”Everybody Gotta Eat” and Insights on Leadership and Resilient Identity from Black Engineers

Dr. Katreena Thomas, Clemson University

Katreena Thomas currently serves as a postdoctoral researcher at Clemson University through the American Society for Engineering Education (ASEE) eFellows postdoctoral fellowship. She received her Ph.D. from Arizona State University in Engineering Education Systems Design. During her doctoral education, she was a member of the Coley Shifting Perceptions, Attitudes, and Cultures in Engineering (SPACE) Lab research group. She also served as the Diversity, Equity, and Inclusion Intern for the Journal of Engineering Education. Her research interests include broadening participation in engineering, engineering leadership, and marginalized student experiences in engineering. Her dissertation explored the experiences of early-career Black engineers in leadership. She received her B.S. in Industrial Engineering from the University of Pittsburgh and her M.S. in Human Systems Engineering from Arizona State University. Before starting her graduate studies, she worked in the tech industry in the operations field. Katreena is committed to justice, equity, diversity, and inclusivity and hopes that her work will impact the culture and environment of the engineering education ecosystem.

Dr. Brooke Charae Coley, Massachusetts Institute of Technology

Brooke Coley, PhD is an Assistant Professor in Engineering at the Polytechnic School of the Ira A. Fulton Schools of Engineering at Arizona State University. Dr. Coley is Principal Investigator of the Shifting Perceptions, Attitudes and Cultures in Engine

"Everybody Gotta Eat" and Insights on Leadership and Resilient Identity from Black Engineers

"If your success is defined as being well-adjusted to injustice and well-adapted to indifference, then we don't want successful leaders. We want great leaders who love the people enough and respect the people enough to be unbought, unbound, unafraid, and unintimidated to tell the truth." – Dr. Cornel West

Introduction

Leadership is a highly sought-after skill and experiential opportunity for engineering students and professionals. Engineering leadership research has explored how engineering incorporates and conceptualizes leadership in engineering professional and educational settings. For example, engineering leadership research has explored the definitions of what engineering leadership is [1], [2]; the skills involved in engineering leadership [3]–[5]; and practices to support engagement in engineering leadership [6]–[11]. While there are studies that explore how engineering leadership is conceptualized, there is a lack of research that incorporates the impact and influence of marginalized voices in engineering leadership. The muting of marginalized voices in engineering leadership ignores the experiences and contributions that marginalized groups add to the leadership conversation in engineering. Marginalized groups, such as Black engineers, bring new insights to leadership studies related to their identities in navigating the space. This study aims to center the authentic voices and experiences of early-career Black engineers engaged in leadership. The research question guiding this study is: How do early-career Black engineers leverage Black language in the meaning-making of their leadership experiences?

Background

Black engineers experience unique challenges in pursuit of engineering as a career path. These challenges are further exacerbated when considering the influence of leadership for Black engineers. One challenge that Black engineers face is related to visibility. Several studies have explored the experiences of invisibility and hypervisibility that Black engineers face during their professional journey [12], [13]. From an invisibility standpoint, many Black engineers are in professional and educational environments where they are the only Black person. Their "only" status creates situations where they feel drowned out by the majority group. In these situations, Black engineers feel unheard and ignored in their attempts to engage with their engineering environment [14]. On the opposite end of this visibility spectrum, Black engineers have also described feelings of hypervisibility in which they are the center of attention, flagged or highlighted in ways that make them stand out from the majority group. McGee et al. [15] present an example where Black students' achievements are questioned despite being earned from their own merits. Black engineers in leadership positions face additional trials in these scenarios of visibility, such as garnering respect, representing their entire race, and extra labor without consideration or compensation for their roles and duties [16], [17].

Language is often used as a tool for shaping identity in STEM fields [18]. For Black people, the use of language is also used as an identity-shaping device that connects us with our

ancestry, community, culture, and identity [19], [20]. It has also served as a strategy for Black people navigating predominantly white spaces. McGee [21], [22] has often described tactics such as code-switching and *frontin'* that Black engineers use to protect themselves from threats to their identity. As McGee explained, frontin' is "the performance of acts that are socially acceptable to the dominant culture but demand the sacrifice of aspects of one's racial, cultural, and/or ethnic identity [22]."

Consequently, these strategies can silence and diminish their cultural identity in a majority space. In such scenarios, Black engineers are subjected to additional stressors in their engineering journey that disengages them from the field. For Black engineering leaders, their outsider-within identity [23] is more prominent with the additional attention that is emphasized due to their leadership role. With an outsider-within identity, Black engineers navigate being in an engineering environment but do not fully fit into it, thus influencing aspects of their experience, such as a sense of belonging [23]. As such, their experiences and how they describe those experiences in leadership shed light on new strategies and considerations that can be leveraged as the engineering field prepares the next generation of engineering leaders, including leaders with marginalized identities. As Ortiz describes in their work, "Black language helps to create a reality and existence that is affirming [20]." The emphasis on Black language in this study aims to reimagine engineering leadership that is affirming and authentic to Black engineers. This work intends to embrace Black language in a scholarly presentation to center early-career Black engineers' marginalized voice in engineering leadership scholarship.

