they really enjoyed me as just being a Black woman.

Charisma's experience with counterspaces came full circle as she now feels the sense of purpose to be the role model that she had. The support offered by identity-related counterspaces is unique in the range of values that are possible. Here we see Charisma benefitted from enhanced identity formation, belonging and acceptance, and career attainment from her interaction with the MEP in both her undergraduate and graduate experiences.

Familial. One of the greatest needs expressed in the stories of the Black engineering graduate students was the presence of a community to be a steadfast anchor of support in critical times. These stories revealed that many students consider these communities as having similar properties to a family and therefore interact with them as such. Often not affiliated with engineering, these spaces create a home away from home feeling, allowing students spaces for vulnerability and a way to unwind as one would in comfortable and familiar settings. These communities become vital to maintaining the students' motivation and drive as they navigate the rigors of graduate engineering programs. From these types of counterspaces, students can glean a heightened sense of community that helps to affirm both their social and academic identities by providing motivation, stress management and a sense of belonging

For Melody, a fourth year engineering PhD student studying at a PWI, her counterspaces allowed her to have a family wherever she was. During her sophomore year, she became a member of a BGLO, and found another family that motivated her throughout her engineering studies. She describes her experience in a BGLO during her undergraduate studies as something she could rely on wherever she is, with widespread, lifelong membership.

I didn't even think about that being a connection, but it's definitely helped me make connections in not only engineering, but it provides me a family no matter where I go. I can go to China, and I'm sure I would meet a soror. I might see, somebody has a lanyard, and it just makes you feel comfortable being in that space. It's definitely helpful taking my mind off of schoolwork, providing me with a family that checks on me, that is worried, or concerned with my well-being, making sure I'm good. If I'm gonna be here for Christmas, come on to the house, sis. It gives me

that, so it's provided me, no matter if it's engineering, STEM, and I think that's something that you don't realize before you're initiated, where it's like there's so many people across the country, where it's like that you could be connected with, that could help you be elevated professionally, personally, spiritually, whatever the case may be, but there are a lot of sorors who are in STEM, and that's then ... it's very empowering.

Melody's membership in a BGLO affords her a built-in counterspace anywhere she goes. This contributes to the belonging and acceptance that are afforded through her participation in this counterspace. However, familial counterspaces can come in a myriad of forms such as roommates, church groups, and even social media groups, if used regularly. Depending on the environment built around them, some NSBE chapters and MEPs serve as familial counterspaces as well. While completing her studies at her undergraduate institution, a close friend of Melody's, who also was her roommate and a fellow member of the MEP, fell ill, spurring her to take action.

I started a GoFundMe account for her, which raised tons of money, so I think a lot of the community service aspects, or the giving back aspects, that definitely helped push me through a challenging program.

In an attempt to protect a vital part of her familial counterspace, Melody achieved a greater sense of purpose and an opportunity to give back once again to one of the support systems that have helped her navigate her degree program. Familial counterspaces are a valuable and encouraging community away from the pressures of engineering that also offer opportunities for increased agency development through a heightened sense of purpose, as was the case for Melody.

Wellbeing:

The final classification of counterspace explicitly targets the physical and mental wellbeing of the participants. Wellbeing counterspaces focus more on providing the emotional, and sometimes spiritual support necessary to maintain good mental health as these students navigate these traditionally extremely stressful environments.

Dani's experience with counterspaces provided her with an outlet to engage with her spirituality and mental health. She was a third year engineering PhD at a PWI who also did her undergraduate studies at a PWI. She is also a member of a BGLO. She was highly involved in her BGLO as well as with NSBE but counterspaces that focused on her spirituality and mental health helped her cope with the tough times she experienced while she navigated engineering. She describes her Bible study at her undergraduate institution as:

The InterVarsity Black Student Movement is a nationwide Bible study type of thing and it's on a lot of different campuses. And they divide it up with different cultures, so there's like an international student one. And then, there's one for Black students and I think there's probably one for Hispanic students. Yeah. So, I was part of the

Black one and I went to conferences with them and I really enjoyed that, because it was nice to be around... It was nice to have conversation, like deeper conversation about the Bible other than like, "These are songs in Sunday school that you hear of." And it just was like a more intellectual type of conversation, so I really liked that in my Bible study.

