Navigational Capital of African American Students in Engineering at a Predominantly White Institution

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***Abstract*—This Research Work in Progress presents the lived experiences of African American students studying engineering at a predominantly White institution with low minority representation. Their experiences are viewed through the lens of navigational capital, positioning predominantly white institutions as an institution created without African Americans in mind. This qualitative study found that African American students use experiences, connections, involvement, and resources to attain resilience, academic invulnerability, and skills that contribute to their success.**

Keywords—underrepresentation, community cultural wealth, undergraduate, student experience

I. Introduction

There are significant disparities between the conferring of science, technology, engineering and mathematics (STEM) bachelor's degrees to minoritized groups at four-year predominantly White institutions (PWIs) and the number of STEM faculty that represent minoritized groups [1], [2]. The Morrill Act of 1862 established engineering as a major at institutions currently known as PWIs. From the very conception of the engineering collegiate culture in 1862, minoritized groups have been ostracized and unwelcomed. Engineering as a major was not created with Communities of Color in mind. Studies have shown that a diverse engineering faculty contributes to improving access and success of diverse students [3]. Considering this, it is important to address the effects of the lack of minority faculty representation at PWIs on student success. This pilot study will begin to identify the ways in which African American students may arrive at success in engineering programs at PWIs where the minority faculty ranges from 0-10%. We define success as the matriculation from undergraduate to graduate programs.

A. Literature Review

Research has highlighted the experience of minoritized students in spaces with few minoritized faculty [4]. There has also been a consistent push for increasing minority representation at PWIs, yet studies show that as of 2019, the number of African American faculty at PWIs have increased by only 2.3% in the last 20 years [5]. Researchers have been studying the experience of the minority student from a critical race standpoint to highlight the lived experience of minority students in engineering programs at PWIs [6] and how they feel like "outsiders within" [7]. Research has highlighted multiple ways that students arrive at success in these institutional spaces created without them in mind. For example, Samuelson presents the belief that navigational capital is an existing asset that African American and Hispanic students use to maneuver their way to success. He provides examples of conditions or constraints faced by students of color including isolation, perceptions of racism, low expectations from faculty or peers, and few faculty members or peers of color to serve as role models and mentors [8]. The relationship between faculty and student is critical to the overall retention and persistence of engineering students [3].

Navigational capital has been applied in education contexts to study its use among minoritized groups, and specifically in engineering education to study the persistence of students of color [6], [9]. Research on navigational capital often focuses on how participants acquire resources from others [9]. There is a limited focus on the experience of the student as the individual agent exercising their own navigational capital [9]. This study will draw from the framework of navigational capital and adapt it to study the success of two African American students in engineering. Integrating knowledge from the navigational capital framework and its existing applications in engineering education, we seek to lay the foundation for the exclusive use of navigational capital to analyze the experiences of minoritized groups in engineering. We seek to begin to fill the gap in research by drawing on the participants' account of their stories to identify the experiences that can be mapped to navigational capital.

B. Theoretical Framework

The framework used for this study was derived from community cultural wealth (CCW). CCW takes an anti-deficit stance on the experiences of individuals from minoritized groups. It takes a critical approach to highlighting the capital groups have based on their culture. Within CCW, there are six capital classifications: aspirational, familial, social, navigational, resistant, and linguistic [6, Fig. 4]. Each of these classifications contribute to the cultural wealth held by different communities. We have chosen to observe the uses of navigational capital among African American students in engineering. Navigational capital highlights the ways in which minoritized groups maneuver their way to success in environments not created with them in mind [6]. These environments include but are not limited to social institutions.

CCW comes from a critical race theory standpoint. It is built on the understanding that racism does exist and is integrated into the very fabric of our American society [6]. The history of communities of color not being considered when the culture of the nation was being established sets the stage for the unique experiences of and challenges faced by individuals from minoritized groups. Navigational capital allows researchers to look at those experiences and challenges. There is an existing understanding that communities of color experience stereotype

threat, racism, microaggression, and other stressful events that can put a strain on their journey to success [7]. Rather than focus on these stressful events as markers of possible failure, we look at the ways students overcome these stressful events and achieve success. We use navigational capital to identify the individual agency that African American students have within institutional constraints of their engineering departments.

