6

A framework adapted from the National Black Male College Achievement Study is introduced in this chapter as a lens through which to explore the enablers of student achievement in STEM. The chapter places an emphasis on reframing deficit-oriented research questions regarding students of color and their trajectories in STEM fields.

An Anti-Deficit Achievement Framework for Research on Students of Color in STEM

Shaun R. Harper

Despite ongoing efforts to narrow representation inequities and racial achievement gaps in science, technology, engineering, and mathematics (STEM) fields, Black and Latino undergraduates continue to lag behind their White and Asian American counterparts (American Council on Education, 2006; Hill and Green, 2007; National Action Council on Minorities in Engineering, 2008; National Science Foundation, 2007). A September 2008 issue of the *Chronicle of Higher Education* included a story with this headline: "Federal Panel Seeks Cause of Minority Students' Poor Science Performance" (Schmidt, 2008). Among the possible explanations was a theory about students of color being "mismatched" with institutions where science courses are too rigorous. The crux of the theory is that these students do poorly because affirmative action policies afford them access to colleges and universities where they cannot keep pace with peers who benefit from more advanced prior science and math instruction. Interestingly, those who subscribe to this theory appear less interested in exploring explanatory insights into STEM success among students who perform well at institutions where they were perceivably overmatched.

This research was supported by grants from Lumina Foundation for Education, the National Association of Student Personnel Administrators, the American College Personnel Association, the National Academic Advising Association, the Penn State University College of Education, the Penn State University Africana Research Center, and the Children, Youth & Families Consortium.

Like this particular news story, most policy reports and published research on college students of color in STEM (especially Blacks and Latinos) are based on important yet repetitive examinations of the following questions:

- Why do so few pursue STEM degrees?
- Why are they so underprepared for college-level math and science courses?
- Why are their grades and other indicators of academic achievement disproportionately lower than those of their White and Asian American counterparts?
- Why do so many change their majors to non-STEM fields?
- Why do so few continue on to graduate degree programs in STEM?

While answering these questions is essential to narrowing racial achievement gaps and attainment disparities in STEM, most empirical studies amplify minority student failure and deficits instead of achievement. As such, we know little about those students who, despite all that we know about what complicates and undermines achievement for their particular racial groups, manage to successfully navigate their ways to college and through the STEM postsecondary pipeline. Seymour and Hewitt (1997) authored a book replete with explanations for why students leave the sciences, while scholars have written comparatively less about those who stay and persist through STEM degree attainment.

In this chapter, I offer the National Black Male College Achievement Study (NBMCAS) as an example of how to explore and better understand the enablers of minority student achievement in STEM. Methods employed in the national study are described in the next section, followed by the presentation of an anti-deficit achievement framework for research on students of color at various junctures of the STEM pipeline, from K–12 schools through doctoral degree attainment and transitions into science research and long-term industry careers. Though informed by and conceptually similar to the framework used in the NBMCAS, I have customized the one introduced here for students of color (women and men, as well as various underrepresented minority groups) in STEM fields.

Study Description

This chapter uses data collected from 219 Black male undergraduates at forty-two colleges and universities in twenty states across the nation. As shown in Table 6.1, the NBMCAS included six different institution types. Administrators (provosts, deans of students, directors of multicultural affairs, and others) nominated, and key student leaders (for example, student government association presidents) helped identify, Black male undergraduates at their institutions who had earned cumulative grade

Table 6.1. National Black Male College Achievement Study Participating Institutions

Institution Type	*College or University*
Public research universities	University of Illinois Indiana University University of Michigan Michigan State University Ohio State University Purdue University
Highly selective private research universities	Brown University Columbia University Harvard University University of Pennsylvania Princeton University Stanford University
Private historically Black colleges and universities	Clark Atlanta University Fisk University Hampton University Howard University Morehouse College Tuskegee University
Public historically Black universities	Albany State University Cheyney University Florida A&M University Norfolk State University North Carolina Central University Tennessee State University
Liberal arts colleges	Amherst College Claremont-McKenna College DePauw University Haverford College Lafayette College Occidental College Pomona College Saint John's University (Minnesota) Swarthmore College Vassar College Wabash College Williams College
Comprehensive state universities	Brooklyn College, City University of New York California State Polytechnic University, Pomona California State University, Long Beach Lock Haven University Towson University Valdosta State University

point averages above 3.0, established lengthy records of leadership and engagement in multiple student organizations, developed meaningful relationships with campus administrators and faculty outside the classroom, participated in enriching educational experiences (for example, summer research programs, internships, and study abroad programs), and earned numerous merit-based scholarships and honors in recognition of their undergraduate achievements. Each student participated in a two- to three-hour face-to-face individual interview on his campus, and some participated in follow-up interviews by telephone.