Framework

This work utilizes Esteban-Guitart's [24]–[26] funds of identity concept to recognize language as an identity-shaping tool. Esteban-Guitart posits that funds of identity "allows us to describe the knowledge, skills, talents, and the ways of being that are embedded in the everyday practices of a community and rooted in macrocultural factors [24]". These specific funds of identity have been categorized as practical (related to activity such as work), social (related to significant others), geographical (related to geographical and locational territories and communities), institutional (related to social institutions such as family, religious practice, or professional field) and cultural (related to artifacts like flags or anthems) funds. With the typology of funds of identity, this concept is also considered as a "set of tools" that consist of "symbolic devices" used in the identity-shaping process. For this study, the funds of identity framework is used to demonstrate how different types of funds are conceptualized in the experiences of early-career Black engineers through the telling of the stories and the specific use of phrases and colloquialisms as cultural artifacts. The lens of funds of identity in this study allows for the exploration of leadership identity and engineering identity as related to Black engineers' cultural identity. Leadership and engineering serve as professional identities that are closely related to practical and institutional funds of identity, where this group's Black identity influences social and cultural funds of identity.

Additionally, this work utilizes Ross et al.'s [27] lens regarding resilient identities. In their work, Ross et al. [27] considered how Black women in the engineering industry develop and experience their identities. The researchers describe resilient identity as "a consistent view of

oneself in spite of contexts that threaten the congruency of those multiple identities." Additionally, Ross et al. [27] explained the importance and role of "reaffirming structures," such as minority engineering programs (MEPs) and engineering ethnic professional organizations such as the National Society of Black Engineers (NSBE). Through engagement in these spaces, Black women in the engineering industry were able to "reauthor" what engineering meant to include space for their marginalized identities in the field [27]. This reauthoring provided them with a space that protected them from harmful identity threats, such as bias and isolation, that can damage their experiences in engineering. The lens of resilient identities is utilized in this study to capture how early-career Black engineers describe their leadership experiences and "reauthor" how they conceptualize and navigate engineering leadership that is authentic to themselves.

Methods

This study was guided by the following research question: How do early career Black engineers leverage Black language in the meaning-making of their leadership experiences? This work stems from previous studies exploring Black engineers' experiences and leadership utilizing narrative inquiry methodologies.

Positionality (First-author)

I identify as an early-career Black woman in engineering engaged in engineering education scholarly activity. My experiences navigating engineering and leadership have shaped my motivation for pursuing this work and provided me with an "insider" perspective concerning the group I am investigating [23]. However, due to my multiple marginalized identities in engineering, the population I am researching, and I have "outsiders-within" perspectives to the field [23]. Therefore, I approach this work with a constructivist lens with the intent to expand engineering leadership knowledge with a critical focus and attention to Black engineers' experiences. I acknowledge my bias in this work and that my positionality in this study cannot be easily removed [28]. However, my unique vantage is a strength and resource in engaging with a population that is often invisible and unheard in engineering education. In leveraging this strength, my goal as an engineering education researcher is to amplify the voices of those historically unheard and inform my research community of how to support a high-quality experience in navigating engineering and engineering education.

Participants (Study Leaders)

In this study, the participants will be referred to as Study Leaders. This title emphasizes their active participation in the co-construction of knowledge throughout the study. To participate in the study, the Study Leader had to; 1) Identify as Black, 2) Serve or previously served in a leadership role in their professional journey, 3) Have early-career status, which is operationalized as being in their final year of completing their engineering bachelor's degree, currently enrolled in graduate school, or within five years of receiving their most recent engineering degree. Recruitment efforts were primarily through connecting with the National Society of Black Engineers (NSBE). Eligible Study Leaders were invited to participate in the

study through interviews and were offered $50 Amazon gift cards for their participation. The demographic information for the Study Leaders is included in Table 1.

Table 1: Study Leader Demographics

Pseudonym	Engineering Background	Current Professional Level	Key Leadership Experience	Gender
Killua	Mechanical	Graduate Student	Peer Mentor	Male
Dad	Mechanical	Early Career & Graduate Student	Organization President	Male
Jae	Civil	Early Career	Management	Female
Gabrielle	Chemical	Early Career & Graduate Student	NSBE Leadership	Female
Jesica	Industrial	5th Year Undergraduate	NSBE Leadership	Femme Presenting

Data Collection and Analysis

The study leaders participated in semi-structured interviews that focused on their leadership experiences, identity, and perceptions of leadership. The semi-structured interviews allowed the interviewer and the Study Leaders to develop a rapport surrounding their shared racial, professional, and career identities. Due to their rapport, the Study Leaders naturally used Black language in the interviews, thus allowing the researcher to capture their authentic perspectives. The interviews were between 60 – 90 minutes long and were conducted and recorded via Zoom. The audio was transcribed using the Otter.ai transcription service.