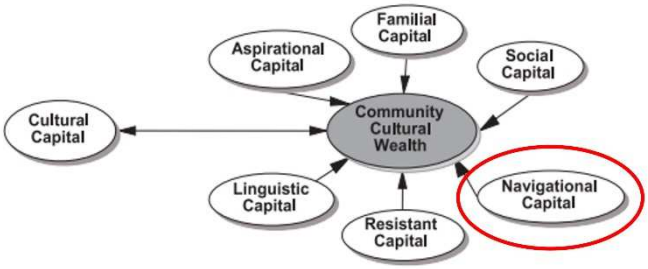

Fig. 1. Theoretical framework of community cultural wealth by [6] used as the basis for this study design and analysis.

II. Methods

A. Interview Participant Recruitment

Participants were chosen from a student population at a single institution (a land grant PWI in the southeastern United States) in an engineering department that has no African American or Black faculty members. Participant selection was bounded by the participants' academic success, which we defined for this study as completing an undergraduate engineering degree and entering a graduate engineering degree program in the same engineering department. We wanted to only focus on students that are retained in their majors.

For this pilot study, two participants were selected. This small number speaks to the unique intersectionality of the participants of this study. The participants had to be Black/African American and retained in their major from undergraduate to graduate at a PWI/LGU with about 2.6% full-time Black/African American female graduate student enrollment and with Black/African American male enrollment unreported. This number does not account for specific statistics within engineering majors nor whether students matriculated from the same university or degree program. If we have small numbers of African American students matriculating into graduate programs in their major, it is our duty as researchers to gain expertise in methods that allow them to learn from small numbers of participants [10].

Participants were sent IRB-approved documentation via email with an overview of the study and their roles in the study. Pseudonyms were selected by the participants at the end of their interviews. Sage identifies as an African American woman and has a mixed racial background. Frank identifies as an African American male.

B. Protocol

The interview protocol was adapted from a related study about student motivation, identity, and sense of belonging in engineering. Changes were made to the protocol to tailor it to the research purpose as seen in Table 1. The interview protocol had four sections: the student's story and indicators of success; engineering identity; navigational capital; and future-oriented motivation. These four sections provided context for participants to share how they arrived at success as defined in this pilot study.

TABLE I. Changes made to interview protocolabout participants' sexperiences at a PWI to capture insights into their navigational capital

Section	***Summary of Changes***
Story/Indicators of Success	Added 4 questions about pursuing a Ph.D. in engineering
Engineering Identity	Added, "Describe the characteristics of a [department] engineer."
Navigational Capital	Added 14 questions from [11]

Sample interview questions include:

Story/Indicators of Success

- When were you first aware of graduate school, or getting a Ph.D.?
- When did you discover the engineering Ph.D. program at LGU?

Navigational Capital:

- Have you faced any difficulties or barriers in this journey?
- What roles have [name of program] played on your journey through [major] engineering?

The goal of the protocol was to reveal the story of the participants in such a way that highlighted the unique paths taken to achieve success.

C. Qualitative Methods

The interviews were conducted via Zoom and transcribed first by Zoom analytics. Transcriptions were finalized and data was cleaned in conjunction with the first pass of coding. This cleaning process deidentified the data to maintain the protection of the participants.

The qualitative analysis was carried out with closed coding, drawing from the framework of navigational capital, to identify skills used by the participants as they maneuver their way to success in an engineering program at a PWI. The first pass was descriptive coding to become familiar with the data and define descriptors of the participants' stories and experiences. This was followed by in vivo coding to highlight the ways the participants identified their experiences, connections, resources, and involvement that shaped their undergraduate career. This process was coupled with the creation of a graphic representation of the phenomena of navigational capital among the participants. The excerpts coded through the in vivo coding were extracted to an Excel spreadsheet to map out the emergence of navigational capital for Sage and Frank.

