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“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

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Stereotype management is introduced to explain high achievement and resilience among 23 Black mathematics and engineering college students. Characterized as a tactical response to ubiquitous forms of racism and racialized experiences across school and non-school contexts, stereotype management emerged along overlapping paths of racial, gender, and mathematics identity development. Interviews revealed that although stereotype management facilitated success in these domains, the students maintained an intense and perpetual state of awareness that their racial identities and Blackness are undervalued and constantly under assault within mathematics and engineering contexts. With age development and maturity, the students progressed from being preoccupied with attempts to prove stereotypes wrong to adopting more self-defined reasons to achieve. The results suggest that stereotype threat is not deterministic.

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KEYWORDS: racial stereotypes, identity, mathematics and engineering education, Black students, higher education, high achievement

Introduction

Mathematicians are old White men. You would never fit in. . . . And Gladis, I mean that as a compliment. (Comments directed to an African American female participant by a sixth-grade science teacher)

Yes, there is engineering . . . but you should pick a major that you are more likely and able to graduate in. (Comments directed to an African American male participant by his mathematics teacher)

Make sure you get a Chinese or Asian roommate! (Joke from an AP high school mathematics teacher directed to an African American male participant after announcing his intent to major in engineering)

Really? Wow! I didn't think you would be able to answer a question like that! And no one helped you? (Comment from an engineering professor directed to an African American female participant)

Much has been written about the phenomenon of *stereotype threat* and its effect on the academic performance of African American students (Blascovich, Spencer, Quinn, & Steele, 2001; Chavous, Harris, Rivas, Helaire, & Green, 2004; Howard & Hammond, 1985; Moore, Madison-Colmore, & Smith, 2003; Steele, 1997, 1999; Steele & Aronson, 1995, 1998; Steele, Spencer, & Aronson, 2002). Stereotype threat is defined as a type of confirmation bias in which the threat of being viewed through the lens of a negative stereotype or the fear of doing something that would inadvertently confirm that stereotype suppresses academic performance among Black students at all academic levels. In the context of standardized math tests, Black students who are aware of racial stereotypes related to mathematics ability may experience anxiety related to the confirmation of those stereotypes, and as a result, their performance on math tests will suffer (Steele & Aronson, 1995, 1998). More generally, in contexts where racial stereotypes are particularly salient, members of the negatively stereotyped groups will be conscious of the content of those stereotypes, and this may negatively affect their performance. Contributing to this threatening atmosphere are comments like those presented at the beginning of this article.

Related to stereotype threat is the literature on *stereotype lift*. Stereotype lift research primarily examines the impact of racial stereotypes on non-historically marginalized groups (e.g., White males) when Blacks or other marginalized groups are stereotyped. Stereotype lift is the performance boost of one group that occurs when negative comparisons are made with a disparaging group (Walton & Cohen, 2003). People may benefit from stereotype lift

when the ability or worth of the group being placed at deficit status is explicitly called into question.

Despite a great deal of evidence that stereotype threat can negatively affect intellectual performance (Chavous et al., 2004; Harpalani, 2007; Oyserman, Brickman, & Rhodes, 2007; Taylor & Antony, 2000), little is known about how Black students in particular *manage* racial stereotypes, even to the point of using them as a motivator for high academic achievement (Harpalani, 2007). In our view, this management is rooted in students' developing understandings of racism and their developing senses of, negotiations of, and assertions of what it means to *be Black*. As a result, students do not automatically experience a suppression of performance in situations where stereotypes exist. Moreover, because students define Blackness on their own terms, they are able to triumph over situational suggestions of Black inferiority.

We present the results of a study of academically successful and academically resilient Black mathematics and engineering college students (McGee, 2009). Life-story interviews of 23 students from four Midwestern universities revealed that these students achieved and maintained their academic success based on different motivations and responses to both perceived and real racism. This study provides evidence of racial stereotypes serving as one of the multiple motivators toward the production of high achievement in mathematics and engineering (McGee, 2009). Over the course of their lives, the students were inclined to recognize these stereotypes, but as a result of key life transitions and recognizing the permanence of racism (D. A. Bell, 1992; Omi & Winant, 1994), they consciously chose not to utilize their energies to get rid of them.