The analysis was a multistep process with memoing techniques employed throughout. First, the researcher listened to each of the interviews to capture descriptive details of the Study Leaders and key elements of their stories. Following this, the researcher read each transcript, building upon the elements noted from listening to the interviews. After this, the researcher developed a reflexive memo from each transcript where they asked themselves prompts that helped them connect with stories as both the researcher and a member of the population. The notes and memos from the steps mentioned earlier served as a basis for developing a codebook. The final codebook for this study included the researchers' inductive codes from their memos and deductive codes developed from the five categories of funds of identity. The coding process was conducted using the Dedoose qualitative analysis program. One round of coding consisted of open coding [29] to capture the initial themes presented in the data. A second round of in vivo coding was conducted to capture specific quotes in which the Study Leaders used Black language in their descriptions. After this round of coding, the codes were exported into one file where the researcher then pattern-coded the reduced data into the themes presented in the findings.

Limitations

While this study captures the unique experiences and perspectives of engineering leadership from a historically unheard group, it is not without its limitations. One particular limitation is the small number of participants (Study Leaders). Black experiences are not monolithic, and this work is not aimed at making claims representative of a larger demographic. Additionally, this study does not aim to compare differences of experience delineated across different racial backgrounds. The experiences described in this work reflect a single researcher's interpretation and a small representation of Black engineering leaders. Despite these limitations, this work aims to present an authentic depiction of what Black engineers typically encounter in their leadership pursuits.

Findings

The stories of the Study Leaders illustrate unique insight into the experiences of early-career Black engineers in leadership positions. During their interviews, the Study Leaders' use of Black language allowed them to emphasize aspects of their stories and reflect on the impact that their experience has made on their engagement with engineering and leadership. The Study Leaders' expressions allowed for a deeper understanding of their perceptions of engineering leadership and their identities within it. In this section, instances of Black language have been emphasized in bold font in the Study Leaders' quotes. Throughout their leadership pursuits, the Study Leaders encountered moments stemming from their cultural and professional identities that challenged or enhanced their experience as leaders. The themes that emerged from these stories and experiences are summarized as 1) it takes a village, 2) the struggle is real, and 3) protecting your peace. These findings are presented and discussed using popular and common phrases used in Black language to preserve the continuity of their experiences to the greater relevancy of Black culture. While several of these phrases are spoken colloquially across cultures, their origins stem from Black language. For the Study Leaders, their Blackness and other personal identities influenced their engagement in engineering and leadership in a multitude of ways.

It takes a village:

The concept of it takes a village stems from the African proverb, "It takes a village to raise a child." The sentiment here is that leadership is community-driven. The motivation of the Study Leaders who volunteered to be in their leadership roles stemmed from a need to support their community. The opportunity to serve their community provided the Study Leaders with a chance to engage with leadership when they may not have otherwise considered engaging in that specific role. Dad captured this drive for community-centered leadership in his quote, "Everybody gotta eat." Dad, who holds both Black and Latino identities, was explaining how when he started working at his engineering company, they did not have an affinity group for Latinx groups, so he took it upon himself to create one. He noticed that there were other groups at the site that catered to other identities, and he acknowledged that the Black affinity group was on a "resurgence where they were like a group that kinda been quiet, not really making a bunch

of noise, to a whole bunch of people coming in and, you know, taking roles and responsibilities and stuff like." But when he saw that there was nothing for Latino groups, he knew he needed to take action. Dad went on to say

> like **everybody got to eat, basically.** So that was, that was my inspiration of founding [LATINX AFFINITY GROUP] because I saw that one of the groups that I heavily identified with was doing well, was doing alright, and another one wasn't, so I wanted to balance that out (…) because this is part of my identity as well (…) you have people that try to push you on one bucket when that's not who you are and that that would dilute your personality.