The NBMCAS magnifies lessons learned from undergraduates who maximized their college experiences and moves beyond the deficit perspective by highlighting institutional agents, policies, programs, and resources that help Black men achieve desired educational outcomes across a range of different institutional contexts. Instead of adding to the now exhaustive body of literature and conversations that highlight all the reasons why Black male participation, engagement, and attainment in higher education are so low (Harper, 2009), I used trajectory analyses to understand how the 219 Black male achievers managed to gain admission to their institutions, overcome hurdles that typically disadvantage their peers, and amass profiles and portfolios of experiences that rendered them competitive for internships, jobs, and admission to highly-selective graduate and professional schools. Fifty-one participants in the NBMCAS (23.3 percent) were STEM majors (see Table 6.2).

In the interviews, considerable emphasis was placed on the students' precollege experiences and the role of parents, peers, and significant others in the formation of their college aspirations. Questions then captured chronologically what the 219 men experienced, who was supportive, and which interventions enhanced their educational experiences and enabled their achievement. Understanding what compelled them to become actively engaged, both inside and outside the classroom, was chosen over the popular approach of trying to discover all the reasons why Black men are so disengaged on college campuses. And instead of focusing on the resources, social and cultural capital, and precollege educational privilege that some participants lacked, efforts were devoted to understanding how they managed to acquire various forms of capital that they did not possess upon entry to their respective colleges and universities.

Also explored was how these students resolved identity conflicts, negotiated popularity alongside achievement in peer groups, and thrived in environments that were sometimes racist and often culturally unresponsive. In sum, the focus was on understanding why Black men excel instead of adding to the already well-understood reasons why they fail. Shown in Table 6.3 is a sample of commonly explored research questions that I reframed to amplify the upside of achievement. Some of my other research describes deeper insights into some of these questions (see Harper, 2004, 2005, 2006, 2008, 2009, 2010; Harper and Quaye, 2007).

Table 6.2. National Black Male College Achievement Study STEM Participant Demographics

Class standing (number)	
First year	1
Sophomores	11
Juniors	12
Seniors	27
Socioeconomic background (%)	
Low income	13.8
Working class	39.2
Middle class	45.1
Financially affluent	1.9
Mean high school GPA	3.60
Mean college GPA	3.44
Undergraduate major (%)	
Computer science/technology	19.6
Biological/life sciences	37.2
Engineering	25.5
Mathematics	5.9
Physical sciences	11.8
Post-undergraduate plans (%)	
Graduate school	82.4
Full-time work	9.8
Unsure	7.8
Ultimate degree aspiration (%)	
Bachelor's degree	1.9
Master's degree	25.5
Doctoral degree	72.6

Note: There were fifty-one STEM majors in the sample.

Given the similarities in deficit-oriented inquiry concerning Black and Latino students in STEM (see Table 6.4), comparable frameworks and methodological approaches used in the NBMCAS are long overdue in the study of students of color and their achievement in STEM fields.

Framework Overview

Presented in Figure 6.1 is an anti-deficit achievement framework that I customized for the study of students of color in STEM. The framework includes a series of possible questions that researchers could explore to better understand how students of color persist and successfully navigate their ways to and through various junctures of the STEM pipeline. This is not intended to be a prescriptive register of research topics; instead, it is an example of anti-deficit questions that would shed light on three pipeline points (pre-college socialization and readiness, college achievement,

Table 6.3. Sample Reframed Research Questions Explored in the NBMCAS

Deficit-Oriented Questions	*Anti-Deficit Reframing*
Why do so few Black male students enroll in college?	How were college aspirations cultivated among Black male undergraduates who are currently enrolled?
Why are Black male undergraduates so disengaged in campus leadership positions and out-of-class activities?	What compelled Black male students to pursue leadership and engagement opportunities on their campuses?
Why are Black male students' rates of persistence and degree attainment lowest among both sexes and all racial/ethnic groups in higher education?	How did Black men manage to persist and earn their degrees, despite transition issues, racist stereotypes, academic underpreparedness, and other negative forces?
Why are Black male students' grade point averages often the lowest among both sexes and all racial/ethnic groups on many campuses?	What resources proved most effective in helping Black male achievers earn GPAs above 3.0 in a variety of majors, including STEM fields?
Why are Black men's relationships with faculty and administrators so weak?	How did Black men go about cultivating meaningful, value-added relationships with key institutional agents?

and post-college persistence in STEM) and nine researchable dimensions of achievement (familial factors, K–12 school forces, out-of-school college preparatory experiences, classroom interactions, out-of-class engagement, experiential and external opportunities, industry careers, graduate school enrollment, and research careers).

