

## **An Exploration of Black Engineering Students' Aspirational Capital within Community Cultural Wealth and Ecological Systems Theory**

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## **Abstract**

High aspirations for the future function as powerful motivators for Black students to pursue and persist in undergraduate engineering programs. Students gain mental strength by maintaining high hopes and beliefs for the future. These aspirations can be intrinsic, originating as internal motivators, or extrinsic, coming from various social circles, such as family and friends. Researchers can benefit from investigating the aspirations of Black students to develop more effective ways for faculty and administrators to support students' dreams and goals.

Community Cultural Wealth (CCW) offers an asset-based framework that describes the strengths and knowledge of Communities of Color in terms of familial, linguistic, aspirational, resistant, navigational, and social capital that Students of Color bring to both the classroom and life. Pairing CCW with Ecological Systems Theory (EST) helps expand the understanding of the proximal and distal access students have to their various forms of capital. The different levels of EST – the microsystem, mesosystem, exosystem, macrosystem, and chronosystem – provide a framework for analyzing how students access the CCW capitals. We have combined these two frameworks to create C<sup>2</sup>WEST, an asset-based contextual theory that offers multiple lenses for viewing how and where in the EST framework individuals access their various types of capital.

Using the C<sup>2</sup>WEST framework, we highlight the different types of aspirational capital of Black students that originate in their microsystem, mesosystem, exosystem, macrosystem, and chronosystem. Aspirational capital is the ability for students to maintain high expectations despite obstacles. We used two case study illustrative examples obtained through interviews with Black students in undergraduate engineering to examine the development and enactment of aspirational capital in the different layers of C<sup>2</sup>WEST. Researchers thematically coded the interviews to familiarize themselves with the data and then chose quotes from the students that exemplified aspirational capital in the various levels.

The C<sup>2</sup>WEST framework will allow researchers to examine the aspirational capital of Black engineering students and gain a better understanding of the goals of Black engineering students. This framework could allow administrators and engineering educators develop better methods of supporting the academic and personal goals of Black students. By understanding the aspirational capital of students at the different levels, engineering educators will be able to provide students with individually tailored support. Through C<sup>2</sup>WEST, Black students could also further realize and conceptualize the access they have to their own aspirations regarding future career and life goals.

## Introduction

In this theory paper, the aspirational capital of Black students will be examined through the C<sup>2</sup>WEST framework. A variety of research has examined the aspirations of Black students in STEM in addition to other types of capital that Black students bring to the fields [1]–[4]. Yosso defines aspirational capital as the “ability to maintain hopes and dreams for the future, even in the face of real and perceived barriers” [5, p. 77]. In a systematic review, Denton et al. [2] examined twenty-eight different studies that mentioned aspirational capital among their participants. In many of these studies, aspirational capital appeared alongside other forms of capital as well, such as familial capital. People of Color mention such aspirations as wanting to help society, becoming an entrepreneur, earning additional degrees, or having a work- life balance, among other goals [1]. However, the different capitals rarely operate on their own. Rather, they often overlap and intersect into multiple forms of capital represented in a single setting or instance [6]. The current study focuses solely on students’ aspirational capital, although other capitals can appear alongside aspirational capital.

The C<sup>2</sup>WEST framework is an asset-based framework that combines Community Cultural Wealth (CCW) [5] and Ecological Systems Theory (EST) [7]. This integrated theoretical framework can be used to examine the different strengths and assets of a student while simultaneously assessing the influence or proximity of the capital to the student and to society. This paper contributes a novel way to examine the aspirations of Black students. As an asset-based framework C<sup>2</sup>WEST considers the scope and categorizes the capitals of CCW in Black engineering students. We look specifically at the aspirational wedge in the C<sup>2</sup>WEST framework to explain the aspirations evidenced in interviews with two Black engineering students. Our motivation for using this framework is to be able to inform both students and engineering educators about ways to categorize and define the aspirational capital of students. Clearly communicating and outlining to a student about their aspirational capital can help them maintain their goals and dreams and provide motivation for continuing to work towards them.

We address the following question in our study: How can the aspirations of Black engineering students be further explained using the C<sup>2</sup>WEST framework?