Like Dad, the Study Leaders' motivation for pursuing leadership was in response to a cultural responsibility to their community and recognizing that their communities are often underserved and underrecognized in engineering environments. This motivation for leadership is connected to leveraging their cultural and social funds of identity. Cultural responsibility is a facet of leadership that the Study Leaders have leaned upon when pursuing and persisting in leadership roles and capacities. The National Society of Black Engineers (NSBE) and other identity-serving engineering programs, such as engineering diversity offices and MEPs, have served as foundational organizations for the engagement of many Study Leaders in leadership. NSBE, whose mission is "t*o increase the number of* ***culturally responsible Black engineers****, who excel academically, succeed professionally, and* ***positively impact the community"*** [30]**,** and identity-centered organizations have been the villages that the Study Leaders have leaned on and leaned into for support throughout their engineering and leadership journeys. These groups, also called counterspaces [31]–[33], have provided the Study Leaders with a familial setting where they can safely pursue leadership and engineering while supporting growth and achievement within these environments. Jesica, who was the NSBE President for her collegiate chapter, described her experience with NSBE and the MEP at her institution as:

> That's **kind of like my family** as far as like base because that's where I met a lot of people. So that's like where I have my mentors, where I can get the academic help in class I need, and just talking to somebody when you're crying about quitting or you know, like, I think that's just a space that I really enjoy. And I've been a part of more heavily since my sophomore year. And I really, really, really, really enjoy [MEP] because it's **kind of like a family**.

Like Jesica, Gabrielle was heavily involved with NSBE and explained that "NSBE was pivotal for me, and still is considering the fact that I'm still involved almost a decade later. Not only was it a community for me, but it showed me that there was more." For Gabrielle, part of the "more" that NSBE showed her included ways to support her community through leadership. She explained that her motivation for running for higher levels of NSBE leadership came from asking herself questions such as, "Then how do I get more involved in this organization that I care so much about?" For the Study Leaders, care is a reciprocal process. Their village provided them with a pool of culturally and socially relevant resources from their funds of identity that supported their well-being when the whole of their engineering environment may have ignored it. So, in return, they showed their care for their village by helming leadership roles and

responsibilities. Through their leadership, the Study Leaders wanted to ensure that "everybody got to eat."

The struggle is real

The idiom "the struggle is real," which has roots in hip-hop and rap music has been popularized to describe how specific stages and situations that people encounter in life can be complex and challenging. For the Study Leaders, navigating engineering with a marginalized identity already has its own set of struggles. These struggles were further intensified when leadership was added to the equation. The early-career status of the Study Leaders often meant that they were experiencing new situations and challenges for the first time while also transitioning into a new environment and role. In these cases, they were still developing their pool of resources around their practical and even institutional funds of identity related to their professional engineering identity. Much of their experiences were gained through trial and error. For Jae, one challenge that she encountered was trying to garner respect from the team she was leading. She described how the team she worked with were "**quick to jump down your throat"** when she was trying to explain something. Jae described how they would try to talk over her and deny what she was saying, and while she speculated that this "abrasive" response from her team was because of her identity, she could not pinpoint which one: race, gender, or age. She described adapting the abrasiveness **"on the fly"** to find a way to communicate with the team that **"caters to their ego.**" Jae and the other Study Leaders all had these "struggle" periods when trying to find their way around their professional engineering settings. While struggle is not uncommon in engineering, many of the Study Leaders did not have the same level of access to support and community as they did in their undergraduate experience to help them through this struggle. Essentially there was a dip in their institutional funds of identity that they had to find ways to replenish in their new role. Dad, who often described his first experiences with his company as being **"thrown into the fucking fire"** and **"thrown to the fucking wolves,**" expressed this sensation that many of the Study Leaders felt in terms of struggling to navigate a new environment and role with little support. Considering that much of their experiences with leadership had been community-driven, the professional and educational engineering environments they have worked and learned in placed prevalence on a business need or competitiveness over community-building. This added intensity to the Study Leaders' struggles navigating engineering leadership. Jae explained,

> Starting, it just **felt like everyone was like 60 feet away**, and you didn't really know much about anything, like you don't really get a," Hey! This is how this operates. This is how you do anything." It's just kind of like, "Oh, hey… start."

Killua also reflected on this attitude that was surrounding him where, as a Black person, support and community were hard to find outside of counterspaces in the institution. When it came to voluntary leadership in discipline or practice-based engineering organizations, many of the Study Leaders were disinterested in being involved. Killua explained his experience: "it **puts you in a box** because (…) I'm the Black guy leftover at the meeting. Who am I going to talk to?" He goes on to explain that this same level of only-ness in the discipline-based organization reflects the attitudes he experienced from his peers in the classroom. He described,

> "In classes, I already have to do all these projects with all these people that just don't want to work with me. Why would I do that outside of classes? (…) Like, I'm open to working with them, **but like, you know, racism**, so like, they already have their opinions of me before they even know me."

For Killua and the other Study Leaders, many of their struggles in their engineering leadership journey also include a layer related to their personal identity. Engineering-focused organizations and settings that should have been able to provide them with a source of practical or institutional funds of identity were not viable options for them. Their engagement in these environments often compromised or detracted from the Study Leaders' cultural and social funds of identity-related to their racial or other personal identities. Many of the Study Leaders found their leadership opportunities through organizations and counterspaces that catered specifically to their identity.