In the discussion that follows, we emphasize the social construction of reality and utilize an interpretive approach to the meanings that individuals give to their phenomenal Black realities in academic and nonacademic contexts (Berger & Luckmann, 1966; Denzin, 1994; Denzin & Lincoln, 2000; Guba & Lincoln, 2005; Ladson-Billings, 2000). Our focus on race does not imply that race, class, and gender intersections are unimportant. However, more nuanced understandings of race—understandings that do not reinforce deficit explanations for disparities in achievement and schooling experiences—must be developed among mathematics and science educators if these intersections are to be seriously considered (Martin, 2009b).

We wish to note that in highlighting racial stereotypes as a motivator, we are not suggesting the introduction of racist stereotypes to promote academic achievement among Black students. Instead, for the students discussed in this article, the ubiquity of these stereotypes was the point of departure and the impetus for the exercise of *positive* agency.

Success, Not Failure

For us, studying successful students is an approach that affirms the pursuit of education by Black students in spite of institutional and structural

obstacles (Anderson, 1988, 1995; Harding, 1981; Perry, 2003). By analyzing the stories of successful Black college students and the larger narratives in which their experiences are embedded, this study takes a fresh look at how mathematics and engineering education can be strengthened by probing the factors that help Black mathematics and engineering students succeed. Additionally, we propose a deeper appreciation of what it means to be Black and academically successful in contexts where Black students are few in number and where negative societal- and school-level beliefs about their ability and motivation persist.

Our focus on the students' developing understandings and assertions of what it means to be Black implicates a concern with racial identity development in the context of mathematics, science, and engineering.¹ Racial identity has been commonly defined as the extent to which race influences a person's self-concept and consequent behavior (Cross, 1991; Sellers, Rowley, Chavous, Shelton, & Smith, 1997). In a society where racial-group membership is emphasized, the development of a racial identity will occur in some form in everyone. Many racial identity scholars (Cross, 1991; Helms, 1990; Sellers et al., 1997) suggest that because of the nature of the Black/White, subordinate/dominant paradigm that exists within our society, it should come as no surprise that the development of racial identity processes is heterogeneous and situation specific. Understanding the extent to which being Black was central to the students portrayed in this article allowed for a better understanding of how and why they responded to assaults on their identities (Cross, 1991; Sellers, Chavous, & Cooke, 1998; Sellers, Smith, Shelton, Rowley, & Chavous, 1998).

Emerging research in mathematics and science education also shows that racial identities are co-constructed with students' disciplinary academic identities. Martin (2000, 2007), for example, has highlighted the co-construction of mathematics and racial identities for Black learners. He defined mathematics identity as follows:

Mathematics identity encompasses the dispositions and deeply held beliefs that individuals develop about their ability to participate and perform effectively in mathematical contexts and to use mathematics to change the conditions of their lives. A mathematics identity encompasses a person's self understandings as well as how they are constructed by others in the context of doing mathematics. Therefore, a mathematics identity is expressed in narrative form as a negotiated self, a negotiation between our own assertions and the external ascriptions of others. Math identities are always under construction. (Martin, 2006a, p. 206)

Research by several scholars (Atwater, 1993, 1995; McGee, 2009, under review; Ellington, 2006; Berry, 2008; Jackson 2009; J. Spencer, 2008a, 2008b, 2009; Stinson, 2006, 2009) has offered confirmation for these simultaneous

constructions of racial and disciplinary identities, showing, for example, that academically successful Black students often develop positive Black and mathematics and science identities.

Despite this emerging research, we note that across the scholarly literature in science, technology, mathematics, and engineering (STEM) education, there has been a lack of research dealing with various forms of racism in the experiences of learners. For example, Martin (2009b) has noted that within mathematics education, there has been a distortion of the concept of *race* and an inadequate theorizing of *racism*:

Within mathematics education research and policy, both race and racism remain undertheorized in relation to mathematics learning, participation, and differential outcomes in achievement and persistence. While race is characterized in the sociological and critical theory literatures as an ideological construction with structural expressions, most studies of differential outcomes in mathematics education begin and end their analyses of race with static racial categories and group labels used for the sole purpose of disaggregating data. One consequence is a widely accepted, and largely uncontested, racial hierarchy of mathematical ability. Disparities in achievement and persistence are inadequately framed as reflecting race effects rather than as consequences of the racialized nature of students' mathematical experiences. (p. 315)