## The C<sup>2</sup>WEST Framework

As Manning et al. [8] describes, C<sup>2</sup>WEST is a conceptual framework that uses the assets described in Yosso’s CCW [5] and the rings outlined in Bronfenbrenner’s EST [7]. As seen in Figure 1 below, each of the capitals of the CCW framework occupies a wedge of the EST circle with the individual at the center. Many researchers have used CCW to describe the multiple assets that Students of Color bring to the university environment [2], [6], [9], [10]. CCW has also been used to examine the aspirations of college-bound students before they enter the university setting [4]. EST has previously been used to examine obstacles and enablers of student success, peer culture, influences on part-time students, and Students of Color in higher education [11]–[15]. .

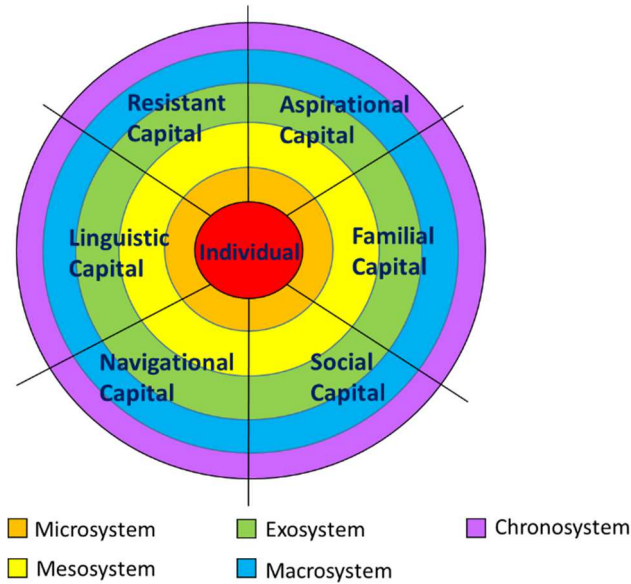


Figure 1. Community Cultural Wealth and Ecological Systems Theory (C<sup>2</sup>WEST) [8]

C<sup>2</sup>WEST incorporates the six types of capitals identified in the CCW framework: familial, linguistic, resistant, navigational, social, and aspirational. Familial capital refers to the knowledge and support supplied by relatives and a broader sense of family. Linguistic capital describes the skills associated with the ability to communicate in multiple styles or languages. Resistant capital reflects the abilities that are created through opposing behaviors, with the goal of challenging the current inequities. Navigational capital is the ability to maneuver through social systems that were not created for People of Color. Social capital refers to the groups, connections, and networks of people that a person can access for assistance. Finally, aspirational capital, the focus of this paper, is the individual's abilities to keep their goals intact despite obstacles [5].

The EST framework contains five layers: the microsystem, mesosystem, exosystem, macrosystem, and chronosystem. The microsystem is “a pattern of activities, roles, and interpersonal relations experienced by the developing person” [5, p. 22] in a singular setting. This could be the student's home, work, or school. The mesosystem is where the individual actively participates in two or more settings. An example would be a single individual's home and work life. The exosystem is when there is at least one setting in which the individual is not involved, however, the individual is still affected by the outcome of that particular setting. The exosystem can be seen in areas such as the work life of a significant other, who also shares the home with the student. The outcome of their significant other's work life would affect the home. Therefore, one setting, the home, involves the student, whereas the second setting, the work life of a significant other, does not involve the student. The macrosystem refers to culture or subcultures that will affect the individual [7]. For example, this can be seen in a work culture or the engineering education culture. Finally, the chronosystem was created added to the original EST framework to encompass change over time that impacts the individual [16]. The chronosystem can be seen when there are changes that relate to the individual that relate to time.

EST and each of the layers are further detailed in [8]. Figure 1 illustrates how the different capitals and rings interact.

The following hypothetical examples further illustrate how this framework can be used to understand student achievements. Students' aspirational capital could be focused at the microsystem level, such as individuals wanting to achieve high goals for themselves. Additionally, there are students that use their aspirations in the mesosystem, which involves high aspirations for multiple microsystems such as the home and workplace. This could be evident in the desire for a work-life balance across family and work. The exosystem involves multiple microsystems, one of which does not immediately involve the student, such as a student wanting to inspire unknown students in their communities. Some students frame their aspirations at the macrosystem-level, such as wanting to "move the needle" to improve how Communities of Color are viewed in STEM or desiring to represent their race. Finally, the chronosystem shows how students' aspirational capital can change over time or how it could change in the future.