Protecting your peace

The phrase "protect your peace" has been a popular phrase to describe the practices and strides that Black people use to take care of themselves holistically. These strategies and practices are typically in response to negative and harmful situations. Black people face that threaten their identities in physical, mental, emotional, spiritual, and societal ways [34]. The Study Leaders' strategies for protecting their peace involved setting boundaries and critically determining how they could minimize threats to their identity while navigating their engineering and leadership journey. Jesica had moments in her experience serving on her institution's student body government board that made her decide not to be involved in predominately white organizations anymore. While she acknowledged that the board was more diverse than the representation at her institution, it was still predominantly white; with over 90 members, only ten were Black or Brown. Despite her initial comfort in joining that board, she explained that it was evident that members often joined in positioning themselves in a higher status for professional gain and titles over the intention of serving the institution and representing the students. She explained, "however, I could see its **ugly hand**. (…) Like, it was still **a white ass organization** where people were just doing what they wanted to do in order to get ahead." Jesica's experience in the student body government prompted her to reflect on how she wanted to navigate being Black at her institution. She further explained,

> I think that organization was a defining moment to the type of Black person I wanted to be. And it wasn't the most favorable Black person, right? Like, I might not be **awarded the same faces as everyone else**. Especially as if it means conforming, like, **that's just not for me**. So, I was just like, okay, cool, like, after this experience, and after this experience, **I'm not yearning to be a part of anything. predominately white. I'm okay.**

For Jesica to protect her peace at her institution, she set a boundary around the spaces she wanted to be involved in. She felt that predominantly white organizations would not give her the level of respect and recognition she needed to feel confident and appreciated in her leadership pursuits. She goes on to say, "I think I was more pleased with what I was getting through NSBE and the

impact that I can have in NSBE than I was joining another white organization, **you know what I mean?"** Once again, NSBE and counterspaces in their environments provided the Study Leaders with a "safe space" [31] where they could successfully develop professionally as leaders and engineers by tapping into their cultural and practical funds of identity.

The actions of Jesica and the other Study Leaders to protect their peace often diverged from the advice and recommendations they received from their more technical managers and supervisors. In their professional settings, the Study Leaders were not receiving much recognition for their leadership endeavors despite them directly impacting the culture and improving the environment for marginalized groups at their companies and institutions. The Study Leaders described the burdens and burnout related to meeting both the technical and social needs through their professional and leadership roles. For some, to stay authentic to who they were and the leadership they wanted to be involved in, they considered alternative careers to engineering. For example, when Gabrielle sought advice from her supervisors at work, they often gave her feedback on her personality. She explained,

> I was getting feedback from my manager by asking how I could be a better engineer, and he was like, "if you could be a little less cheery, I think it'd be a little less intimidating to our operators. You're a little bit too happy." And I took that as feedback.

Despite Gabrielle's technical accomplishments as an engineer, the feedback she received inicated that she did not fit a "technical mold." She decided to pivot into a field where she could leverage her social capabilities more. She further explained,

> So as opposed to really trying to force and change my mind about my technical side. I'm just gonna like lean into what I'm great at and do that, because that's what makes me happy. (…) If I could have went back and had a best case scenario, if I could have had a mentor or someone who like trained me on how to be good at both, as opposed to having to pick a path, I think that would have kept me staying in engineering as opposed to now I'm leaning into what people said I was good at and I'm going to Business School. I'm gonna be using my **soft fluffy skills,** and like I'm moving out of engineering. And I wouldn't be surprised if other people in like my situation do the same thing.

The Study Leaders were put into situations where engineering was not a space where their authentic selves could be recognized despite all of their technical training and expertise. So instead of opting to, as the Study Leaders explained, "code-switch," "conform," or continually "prove" themselves, many of them considered professional environments outside of engineering. Despite having successfully attained an engineering degree, many of them felt they were still being "pushed out" of engineering.

Discussion

The stories of the Study Leaders illuminate areas of engineering leadership that are underexplored in research and practice. While leadership is recognized as an integral part of

engineering and engineering education, there are nuances of leadership that are unique to marginalized groups in engineering, such as Black engineers. Studies regarding engineering leadership often highlight the importance of technical competency and social or professional skills related to effective engineering leadership [3]–[5]. These skills are closely connected to an engineer's various funds of identity in where, how, and who they interact with in leadership. However, for the early-career Black engineers in this study, these aspects of their identity and leadership are only recognized and appreciated in specific spaces in engineering. In the greater landscape of engineering, these engineers often had to pick between their technical identity and their social or cultural identities. However, through engagement in organizations like NSBE and other counterspaces in their engineering environments, these leaders could authentically lead while supporting the technical and social aspects of their identity. While Black engineers should ideally be able to feel empowered to be leaders in their professional settings, that was not the case for these participants. Counterspaces provided leadership opportunities for Black engineers that were community-driven, empowering, and culturally relevant for early-career Black engineers. Early-career Black engineers felt burdened, burnt out, and unappreciated when these elements were absent in their leadership pursuits. These perceptions then catalyzed many of them to seek opportunities outside of engineering despite having successfully attained an engineering degree and technical experience.