Moreover, the voices of Black learners themselves are often absent from the larger discourse on achievement and persistence outcomes, particularly of those who have successfully negotiated the mathematics, science, and engineering pipelines. Considering the preponderance of research highlighting Black failure, there is a significant gap in understanding success among Black students in the academically competitive and socially valued STEM disciplines (Berry, 2008; Ellington, 2006; Fullilove & Treisman, 1990; Gutiérrez, 2000; Hrabowski & Maton, 1995; Martin, 2000, 2007, 2009a; Maton, Hrabowski, & Schmitt, 2000; McGee, 2009, under review; Moody, 2003; Stinson, 2006, 2009; Tate, 2005a; Fullilove & Treisman, 1990).

Critical Race Theory and Racial Micro-Aggressions

Researchers have used several approaches to better understand the roles that racism and the meanings for race play in the academic experiences of Black students, including understanding the interplay between everyday racism (e.g., Essed, 1991, 2002), institutional racism (e.g., Lewis, 2003; Marable, 2011), structural racism (e.g., Bonilla-Silva, 1997, 2001, 2003), and colorblind racism (e.g., Bonilla-Silva, 2003).

Recently, a number of scholars have employed critical race theory (CRT; Bell, 1992, 2004; Delgado & Stefancic, 2001; Dixon, 2011; Decuir & Dixon, 2004; Ladson-Billings & Tate, 1995; Lynn & Bridges, 2009; Milner, 2008;

Parker & Stovall, 2004; Solórzano, Ceja, & Yosso, 2000; Stovall, 2006). CRT has been used as a framework for examining "persistent racial inequities in education, qualitative research methods, pedagogy and practice, the schooling experiences of marginalized students of color, and the efficacy of race-conscious education policy" (Lynn & Parker, 2006, p. 257). As a method of inquiry and critique, CRT is characterized by the following:

1. draws from an historical perspective that incorporates the work of critical legal and education scholars concerned about racism in education;
2. extends and expands the "scholarship of the people," which is overwhelmingly by scholars of color, for people of color, affected by or concerned about education;
3. allows for linkages to other "race-based epistemologies" (e.g., Black racial identity) to provide a more holistic approach for illuminating and solving problems in education.

A more recent focus of critical race theory is the framing of micro-aggressions, defined as "subtle, stunning, often automatic, and nonverbal exchanges which are 'put downs' of blacks by offenders" (Solórzano et al., 2000, p. 145). Research suggests that when Black college students in predominantly White college environments experience racial micro-aggressions (e.g., a professor's low expectations for academic achievement, undue scrutiny of minority social events by campus police, a feeling of exclusion during the formation of study groups, and inaction on the part of authority figures when racial injustices occur), they can feel academically and socially alienated. As a defense mechanism, these students often created their own counterspaces. These alternative spaces typically include race-based campus and community organizations (Crocker & Major, 1989; Solórzano et al., 2000; Sue et al., 2007).

While acknowledging the multiple forms of racial discrimination, including racial micro-aggressions that can emerge in higher education contexts, we are particularly concerned with racial stereotypes. The results of this study will show that these sometimes subtle, yet pervasive reminders of the racial hierarchy on college campuses are a key factor in how African American students perceive and respond to their college experiences. In this article, our goal is not to evaluate the stereotypes themselves. We focus instead on how Black students respond to and *manage* these stereotypes while maintaining high achievement in competitive majors like mathematics and engineering, academic areas that are particularly rife with gross inequities in participation and prone to racial stereotypes about ability and competence (Martin, 2009b; McGee, under review; Nasir, McLaughlin, & Jones, 2009; J. Spencer, 2008a, 2008b, 2009; Stinson, 2006; Strutchens & Silver, 2000; Tate, 1994, 1995a, 1995b).