Our initial introduction of C<sup>2</sup>WEST examined the story of a Black female student studying computer engineering at a predominantly White institution (PWI) [8]. In the preliminary use of the framework, we created a C<sup>2</sup>WEST map of this student. The creation of the map involved marking instances in each of the different wedges of familial, linguistic, aspirational, resistant, navigational, and social and when they appeared in the various layers of the microsystem, mesosystem, exosystem, macrosystem, and chronosystem. Through an in-depth analysis of her interview, we found that the student had an abundance of different types of capital throughout the different layers of the EST framework.

C<sup>2</sup>WEST can be used to help engineering educators and student advocates further understand the proximal and distal access an individual has to their available capital. The framework can also be utilized to further understand the strengths and assets students bring to their studies. If the strengths and assets of students are better understood then faculty and administration can further bolster and enhance the abilities the student has previously achieved and supplement where the student could use additional support. We proposed this framework in [8]; in this paper, we elaborate on the details of the aspirational capital segment of CCW, while recognizing that the different types of support students receive can result in multiple types of capital being represented.

## Illustrating Aspirational Capital in the C<sup>2</sup>WEST Framework

### Methods

In order to illustrate different forms of aspirational capital that could exist in the various levels of the C<sup>2</sup>WEST framework, we use interviews from two students who participated in our larger study of Black engineering students. These interviews were chosen from a larger qualitative study that examined the experiences of Black students in mechanical, electrical, and computer engineering. The original study utilized 79 interviews from four institutions in the southeastern

United States. Students that chose to share their stories received a \$50 incentive to participate; interviews ranged from 60 –120 minutes.

The interviews were chosen at random from a Historically Black College (HBCU) that participated in the original study. Manning et al. [8] displayed an example of the utilizing the C<sup>2</sup>WEST on a Black student attending a predominantly White institution (PWI). The authors wanted to extend this framework by observing the potential of utilizing the aspirational wedge of the C<sup>2</sup>WEST framework on students that attended HBCUs. The majors and genders of the students were purposefully different from each other to test the boundaries of the framework.

Both interviews were read through once, and then thematically coded once to help researchers familiarize themselves with the data. The codes from each interview were combined together to form eight individual themes. Once the eight themes were formed, a single interview was coded using the themes to discover if any new themes emerged. The researchers decided that the eight themes effectively covered the data. Finally, from those themes, unique quotes were chosen to illustrate the layers in the aspirational capital of the C<sup>2</sup>WEST framework.

#### Darius' Aspirational Capital as seen in C<sup>2</sup>WEST

Darius is a first-time-in-college (FTIC) sophomore electrical engineering student. He attends a HBCU. His mother and father both attended college but neither have completed their degree. He currently works on an automotive team on his campus where they use a real car for testing. He ultimately hopes to work for Tesla.

While Darius' story contained a multitude of examples of aspirational capital in the various layers of the C<sup>2</sup>WEST framework, we have chosen to highlight four forms of aspirational capital, depicted in Figure 2 below. The black lettered boxes in Figure 2 display to which layers the various forms of aspirational capital belong.