While the sample questions provided in the framework are flexible and exchangeable, they are designed to be "instead of" queries; that is, instead of relying on existing theories and conceptual models to repeatedly examine deficits, researchers using this framework should deliberately attempt to discover how some students of color have managed to succeed in STEM. The anti-deficit achievement framework is informed by the theories from psychology, sociology, and education, each of which can be explored in an *instead-of* fashion:

Cultural capital and social capital theories (Bourdieu, 1986, 1987). Instead of exploring how those who attended low-resource K–12 schools lack prior exposure to high-level science instruction, cutting-edge

Table 6.4. Sample Reframed Research Questions for Students of Color in STEM

Deficit-Oriented Questions	*Anti-Deficit Reframing*
Why do so few pursue STEM majors?	What stimulates and sustains students' interest in attaining degrees in STEM fields?
Why are they so underprepared for college-level mathematics and science courses?	How do STEM achievers from low-resource high schools transcend academic underpreparedness and previous educational disadvantage?
Why are their grades and other indicators of academic achievement disproportionately lower than those of their White and Asian American counterparts?	What enables students of color in STEM to make the dean's list, compete for prestigious fellowships and research opportunities, and earn high GPAs?
Why do so many change their majors to non-STEM fields?	What compels students of color to persist in STEM fields, despite academic challenge and the underrepresentation of same-race peers and faculty?
Why do so few continue on to graduate degree programs in STEM?	What are common aspects of students' pathways from high school completion through doctoral degree attainment in STEM fields?

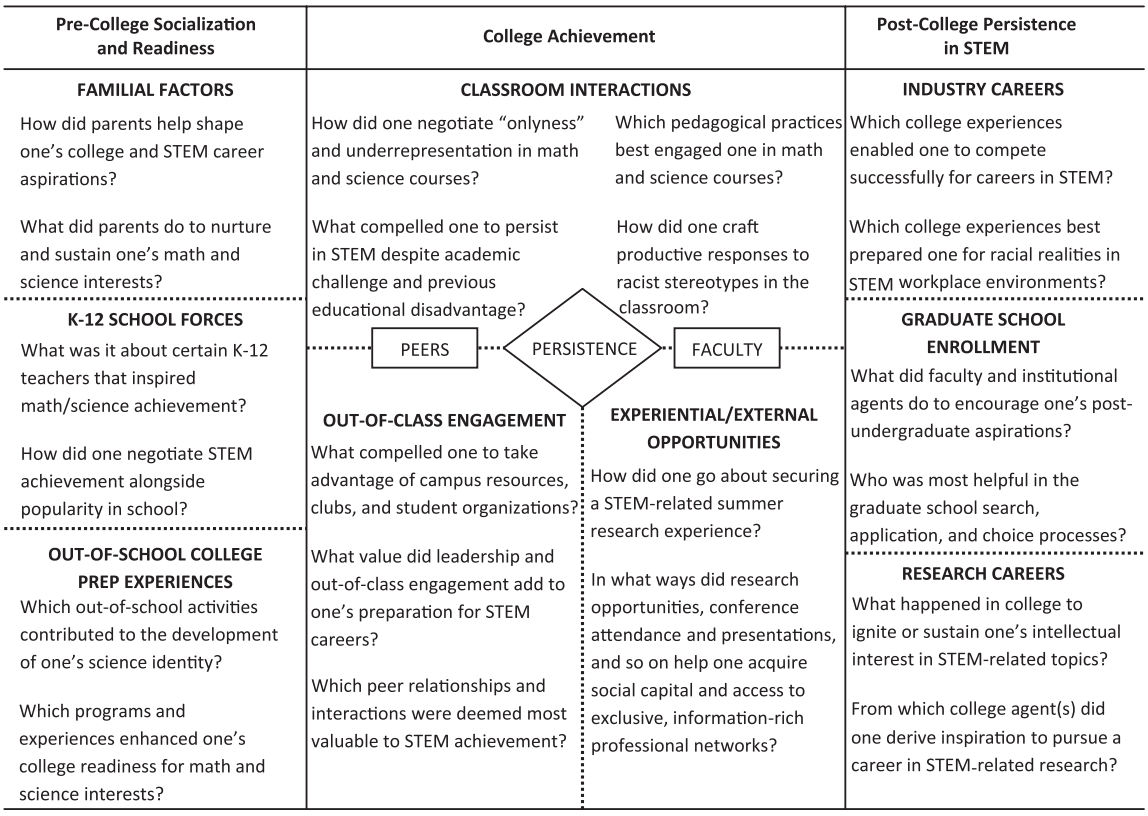
technologies, sophisticated lab equipment, and insider knowledge shared among family members who have taken college-level STEM courses, an anti-deficit inquiry focuses on understanding how achievers from these backgrounds manage to overcome such disadvantage. Moreover, an anti-deficit inquiry attempts to elucidate how minority students, particularly those from lower-income and working-class backgrounds, cultivate meaningful and value-added relationships with STEM faculty and professionally well-connected others in their fields.