III. Preliminary Results

A. Navigational Capital

Navigational capital can be defined as resilience, academic invulnerability, and skills [6], [8]. These three concepts come together to denote the journey of an individual as they achieve success in an environment not created with them in mind. The results showed that the participants tapped into their navigational capital when they used experiences, connections, involvement and resources to be resilient, academically invulnerable and skillful. In other words, they learned from experiences (theirs or others'), capitalized on their connections, positioned themselves through involvement and used their resources to achieve success in their engineering program. We describe each of these factors and how the participants connected them to demonstrate resilience, academic invulnerability and skills.

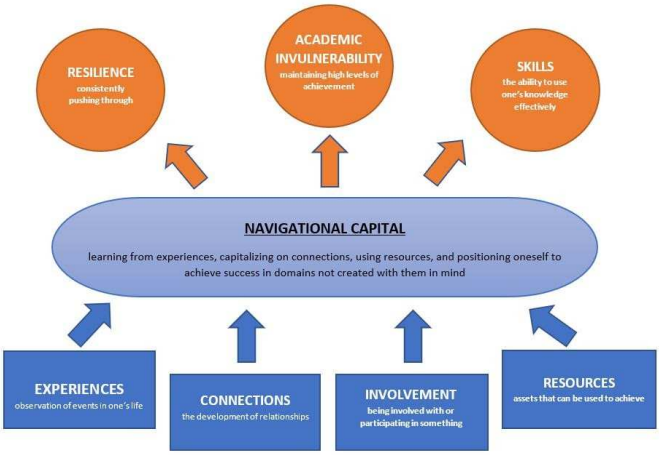

Fig. 2. Relationships between aspects of navigational capital based on data analysis of participant interviews.

1) Experiences: When participants described using experiences as part of their navigational capital, they tapped into experiences of their own or of someone else. The participants learned from those experiences for subsequent functioning.

> *"Half of my family was like Black. I had a lot of experience kind of like seeing what people are like from you know those two very different cultures. And I feel like that's kind of helped me with like trying to connect with people…" – Sage*

Sage comes from a blended family (African American and White), and identifies as African American. As an African American woman at a PWI, she understood that most of the individuals around her would be White. Sage drew from the **experiences** she had with her blended family to enhance her subsequent functioning. Sage's experiences helped her to understand the cultures of Black and White people. She was able to turn that into a **skill** to connect with others at her PWI. The point at which Sage took her familial **experiences** to use as a **skill** to *manuever her way to success at a PWI* was an example of her navigational capital. Sage connected mostly with faculty, all of whom were not from minoritized populations, so her experience with White culture was key in developing relationships with faculty members that would later contribute to her acceptance into the Ph.D. program.

2) Connections: When participants used connections to exercise their navigational capital, they thought about their network. Their connections stemmed from different relationships they had built with peers, professors, staff and other affiliated entities. Participants took those connections and began to use the relationships they had built over years to contribute to their resilience, to help them achieve academic invulnerability, and to develop skills.

> *"It took me a minute to build those relationships and it definitely paid off in terms of you know, like having reliable study partners, having reliable people who knew like whatever I didn't understand they did, whatever they didn't understand I did you know, so it was a mutual agreement, we can we can actually help each other…" - Frank*

Frank capitalized on his **connections** to develop **academic invulnerability**. Frank was able to buld his **connections** by making meaningful relationships with his classmates. His intentionality can be seen in his account of why he built those relationships. Frank knew the importance of having reliable people to be there for him when he encountered a topic he did not understand. He cultivated an environment between himself and the classmates he made relationships with such that he could not fail. He set himself up to achieve academic invulnerability in his classes by building connections with his classmates thereby exhibiting individual agency in his journey to success at his PWI.

3) Involvement: When participants used their involvement to exercise their navigational capital, they strategically positioned themselves into different organizations within their communities. They identified with these communities by race, gender, major, interests, etc. The participants then used this involvement to be resilient, to achieve academic invulnerability, and to develop skills.