Many studies explore the reasons why participation in engineering has remained stagnantly low for Black engineers over several years [35]. Many of these studies describe the situations that Black engineers face in their engineering journeys related to stereotypes [21], [36], assimilation into a dominant culture [37], and cultures of exclusion [38]. Intrinsically, much of the leadership that Black engineers exhibit is through resiliency in navigating a harsh environment, community focus, and authenticity to oneself. These are elements of leadership that require more exploration in engineering leadership research. In their work about resilient engineering identities, Ross et al. describe these tenets of environment, community, and self for Black engineers [27]. The leadership pursuits of the Study Leaders in this study stemmed from their resilient identities in engineering. There is an opportunity to investigate engineering leadership more deeply when considering how various groups, inclusive of marginalized groups, in engineering experience leadership in myriad ways.

The experiences of early-career Black engineers in leadership have illuminated additional factors that should be considered in the greater landscape of engineering leadership research and practice. From the stories of the Study Leaders, there is a deeper resonance to engineering leadership than just technical and social skills. There's a significance of social *responsibility* that should be emphasized as we consider the structures, strategies, and practices involved with engineering leadership. There are many types of leadership styles that consider the weight of social responsibility, such as servant leadership and social change [39], [40]. However, within this social responsibility, engineering leaders should consider aspects of oneself, their cultural relevancy, their communities, and their environments in enacting their leadership. Engineering leadership is more than just technical competency and social skills like communication and time management. There is an entire systemic ecosystem involved in engineering leadership that

involves factors inclusive of leaders, their teams, technology, the working environment, community engagement, and the interactions between these various aspects.

Lastly, it is essential for engineering leaders to have opportunities to reflect on their leadership experiences as well as receive recognition for their leadership pursuits, especially those that support and build culture and community in their environments. Ross et al. describe the role of identity-centered engineering professional organizations and how they serve as communities of practice for Black engineers [27]. As described in the findings, the Study Leaders found leadership opportunities in these types of spaces, where they were able to safely develop their engineering and leadership identities. These spaces provided them with a community to serve that they cared about, as well as friends, colleagues, and mentors with whom they could share stories and experiences. Early-career Black engineers' authentic selves were recognized and embraced in these spaces. These characteristics should be encouraged and integrated throughout the engineering ecosystem. Studies have explored how empowering these counterspaces and reaffirming structures are for Black engineers [31]–[33]. However, without proper recognition and integration of the importance of these spaces in engineering, early-career Black engineering leaders may perceive themselves as "outsiders-within in engineering" [23]. So, despite their ability to contribute to engineering through their leadership with both technical expertise and social responsibility, they might seek opportunities outside of engineering where their social and cultural responsibilities are also recognized.

Conclusion

Exploring how early-career Black engineers make sense of their leadership experience through their authentic voices has provided additional insights into value-added features of engineering leadership. The prominence of capturing Black engineers' leadership experiences through Black language adds cultural relevancy to the engineering leadership conversation. Engineering leadership has primarily focused on technical expertise and social skill development. However, early-career Black engineers also describe the importance of community, cultural and social responsibility in their leadership endeavors. They explain a variety of challenges that they encounter due to threats and pressures they receive in their roles. These insights help shape engineering leadership to consider more than the individual influences that leaders have on the engineering ecosystem but how the engineering ecosystem works systemically with structures, individuals, and communities.

References

[1] R. L. D. Komarek, "In search of a definition and frameworks for engineering leadership development," *New Dir Stud Leadersh*, vol. 2022, no. 173, pp. 33–41, Mar. 2022, doi: 10.1002/YD.20477.

[2] R. Paul, A. Sen, and E. Wyatt, "What is engineering leadership? A proposed definition," *ASEE Annual Conference and Exposition, Conference Proceedings*, vol. 2018-June, 2018.

[3] J. v Farr and D. M. Brazil, "Leadership Skills Development for Engineers," *Engineering Management Journal*, vol. 21, no. 1, 2009.

[4] M. F. Cox, O. Cekic, and S. G. Adams, "Developing leadership skills of undergraduate engineering students: Perspectives from engineering faculty," *J STEM Educ*, vol. 11, no. 3/4, pp. 22–33, 2010.

[5] S. Kumar and J. K. Hsiao, "Engineers learn 'soft skills the hard way': Planting a seed of leadership in engineering classes," *Leadership and Management in Engineering*, 2007, doi: 10.1061/(ASCE)1532-6748(2007)7:1(18).