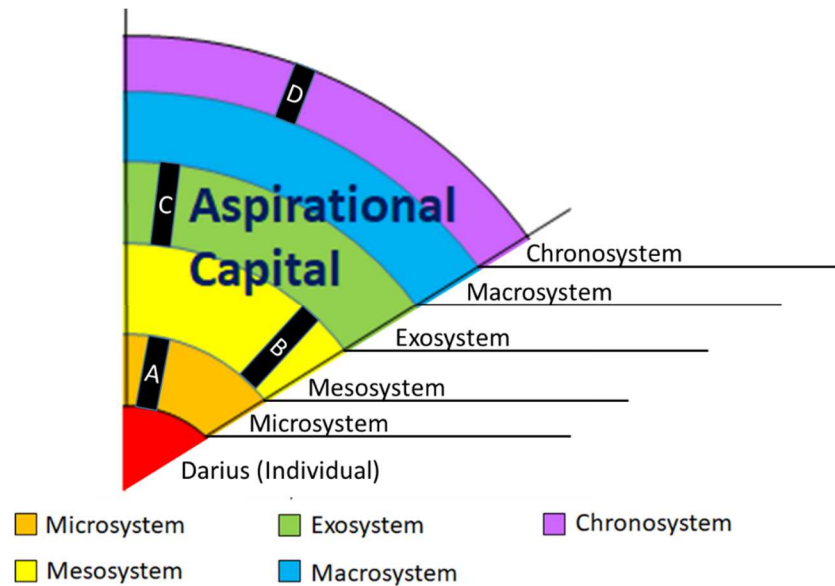


Figure 2. C<sup>2</sup>WEST Mapping of Darius' Aspirational Capital where the A – D black bars represent aspirational capital in their respective layers

Bar A in the innermost orange layer describes aspirational capital in the microsystem. Darius was asked in the interview what his education and career goals were and he mentioned his research on automation, saying “that’s what my research is on right now and that’s what I’m going to be interning with this summer. I like it so far.” This response contains information about the system in which Darius is involved; his research is a microsystem with him at the center. However, if Darius had further mentioned additional settings such as how this could affect his home life or interactions with coworkers, then the aspirational capital would move into the outer layers of the framework such as the mesosystem, which is the layer than contains two or more settings.

Bar B represents Darius’ aspirational capital in his mesosystem, the yellow layer second from the center. In his interview, Darius takes time to consider his goals once he has graduated from college. He talks about different companies he has spoken to and their expectations of their employees. Darius says:

That kind of boosted my confidence in the major that I chose because I want to be able to go to work and then, still have my life outside of work and still, if I want to hang out with my friends, I can do that because I have the time to do so.”

He talks about several microsystems where he remains active, such as his “life outside of work” and “to hang out with his friends. Because both of these microsystems involve Darius, this places Bar B as aspirational capital in his mesosystem.

Bar C displays aspirational capital in the exosystem, at the middle green layer. When Darius was asked about his future career goals, he began to describe how and when he initially switched majors from an applied engineering technology degree to a “straight” electrical engineering degree:

That's when I switched to just straight Electrical Engineering because I want to be the top guy in-charge, not like the manager but I don't want to be the assistant to an engineer. I want to be the engineer.

This quote shows that Darius wants to be the "top guy in-charge." Thus, he aspires to be at a higher level within a company as an engineer. This achievement would affect people in multiple microsystems who Darius may or may not meet because he would be the leading engineer potentially guiding other engineers and technologists. Therefore, the capital belongs in the exosystem, as the exosystem contains at least one system where the person is not involved, such as future coworkers or subordinates.

Finally, the black bar labeled D in Figure 2 displays aspirational capital in the chronosystem in the outermost purple layer from the center. Darius specifically mentions multiple times in his story that he wants to contribute to the "future of America or the future of the world." He also says he wants his "name to kind of be in the stars when it comes to the flying cars and stuff that people say is coming." This demonstrates aspirational capital in the chronosystem because he is considering the time perspective of his career. He is not simply looking at one point in time with his future aspirations; he is also looking at a future society or world in which his contributions shine.

#### Maya's Aspirational Capital as seen in C<sup>2</sup>WEST

Maya is a FTIC sophomore computer engineering student. She attends an HBCU and her mother has a bachelor's degree and her father has an associate's degree. She also has career interests in working with autonomous vehicles. For Maya's map, we have chosen to examine the aspirational capital in the black boxes labeled E, F, G, and H in the various rings of the framework depicted in Figure 3 below.