Stereotype Threat

As a result of educational inequities and court-sanctioned discrimination that has institutionalized differential access to education, Black students in America have endured myriad hardships that have often challenged and impeded their academic achievements (D. A. Bell, 2004; Darling-Hammond, 2007; B. Harper, 2007; Kozol, 2005; Ladson-Billings, 2006, 2008; Tillman, 2008). A number of researchers have documented the inferior education, lack of in-school and community resources, obsolete curricula and teaching methods, dilapidated facilities, and inexperienced teachers that are commonplace in predominantly low-income Black communities (Anderson, 1988, 2002; Darling-Hammond, 2007; Hale, 2001; King, 1991; Kozol, 1991; Lewis, 2003; Noguera, 2003; Oakes, 1990; Perry, 2003).

Moreover, Blacks have been socially constructed as biologically, intellectually, and culturally inferior to Whites, and this construction has persisted (Blum, 2002; Frederickson, 2002; Omi & Winant, 1994; Zack, 2002). Blacks have been, and continue to be, associated with terms such as: *poverty, ignorance, shiftless, immoral, inferior, and an overall general nuisance*. Black students have been further victimized by notions that they are intellectually inferior to other social groups, particularly in discussions of so-called racial achievement gaps (Herrnstein & Murray, 1994; Thernstrom & Thernstrom, 2003).

Although highly informative, we argue that the research on stereotypes and racial micro-aggressions still paints an incomplete picture of Black students in the areas of mathematics and engineering. For example, Steele tested the negative environmental condition of racism (through racial preference) with a series of experiments in which academically able Black students were cued about race before engaging in an intellectual task. Their subsequent performance was lower than that of Blacks who did not receive such cues (Steele, 1997, 1999; Steele & Aronson, 1998). The students in our study did not need experimental prompts or cues that their mathematics and engineering classrooms were breeding grounds for stereotypes. Most of the students described racial stereotypes as ubiquitous and were inclined to take a stance that they simply existed. Additionally, tests and exams were a small part of the overall mathematics and engineering socializations and experiences of these students. Moreover, Steele's and critical race theorists' work does not detail the process by which students manage racial stereotypes and racial micro-aggressions over time throughout their academic and social experiences.

As we will show in the following, as students began to understand the nature of racism, perpetuated through bias and stereotypes, they adopted more psychologically affirming strategies for academic resilience in spite of stereotypes rather than internalizing their understandings to the degree that it lessened their performance. Students responded to the stereotypes

by exercising agency and achieving success. Research on stereotype threat also does not unpack the complicated and sometimes subtle nature of cues that may trigger Black students' awareness that they are being stereotyped. As our discussion will show, cues as simple as a look of disbelief at a Black student entering into a high-level mathematics classroom or being excessively praised for a correct mathematics answer can complicate the perceptions and strategies of these students in how they navigate their mathematics education. Steele (1997) does note that African American students can feel that their intelligence and ability are always on trial, even while they are effectively interacting and succeeding across cultures; however, he provides less evidence on how stereotype threat manifests itself in real versus experimental environments.

Stereotype Management

Stereotype management is introduced to explain academic resilience (traditionally valued high achievement in spite of negative intellectual and societal based stereotypes and other forms of racial bias) among Black mathematics and engineering students. Described as a tactical response to the ongoing presence of stereotype threat, stereotype management emerged along overlapping paths of racial, gender, and mathematics identity development. We further demonstrate that although stereotype management fosters engineering and mathematics success, the participants in this study maintained a concentrated and constant state of awareness that being Black is conceptualized by others as a marker of inferiority in mathematics and engineering contexts. With age development and maturity, the students progressed from more fragile mathematics and engineering identities, characterized by attempts to prove stereotypes wrong, to a more robust form, characterized by a desire to serve as a role model for marginalized learners of color.

Although the participants reacted deeply to their racialized environments, many of the self-defense mechanisms required that their true feelings remain internalized. However, we determined that such reactions are not necessarily maladaptive but may suggest *necessary and strategic responses* for attending to frequently unacknowledged and structurally organized barriers and systemic challenges (McGee & Spencer, in press). Management of stereotypes represents one such response.