Dani had to move closer to home over the course of her undergraduate journey, causing her to transfer schools. Because of this, Dani chose to turn to her faith to bring her comfort during tough times navigating her undergraduate degree because of the peace of mind offered via personal connections, a sense of community and stimulating conversation.

When she transitioned into graduate school, one factor in her choice of school was based on the fact that there is no Greek life on campus. Having dedicated so much time to it at both of her undergraduate institutions, Dani chose to rely on other types of counterspaces in order to fulfill her need for support:

I would say Bible study is helpful. Oh, I joined church and church has connect group, which is like small groups. So, I do small groups and get some support from that. So, I think my support comes from Bible study and church small group and my therapy.

Dani experienced the loss of her father during graduate school and the support from her advisor and therapy provided her with support and the mental breaks she needed to cope with this tragic experience. Wellbeing counterspaces offer a myriad of values that can help to strengthen

Discussion

The various counterspaces described in the findings all have explicit and/or implicit values that have been acknowledged through the stories of the participants. For example, engagement with a MEP explicitly provides academic support but students also went there to receive emotional support during challenging and critical events. This work parallels similar findings that Ong et al. present in their work regarding women of color in STEM and their interaction with counterspaces [9]. These values are described in further detail in this discussion.

Career attainment

Career attainment encompasses the opportunities and support that students receive in regard to their realization of career goals. In their work surrounding counterspaces, Ong et al. describe that mentorship within counterspaces has provided students with personal advice towards navigating their STEM programs and given them insight towards future career goals [9]. Mentorship and advising was often provided through MEPs but students have also found these with their

graduate faculty advisors, through their BGLO affiliation, and other interactions stemming from engineering or identity related activities such as conferences. Furthermore, the participants of this study gained professional development skills and opportunities at the undergraduate level to explore internships, co-ops, international studies, and research experiences. Transitioning into the graduate program, they were able to gain exposure and access to graduate fellowships such as the National GEM Consortium (GEM) and the National Science Foundation Graduate Research Fellowship Program (NSF GRFP).

Mental health and wellness

Mental health is a growing concern for undergraduate and graduate students across all disciplines; underrepresented students in engineering are disproportionately impacted by mental health challenges in pursuit or as a result of their studies. There remains a stigma around mental health that limits its acknowledgment and willingness for it to be addressed and discussed among engineering. Smith defines racial battle fatigue as a response to the distressing mental conditions that result from facing racism daily. They suggest that racialized experiences that stimulate racial battle fatigue come with symptoms such as frustration, shock, anxiety and helplessness [10]. The counterspaces that participants described were resources they used to cope and manage the aforementioned symptoms. These counterspaces enhanced their willingness to persist in their programs during instances when they lacked motivation through providing a space that allowed them to vent, or express frustration. Students described going to therapy or counseling through their institutions. Church-affiliated engagement in counterspaces, such as Bible studies and student spirituality groups were commonly articulated across the stories indicating its importance for Black students to have available to them. It is keen that Black students identify therapy, counseling, church, or faith-based environments as counterspaces. When Black students are faced with mental health and wellness challenges, their healing process requires internal commitment and external support [11].

Personal growth, responsibility, and obligation

[NSBE] helped me so much in how to have tough conversations, how to let people know that they're letting me down, and [a variety of skills] I specifically learned through NSBE that if I wasn't involved in NSBE, I would have had to learn in graduate school somehow.