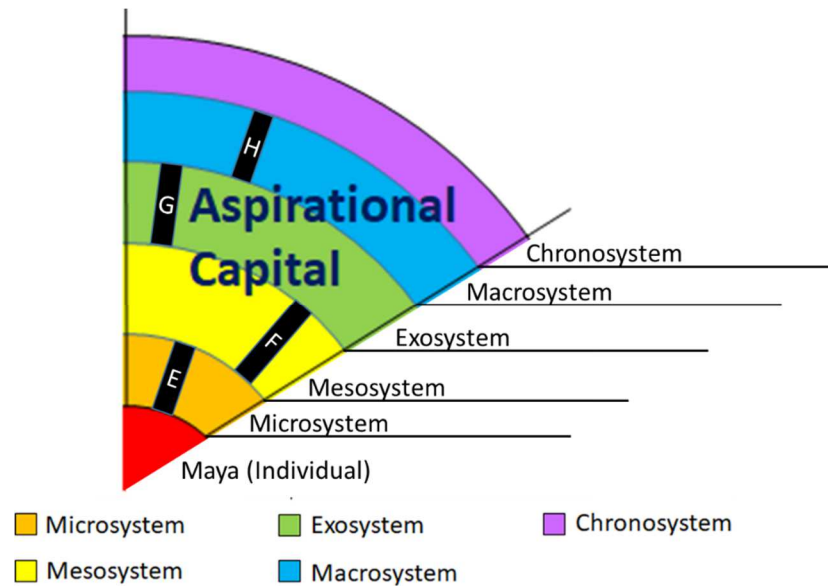


Figure 3. C<sup>2</sup>WEST Mapping of Maya's Aspirational Capital where the E – H black bars represent aspirational capital in their respective layers

Bar E, which is located in the microsystem, in the layer closest to the individual in the orange ring. Maya talks about looking to do an internship or cooperative education in the coming year. She does not mention aspects of the potential job that would indicate more than one microsystem. If Maya's description of the job opportunity included multiple microsystems or settings, this aspirational capital could potentially be in either the mesosystem or exosystem. However, because Maya describes the job without the additional topic of coworkers, or additional settings, Bar E is aspirational capital in the microsystem. This is similar to Bar A in Darius' story.

Bar F is placed in Maya's mesosystem, the yellow layer second from the inner red individual wedge. During the interview Maya begins to talk about her reasons for choosing computer engineering:

And then when I thought more about it, computer engineering, I know everybody has some type of technology. I have little cousins who are like two or three who are on little tablets and stuff. It's like, hm, okay, well instead of hindering, what can I do to help make you better almost.

Maya described wanting to help her cousins be better through the use of technology. Her cousins would act as individuals that may not necessarily be in her microsystem but the cousins would be an additional microsystem in which the individual, Maya, would have direct influence. She said she wants to influence them in a positive way through her choice of major. Thus, it is suitable to place Bar F in Maya's mesosystem as this aspiration involves two or more settings.

Bar G is positioned in Maya's exosystem, in the green layer that is third from the innermost layer. During her interview she indicates that her family routinely volunteers, she explains that

she “grew up helping.” When she was asked “So you felt like engineering could allow you to continue that?” Maya agreed. This demonstrates that Maya is interested in helping people that are not connected to her in her microsystems. This indicates that there is at least one microsystem that Maya aspires to help that does not currently contain her. Therefore, the aspirational capital indicated by Bar G is best placed in her exosystem.

Finally, Bar H displays aspirational capital in the macrosystem, the blue layer located fourth from the innermost layer. Maya talked about her career goals for the future and her major. She said, “So I’m computer engineering, and I want to work for a company to create devices that will just help better the world.” This shows that she wants to affect the world for the better on a broader level. This indicates that the best fit for this particular aspirational capital would lie in the macrosystem as it concerns the world, which in turn contains multiple systems creating cultures.

## Discussion

There are several noteworthy takeaways from applying aspirational capital in the C<sup>2</sup>WEST framework to Maya and Darius’ stories. Both stories indicate that the students are looking towards their immediate future, as their aspirational capital appears in their microsystem. The students are looking towards a future that has a close proximity to them in the form of research and internships. If the internship or future included multiple microsystems such as their home life, or additional work departments of which they were a part, then the aspirational capital could reside in the mesosystem. If the students described a future where at least one system did not contain them, then this could be considered part of their exosystem. For example, this could include talking about future coworkers, employees, or supervisors. It is important for the students to look towards a future in their microsystem because these goals are closest to them. Aspirations in their microsystem are also important to achieve as it will create additional microsystems for them to exist in which they can expand their aspirational capital.

We also observed aspirational capital in the mesosystem in Maya’s story. Maya mentioned wanting to help her cousins through her engineering degree, demonstrating aspirational capital in the mesosystem. This could also be seen by some researchers as familial capital. However, it is common for the different layers in the system to involve multiple types of capital without forcing it into a single type of capital. Different types of support appearing as multiple types of capital such as aspirational capital and familial capital working together appears in other works as well [1] [2]. However, we chose to place this particular strength in aspirational capital alone because she mentions using her degree to help others, including people in microsystems in which she exists. Therefore, this instance in her story belongs in her mesosystem in aspirational capital as it shows aspirations for people in her microsystems.