[6] M. F. Cox, C. A. Berry, and K. A. Smith, "Development of a Leadership, Policy, and Change Course for Science, Technology, Engineering, and Mathematics Graduate Students," *J STEM Educ*, vol. 10, no. 3–4, pp. 9–16, 2009, [Online]. Available: http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=EJ945964&lang=zh-cn&site=ehost-live%5Cnhttp://ojs.jstem.org/index.php?journal=JSTEM&page=article&op=view&path[]=1435

[7] M. R. Kendall, D. Chachra, K. Gipson, and K. Roach, "Motivating the need for an engineering-specific approach to student leadership development," *New Dir Stud Leadersh*, vol. 2022, no. 173, pp. 13–21, Mar. 2022, doi: 10.1002/YD.20475.

[8] C. Rottmann, R. Sacks, and D. Reeve, "Engineering leadership: Grounding leadership theory in engineers' professional identities," *Leadership*, vol. 11, no. 3, pp. 351–373, 2015, doi: 10.1177/1742715014543581.

[9] M. Abdulwahed and M. O. Hasna, "Leadership: Models, Competencies, and the Emergence of Engineering Leadership," in *Engineering and Technology Talent for Innovation and Knowledge-Based Economies*, Cham: Springer International Publishing, 2017, pp. 35–45. doi: 10.1007/978-3-319-46439-8_3.

[10] M. Klassen, D. Reeve, G. J. Evans, C. Rottmann, P. K. Sheridan, and A. Simpson, "Engineering: Moving Leadership From the Periphery to the Core of an Intensely Technical Curriculum," *New Dir Stud Leadersh*, vol. 2020, no. 165, pp. 113–124, Mar. 2020, doi: 10.1002/yd.20373.

[11] B. Ahn, M. F. Cox, J. London, O. Cekic, and J. Zhu, "Creating an instrument to measure leadership, change, and synthesis in engineering undergraduates," *Journal of Engineering Education*, vol. 103, no. 1, pp. 115–136, 2014, doi: 10.1002/jee.20036.

[12] E. McGee, "'Black Genius, Asian Fail': The Detriment of Stereotype Lift and Stereotype Threat in High-Achieving Asian and Black STEM Students," *AERA Open*, vol. 4, no. 4, p. 233285841881665, Oct. 2018, doi: 10.1177/2332858418816658.

[13] Basile and Black, "They hated me till I was one of the 'good ones' : Toward Understanding and Disrupting the Differential Racialization of Undergraduate African American STEM Majors," *J Negro Educ*, vol. 88, no. 3, p. 379, 2020, doi: 10.7709/jnegroeducation.88.3.0379.

[14] A. N. Griffith, N. M. Hurd, and S. B. Hussain, "'I Didn't Come to School for This': A Qualitative Examination of Experiences With Race-Related Stressors and Coping Responses Among Black Students Attending a Predominantly White Institution," *J Adolesc Res*, vol. 34, no. 2, pp. 115–139, 2019, doi: 10.1177/0743558417742983.

[15] E. O. McGee, P. K. Botchway, D. E. Naphan-Kingery, A. J. Brockman, S. Houston, and D. T. White, "Racism camouflaged as impostorism and the impact on black STEM doctoral students," 2021, doi: 10.1080/13613324.2021.1924137.

[16] K. M. Thomas, "Leading as 'the Other,'" *J Leadersh Organ Stud*, vol. 26, no. 3, pp. 402–406, 2019, doi: 10.1177/1548051819849005.

[17] E. O. McGee, D. M. Griffith, and S. L. Houston, "'I know I have to work twice as hard and hope that makes me good enough': Exploring the stress and strain of Black doctoral students in engineering and computing," *Teach Coll Rec*, vol. 121, no. 4, pp. 1–38, 2019.

[18] M. Civil, "STEM learning research through a funds of knowledge lens," *Cult Stud Sci Educ*, vol. 11, no. 1, pp. 41–59, Mar. 2016, doi: 10.1007/s11422-014-9648-2.

[19] T. C. Jones, "Creating a world for me: Students of color navigating STEM identity," *Journal of Negro Education*, vol. 88, no. 3, pp. 358–378, 2019, doi: 10.7709/jnegroeducation.88.3.0358.

[20] N. A. Ortiz, "Let our rejoicing rise without bound: a focus on black language and mathematics learning," *https://doi.org/10.1080/09518398.2022.2061623*, pp. 1–13, Apr. 2022, doi: 10.1080/09518398.2022.2061623.

[21] E. O. McGee and D. B. Martin, "'You Would Not Believe What I Have to Go Through to Prove My Intellectual Value!' Stereotype Management Among Academically Successful Black Mathematics and Engineering Students," *Am Educ Res J*, vol. 48, no. 6, pp. 1347–1389, Dec. 2011, doi: 10.3102/0002831211423972.