- Shasha

The participants attributed much of their engineering success to the counterspaces they utilized. From this, they sought a heightened involvement within their counterspaces that promoted a sense of responsibility and obligation. The participants recognized the impact counterspaces such as NSBE had on their experience and wanted to ensure that they counterspaces were sustainable. Hunter suggests that Black students feel the need to 'represent' and improve the conditions of

their environment to make things better for those that come after them. They describe that for Black students responsibility is not a barrier, but something that increases a student's purpose and motivation [12]. They expressed this through attaining leadership, mentoring roles, and volunteering on behalf of their utilized counterspaces. Ong similarly found that counterspaces offered women of color in STEM opportunities to take on leadership and avenues to apply discipline-based knowledge to real-world problems and community outreach [9]. The skills attributed to these enhanced roles in the counterspaces promote personal growth through soft skill development, confidence building, and leadership skills.

Agency and identity forming

Counterspaces that celebrated the participant's identity such as BGLOs and identity-oriented conferences gave students a sense of pride. Given that it is a majority white male dominated space, engineering can create an isolating environment for Black students, which Long and Meija assert "may damage students' self-esteem, ethnic identity, and ability to tackle societal problems" [13]. These spaces address these deficits by affirming their racial identity in spaces and allowed them to network and interact with people with shared experience, helping them to take pride in their chosen identities. As Dani describes, "You can't mess with me anymore. I'm a [BGLO member]. That means something." Ong et al. describe the impact of diversity conferences as connecting a large concentration of women in color through their similar experiences in STEM education [9]. A similar phenomenon can be seen with Black students and their attendance to the NSBE National Convention. Many students described their first NSBE conferences as exciting, as they were elated to see so many Black students in engineering under one roof. Melody, who went to her first NSBE conference after recently becoming a member of her BGLO stated, "being able to see all that greatness in one room was just so amazing". Members in BGLOs like Melody were excited to wear their organization's letters or to interact with other members from other institutions and spaces during identity-oriented conferences. Ong recognized this value can be supported by institutions via offering social events that celebrate diversity and highlighting women of color in faculty or leadership roles [9].

Belonging and acceptance

Counterspaces provide an avenue for Black students navigating engineering programs to mitigate their feelings of isolation stemming from often being the only Black representatives in their academic fields. The participants sought counterspaces to feel inclusivity among like-minded peers at their respective institution. This notion is supported through Case and Hunter's explanation that students experience a sense of belonging when their needs are connected to needs of a larger group and serves as a main tenet of counterspaces [12]. Additionally, Ong explains that microaggressions intensify the sense of isolation for marginalized groups in STEM [9]. All the counterspaces of this study effectively provided the participants with a sense of belonging and acceptance.

Limitations

The findings of this qualitative study are not intended to be generalizable for all Black engineering students given the small sample size though it adds to the depth of the data. This study sought to identify counterspaces and uncover their perceived values as described through the stories of Black graduate engineering students, allowing the research team to delve into the richness of the participants stories. Additionally, the counterspaces and values described by this study are not the only options available. In spite of the limitations, this study adds to our understanding of how Black engineering students identify and participate in counterspaces.

Conclusion, Implications and Future Work

The purpose of this study was to identify utilized counterspaces of Black engineering students and their perceived values. There were four salient categories of counterspaces each fostering a variety of values for these students. The findings of this study contribute to the current research around counterspaces applying an added context to Black engineering students. Counterspaces are a necessary entity to for Black engineering students to feel supported and connected to their institutions. Ong suggests counterspaces can be physical, conceptual or ideological settings and that by having counterspaces in close proximity to the power structures of STEM, engineering programs can “set the tone for what kinds of social behaviors are encouraged and tolerated in classrooms, laboratories and other social space” [9]. This work sheds light upon thinking about the transition for Black students in engineering and that they do not have continuity at the graduate level with regards to identifying counterspaces. This leaves students to have to identify new spaces in real time while adjusting to the new demands of graduate school. Additionally, there is a salient theme of mental health and wellness being an area of concern for Black students in engineering. While counterspaces provide avenues for Black students to express their wellness concerns there is an opportunity for institutions to rise to the call as well. These issues will be further explored in future work of the larger study.

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