Aspirational capital also appeared in systems further from the individual. Maya demonstrated aspirational capital in the macrosystem and Darius displayed aspirational capital in the chronosystem. Both students enacting aspirations in the outer levels indicates that the students are thinking about their aspirations and hopes beyond their own microsystems. At the

macrosystem level, Maya is thinking about how to impact society, cultures, or subcultures in the macrosystem. This demonstrates a different and higher level of aspirational capital due to the fact that she is attempting to impact larger systems beyond just her own microsystems. Darius has a desire to impact the “future of America.” This shows high aspirational capital in the chronosystem because it displays both knowledge and a desire to affect not only the world at present but also the future of the world. He also mentions that he wants to be at the forefront of changing society, again demonstrating aspirational capital that would change over time.

We would expect engineering students to have aspirational capital in multiple systems because students often use aspirations as goals to continue to persist in STEM [2]. It is beneficial for students to have goals that exist in their immediate circle, or their microsystem. There are also benefits to the student looking at the larger picture as they consider additional microsystems in which they are involved, their mesosystem, or systems in which they do not currently exist in at least one, their exosystem. It is also important to be looking towards impacting society or larger cultures, their macrosystem, as well as specifically wanting to change things over time, which would appear in their chronosystem. It is necessary to examine aspirational capital in multiple systems as it allows students to understand and categorize their own aspirations. This in turn will aid students implementing these goals in their lives. Examining aspirational capital at the various levels also allows engineering educators to better prepare students for their future by being able to add support tailored to the students’ aspirations. For example, if a student is interested in internships, or cooperative educational experiences, this would be aspirational capital in their microsystem. If the professor is aware of their microsystem level aspirational capital, they can personally seek the student out to inform them of possible opportunities to fulfill this aspiration.

## Conclusion

We used the aspirational wedge of the C<sup>2</sup>WEST framework to highlight key examples of aspirational capital mentioned in interviews with two Black engineering students. We looked for further insight into the aspirational capital of the participants. Both Darius and Maya have a copious amount of aspirational capital that spanned across the system layers of the C<sup>2</sup>WEST framework. We believe that aspirational capital provides an essential impetus to persist in engineering programs degrees and helps students develop a focus for how they can use their degrees in the future. The framework continues to hold promise for explaining the access students have to their different capitals and how they view their aspirations. We believe this framework will continue to be able to explain the types of capitals and their proximity to students as seen in the stories of Students of Color.

Future research will continue to explore the abilities of the C<sup>2</sup>WEST framework to explain the assets of the Black engineering students and additional Students of Color. We will look at the individual wedges of the framework as well as how the capitals could potentially overlap. It is also important to note that interactions between the systems are possible as well and highly likely. The systems have unique definitions, however, similar to the types of capital, they do not exist completely separated. C<sup>2</sup>WEST is important to explain the access and distance students

have to their capitals. The framework can be used to view students' current strengths and potential ways for engineering educators to add additional support. For example, in Maya's microsystem she explains that she is looking for potential internships. Faculty could be sure to reach out to her individually if they hear about opportunities. Engineering educators could also support Darius' desire for a work-life balance by reaching out to him to provide mentorship on how they navigate their own work-life balance.

While still under development as a tool for analysis, we believe that C<sup>2</sup>WEST will have practical implications as well. First, advancing understanding of the ways that systems interact to help students accumulate and access capital can identify key points to promote interaction between systems or contexts. Second, the framework might be useful for designing interventions to help students recognize their many assets.

However, it is imperative to realize that the framework was not created to explain the real and perceived barriers that students face on their STEM pathway. Future research should examine how such barriers may promote or hinder the enactment of various forms of capital, including aspirational capital.

We explored the use of C<sup>2</sup>WEST as a lens for highlighting aspirational capital across an individual's ecosystem. The framework helped distinctly identify examples of aspirational capital within and across multiple contexts. The examples highlighted provide evidence that the framework is viable as a tool for analysis of interview data, and can serve as a guide for researchers looking to add further dimension to their analysis.

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