[22] E. O. McGee, "Devalued Black and Latino Racial Identities: A By-Product of STEM College Culture," *Am Educ Res J*, vol. 53, no. 6, pp. 1626–1662, Dec. 2016, doi: 10.3102/0002831216676572.

[23] D. Rios, A. Stewart, and A. J. Stewart, "Insider and Outsider-Within Standpoints: The Experiences of Diverse Faculty in Science and Engineering Fields," *J Women Minor Sci Eng*, vol. 21, no. 4, pp. 295–322, 2015, doi: 10.1615/JWomenMinorScienEng.2015010375.

[24] M. Esteban-Guitart, "Funds of Identity," *Encyclopedia of Critical Psychology*, pp. 752–757, 2014, doi: 10.1007/978-1-4614-5583-7_576.

[25] M. Esteban-Guitart and L. C. Moll, "Funds of Identity: A new concept based on the Funds of Knowledge approach," *Cult Psychol*, vol. 20, no. 1, pp. 31–48, 2014, doi: 10.1177/1354067X13515934.

[26] M. Esteban-Guitart and L. C. Moll, “Lived experience, funds of identity and education,” *Cult Psychol*, vol. 20, no. 1, pp. 70–81, 2014, doi: 10.1177/1354067X13515940.

[27] M. S. Ross, J. L. Huff, and A. Godwin, “Resilient engineering identity development critical to prolonged engagement of Black women in engineering,” *Journal of Engineering Education*, vol. 110, no. 1, pp. 92–113, Jan. 2021, doi: 10.1002/jee.20374.

[28] S. Secules *et al.*, “Positionality practices and dimensions of impact on equity research: A collaborative inquiry and call to the community,” *Journal of Engineering Education*, vol. 110, no. 1, pp. 19–43, Jan. 2021, doi: 10.1002/jee.20377.

[29] J. Saldaña, *The Coding Manual for Qualitative Researchers*, 3rd ed. 2016. doi: 10.1017/CBO9781107415324.004.

[30] “NSBE Vision, Mission & Objectives - National Society of Black Engineers.” https://www.nsbe.org/About-Us/NSBE-Vision-Mission-Objectives.aspx#.YIg8bJBKgXY (accessed Apr. 26, 2021).

[31] K. Thomas, M. L. Greene, B. C. Coley, and J. S. London, “Black faces, White spaces: Understanding the role of counterspaces in the Black engineering graduate student experience,” in *2021 CoNECD*, Jan. 2021. Accessed: Mar. 16, 2021. [Online]. Available: https://peer.asee.org/36071

[32] A. D. Case and C. D. Hunter, “Counterspaces: A Unit of Analysis for Understanding the Role of Settings in Marginalized Individuals’ Adaptive Responses to Oppression,” *Am J Community Psychol*, vol. 50, no. 1–2, pp. 257–270, 2012, doi: 10.1007/s10464-012-9497-7.

[33] M. Ong, J. M. Smith, and L. T. Ko, “Counterspaces for Women of Color in STEM Higher Education: Marginal and Central Spaces for Persistence and Success,” *J Res Sci Teach*, vol. 55, no. 2, pp. 206–245, 2018, doi: 10.1002/tea.21417.

[34] A. A. Tichavakunda, “Black joy on white campuses: Exploring black students’ recreation and celebration at a historically white institution,” *Review of Higher Education*, vol. 44, no. 3, pp. 297–324, 2020, doi: 10.1353/rhe.2021.0003.

[35] American Society for Engineering Education, “Engineering and engineering technology by the numbers,” 2020.

[36] E. O. McGee, “Young, Black, Mathematically Gifted, and Stereotyped,” *The High School Journal*, 2013, doi: 10.1353/hsj.2013.0011.

[37] E. O. McGee, “Interrogating Structural Racism in STEM Higher Education,” *Educational Researcher*, vol. 49, no. 9, pp. 633–644, Dec. 2020, doi: 10.3102/0013189X20972718.

[38] M. G. Eastman, M. L. Miles, and R. Yerrick, “Exploring the White and male culture: Investigating individual perspectives of equity and privilege in engineering education,” *Journal of Engineering Education*, vol. 108, no. 4, pp. 459–480, 2019, doi: 10.1002/jee.20290.

[39] C. Kiersch and J. Peters, “Leadership from the Inside Out: Student Leadership Development within Authentic Leadership and Servant Leadership Frameworks,” 2017, doi: 10.12806/V16/I1/T4.

[40] K. L. Guthrie and V. S. Chunoo, “Changing the Narrative: Socially Just Leadership Education,” *Journal of College Orientation, Transition, and Retention,* vol. 28, no. 3, p. 336, Nov. 2021, doi: 10.24926/jcotr.v28i3.3707.