Stereotype threat theory (Steele, 1997; Steele and Aronson, 1995). Instead of further examining how racist stereotypes have a negative effect on minority student performance in STEM courses, an anti-deficit inquiry pursues insights into strategies these students employ to resist the internalization of discouraging misconceptions about members of their racial groups and how they manage to respond productively to stereotypes they encounter on campus.

Attribution theory (Weiner, 1985). An anti-deficit inquiry invites minority STEM achievers to name the persons, resources, experiences, and opportunities to which they attribute their achievements instead of continually having them identify all the barriers to persistence and success.

Campus ecology theories (Moos, 1986; Strange and Banning, 2001). Instead of repeatedly documenting how few minority persons are in STEM

Figure 6.1. Anti-Deficit Achievement Framework for Studying Students of Color in STEM



classrooms, an anti-deficit inquiry tries to explain how a student of color who is one of few non-White persons in her or his major manages to thrive and negotiate environments that are culturally foreign, unresponsive, politically complex, and overwhelmingly White.

Self-efficacy theory (Bandura, 1997). Instead of routinely asking why some students of color struggle to perform well in college-level science and math, an anti-deficit inquiry seeks to understand how achievers develop science identities, how their confidence in specific science- and math-related tasks is developed, and how recognition of competence in certain tasks leads to various forms of achievement in others.

Critical race theory (Harper, 2009; Solórzano and Yosso, 2002; Yosso, 2005). Instead of relying on deficit-laden reinforcements of minority student underachievement from the education and social science literature, an anti-deficit inquiry recognizes students of color as experts on their experiential realities and empowers them to offer counternarratives concerning their success in STEM fields.

Theories on college student retention (Swail, Redd, and Perna, 2003; Tinto, 1993). An anti-deficit inquiry explores the undercurrents of retention in STEM and factors that keep students of color enrolled through degree attainment instead of concentrating on the social, academic and cognitive, financial, and institutional barriers to persistence.

Possible selves theory (Markus and Nurius, 1986; Oyserman, Grant, and Ager, 1995). Instead of surveying those who dropped out the STEM pipeline, an anti-deficit inquiry takes account of which experiences afford STEM persisters opportunities to envision themselves in future long-term careers as chemists, mechanical engineers, math professors, and so on.

These are just some examples of how researchers can use popular theories in uncommon ways to advance the study of minority student achievement in STEM.

At the core of the post-secondary pipeline point in the framework is persistence toward degree attainment. Higher education researchers have consistently discovered that peers exert an extraordinarily powerful influence on college student persistence, achievement, and outcomes (Astin, 1993; Pascarella and Terenzini, 2005). Moreover, other studies (for example, Cole and Espinoza, 2008; Hurtado and others, 2009; Leslie, McClure, and Oaxaca, 1998) have uncovered the nexus between student-faculty interaction and success in STEM, especially among students of color. Hence, peers and faculty are pivotal to persistence and are at the center of the framework.

In sum, this framework is mostly about the questions researchers ask. Implicit is an important overarching assumption: those who endeavor to improve student success in STEM would learn much by inviting those who have been successful to offer explanatory insights into their

success. Posing the twenty-one sample questions provided in Figure 6.1 (and other queries that are similarly framed) to STEM achievers who made it through the first year of college with a GPA above 3.0, persisted through baccalaureate degree attainment without changing their majors, transitioned immediately to graduate programs in STEM fields, and ultimately became researchers or industry professionals would yield instructive implications for higher education scholars, parents, K–12 teachers, college faculty, and policymakers who care much about increasing STEM degree attainment.

Conclusion

STEM majors who participated in the NBMCAS named specific programs that exposed them to college and contributed to their readiness for first-year math and science courses: the Detroit Area Pre-College Engineering Program, the University of Michigan Summer Engineering Academy, and the Minority Introduction to Engineering and Science Program at MIT, to name a few. They also reflected on how same-race peers played a critical role in fostering their sense of belonging in STEM courses, talked about how the National Society of Black Engineers and other student organizations enabled them to connect with other minority STEM achievers, and identified key undergraduate experiences that cemented their long-term commitments to science research (for example, Cullen Buie, who graduated from Ohio State having done extensive robotics research with Greg Washington, went on to earn a Ph.D. in mechanical engineering from Stanford and is now a tenure-track assistant professor at MIT). I have reported these and other findings from the NBMCAS in various publications (see Harper, 2004, 2005, 2006, 2008, 2009, 2010; Harper and Quaye, 2007). Because the NBMCAS included but was not exclusively a study of Black men in STEM, findings reported in my other studies do not reflect the fullness of what researchers could discover if they were to undertake a study using the STEM-specific framework introduced in this chapter. Much remains unknown about what enables students of color to succeed in STEM fields.

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