In the following, we present three fundamental differences between stereotype management and stereotype threat that emerged from the results of this research (see Table 1). The first difference has to do with how the racial stereotypes are manifested. Researchers who study stereotype threat typically do so by manufacturing situations that are most likely to lead to stereotype threat. Steele and Aronson (1995), for example, simply had Black college students indicate their race prior to taking a test. They found that

Table 1
Three Fundamental Differences in Stereotype Threat and Stereotype Management

Stereotype Threat	Stereotype Management
The stereotype has to be primed Leads to academic disengagement	The stereotype is omnipresent Leads to additional motivation for high achievement
Experimental/manufactured in mostly test-taking situations	Everyday micro-aggressions inside and outside the classroom

merely asking participants to indicate their race caused Black students' anxiety to increase and their test scores to drop, even though the test had been described as nondiagnostic of ability. However, our study concluded that stereotypes or the threat of being stereotyped, particularly at predominately White secondary institutions, were ubiquitous. This observation is not about particular individuals but more about campus climates. The students did express that they felt more stereotyped in situations in which there were only a few or no other Blacks present, demonstrating how particular situations were more inclined to activate stereotypes. However, even when they were studying at home alone, for example, participants still felt burdened by the notion that they had to prove that they were worthy of being perceived as intellectually capable. Therefore, once the stereotype has been activated and perceived as a racialized threat, its longevity exists far past the situation or event in which the student was stereotyped.

The second difference has to do with the academic consequences of being stereotyped. Research on stereotype threat concludes that students disengage academically or perform more poorly if they strongly identify with the domain (e.g., math or engineering, being Black). Our data on stereotype management suggest that being stereotyped creates an extra incentive to not only perform as well as the students typically stereotyped as high achieving in mathematics and engineering (e.g., White, Asian), but some students strived to score better than those students or the best student in the class.

The third difference involves the research methods used to explore stereotypes. Stereotype threat has been replicated in over 300 peer-reviewed journal articles (see Nguyen & Ryan, 2008, for a meta-analysis). The effects of being stereotyped have been studied using test-taking and other experimental conditions. Recent work from Steele (2010) uses dramatic personal stories, along with quantitative analysis, to detail the experiences and outcomes of negative stereotyping. The method used to explore students' meaning making for stereotypes and their subsequent responses in our study

is grounded in qualitative research methods, particularly in the psychology of life stories type of analysis (McAdams, 2001, 2008a, 2008b; McAdams, Josselson, & Lieblich, 2006), counterstorytelling (Delgado, 2000), and identity development perspectives (M. B. Spencer, 2006, 2008; M. B. Spencer et al., 2006).

Research Questions

The previous discussion and our beliefs about the need to extend research on stereotype threat to include real-time, nonexperimental conditions and retrospective accounts by students on how they effectively deal with racism and stereotypes speak to the following questions:

Research Question 1: How do a select group of Black college mathematics and engineering students develop success-oriented belief systems and identities and interpret high achievement outcomes?

Research Question 2: To what extent do academically successful Black college students characterize and respond to learning and participation in mathematics and engineering as racialized forms of experience?

Research Question 3: How do they recognize, respond to, and manage these racialized experiences and the stereotypes that emerge?

Research Question 4: What factors promote and motivate these students to remain resilient in the face of these stereotypes?

Context and Method

Over the course of the 2006-2008 academic years, the first author interviewed 23 high-achieving Black mathematics and engineering students (juniors, seniors, graduate students) from four Midwestern universities: Browning University (5 students), Soho University (4 students), Medium University (8 students), and Ivy University (6 students).

Institutions

Medium University and Browning University are public institutions located in large urban cities in the Midwest that serve the local populations. Medium University is primarily a commuter campus and has a student population between 20,000 and 30,000. About 90% of Medium's students are residents of the state. Browning University largely enrolls Blacks who seek relatively affordable postsecondary education. Many of the Browning students may be considered "nontraditional," that is, many students were over the age of 24. Soho University, although located on the south side of a large urban Midwestern city, houses a large international population and caters to science, technology, engineering, and mathematics students. Ivy University, a private institution, is located in a Midwestern affluent suburb

and attracts an international and middle- to upper-class student population due to its academic reputation and high tuition costs. Using the four institutions selected was valuable because their respective social contexts reflected varying pressures and supports that bear upon the students' identities as *Black* mathematics and engineering learners. Across these contexts, students assert their own understandings of Blackness and respond to and negotiate the ways Blackness is defined and perceived in each of these contexts.

Students

The 23 participants—14 males and 9 females—ranged in age from 19 to 45, with the median age being 26.3 years. Of the 23 students, 4 males and 2 females were attending graduate school. Of the 6 graduate students, 3 were in master's programs, and the other 3 students were in PhD-level mathematics or engineering programs (see Table 2).