> *"I was trying to get involved to make sure that my voice was being heard, because if anybody else ain't gonna speak about it, I will …" – Frank*

As a member of a minoritized group, Frank was well aware of the struggles of not being heard. There were individuals at his PWI from the same cultural background as those that historically stiffled the voices of African American peoples. He knew the importance of his voice being heard and was able to position himself to achieve that through **involvement**. Despite the silencing culture of White to Black individuals, Frank found a way to persist and have his voice heard. This shows how Frank was able to use his involvement to become **resilient** at his PWI, which was how he *manuevered his way to success*. He

developed **skills** at making sure that his views were heard and that he was seen. This eventually led to recognition from faculty, which was important to his success as an accepted PhD student.

4) Resources: When participants described using resources to exercise their navigational capital, they considered all that has been offered to them or shown to them throughout their engineering student experience. They referred to the availability of these resources and oftentimes would jump at an opportunity to use said resources.

> *"Like having the resource of the co-op office and that experience and just internships also like the research internships which are a little bit more departmental were definitely very beneficial to me throughout undergrad" – Sage*

Sage identifies the **resources** that were beneficial to her throughout undergrad. Although she had internship and research experiences, she does not identify a specific resource for these opportunities. It is important to note, however, that she identifies the internships as a resource and connects them to her academic success. This trend of identifying few specific resources as explicitly contributing to success can be seen in the data from both Frank and Sage. It is unclear how they used their resources to be resilient, achieve academic invulnerability, and develop skill.

IV. Discussion and Conclusion

The participants spoke least about how they used their resources. They were more so able to identify their connections, experiences, and involvement. The few mentions of resources were not distinct enough to make any substantial connection to the factors that denote navigational capital. The students spoke explicitly about their PWI culture in their engineering department. They did not expect to have role models in their major that looked like them and went into their undergraduate experience with the understanding that they will be the distinct minority in their classes. Understanding this, they did not make notable mention to the way a lack of minority faculty affected their success. They identified ways they maneuvered around this fact through involvement, experiences, and connections.

The institutional support for individuals from minoritized groups differs across different institutions and types of institutions. Some universities may have engineering-specific programs (Minority Engineering Programs, or MEPs), while others may aim to provide support to all minoritized students. The important factor to highlight is the accessibility of these programs and subsequent recognition of them as resources by minoritized students. At the PWI in this study, Frank identified his involvement in a MEP and how beneficial this experience was to his success. Sage speaks about the same program, stating that she "missed the train" and did not participate in it. This shows how although programs may be in place at different PWIs, their reach and awareness of them needs to be re-evaluated.

The participants, much like many other minoritized students at PWIs, were cognizant of the racial makeup of their university when they applied. Upon acceptance, they took on the challenge of being a racial minority in exchange for a credible degree they know will hold weight compared to other engineering programs. This exchange is an indicator of the necessity of knowing how to tap into navigational capital. Minoritized students enter PWIs with the goal of arriving at success. In this study, success is defined as the matriculation from undergrad to Ph.D. Research shows that African American students struggle with feeling like the "outsider within" in graduate programs [7] and that the engineering culture can permeate from undergraduate to graduate programs. Students at PWIs can benefit from understanding their own navigational capital to help them identify the qualities and competencies required to successfully navigate educational institutions by exposing their capacity to maintain high levels of achievement, their connections to networks that facilitate navigation, and their ability to draw from experiences to enhance resilience [8].

V. Limitations & Future Work

One of the limitations of this pilot study is the small sample size. Although this pilot study presents rich, focused data to build on, we look forward to including more voices from African American students in engineering at PWIs as we expand beyond this pilot study.

A second limitation of this study is the fact that the results are preliminary and call for further study into the cultures cultivated in different engineering programs at PWIs and how African American students navigate them. We plan to further analyze the data to identify how students use their navigational capital to achieve this.

Finally, this study looks at the broader view of the participants' experiences and maps those experiences to navigational capital. Because the protocol was adapted from a previously established protocol about students' experience in engineering, the amount of data from the interview focused on navigational capital is limited. We plan to revise the protocol to specifically focus on aspects of navigational capital that were revealed in this pilot study. To identify other aspects of student experiences that are not reflected in that framework, we will also use open coding in future analyses.

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