Campus programs serving Black students, particularly those in engineering and mathematics (e.g., National Society of Black Engineers [NSBE] and the Black Student Union), were targeted for participant recruitment. Each participant who completed the interviewing process received \$10. The selection criteria for the students included Black or African American self-identification, along with standard measures of high academic and mathematics achievement. The criteria for undergraduate participation were (a) unofficial college transcripts that indicated the participants' junior or senior status or graduate-level mathematics or engineering majors, (b) maintenance of at least a 2.9 grade point average (on a 4.0 scale) in mathematics courses, (c) successful completion of at least 10 mathematics and/or engineering-related courses, and (d) an A or B in at least five of those classes. The overall grade point averages (GPA) of the students in this study ranged from 2.9 to 4.4 (some students received graduate-level credits), with a median of 3.4 (several students received over 4.0 by enrolling in graduate-level courses). For graduate students, the criteria were being a recipient of a bachelor's of science degree in mathematics or engineering and pursuit of graduate-level mathematics and engineering degrees. Table 2 provides demographic information and the distribution of the students across these four universities.

Although we use the term *Black* in this study to describe both U.S.-born Black Americans and non-U.S.-born Blacks, we are cognizant of the nuances in racial identity that may occur for reasons that deal with nationality and culture. For example, a U.S.-born Black American student may have a vastly different racial identity than a Black student who was raised in Ghana and has recently come to the United States for educational reasons. The first author performed a pilot study that involved 4 non-U.S.-born Blacks (2 males from Nigeria, 1 female from Kenya, and 1 male from Kenya) and 5 U.S.-born Blacks, who were all graduating seniors in an undergraduate mathematics or engineering program. Results of that study showed that

Table 2
All 23 Participants

Graduate Students						
Name	Age	Gender	College	Grad Major	Intended Career	Graduate Level
Rob	40	Male	Soho	Mathematics	Professor	PhD
Jimmy	25	Male	Ivy	Biomedical engineering	University professor	PhD
Valerie	24	Female	Ivy	Biochemical engineering	College professor	PhD
Wisdom	26	Female	Medium	Biomedical engineering	Professor or business owner	MS
Jamal	28	Male	Medium	Engineering computer science	Math test engineer	MS
Albert	25	Male	Medium	Applied mathematics	Return to Nigeria for unspecified work	MS
Undergraduate Students						
Name	Age	Gender	College	Major	Intended Career	Intended Grad Major
Cory	20	Male	Soho	Applied math	Math professor or cryptologist	Math
Rich	23	Male	Soho	Chemical engineering	Entrepreneur	MBA
Mike	26	Male	Soho	Mechanical engineering	Full-time pastor	Divinity
Denise	45	Female	Browning	Applied math	Entrepreneur	No grad school
Hakeem	39	Male	Browning	Math	Teacher	No grad school
Damon	29	Male	Browning	Electrical engineering	Electrical engineer	No grad school
Gladis	40	Female	Browning	Applied math	College professor	Math
Lisa	26	Female	Browning	Math	Undecided	Applied math and physics
Anita	25	Female	Medium	Electrical engineering	Lobbyist or teacher	Energy policy
Supo	19	Male	Medium	Mechanical engineering	Engineer	Mechanical or electrical engineering
Tiffany	24	Female	Medium	Electrical engineering	Undecided	Engineering education
Bobby	22	Male	Medium	Industrial engineering	Business owner	MBA
Feya	24	Female	Medium	Civil engineering	Math professor	Civil engineering or math
Chrissy	19	Female	Ivy	Electrical engineering	Electrical engineering or management	Electrical engineering
Olu	20	Male	Ivy	Electrical engineering	Management	Management
Chalmus	21	Male	Ivy	Mechanical engineering	Entrepreneur	MBA
Calvin	21	Male	Ivy	Civil engineering	Eng planner	Civil engineering or transportation

the non-U.S.-born students, despite their identifications with their country of birth, became acutely aware of their Blackness as a result of systematic and blatant racism in the U.S. context. As a result, some U.S. Blacks and non-U.S. Black mathematics and engineering majors formed common identities based on their shared experiences in America.

Of the 6 graduate students, 4 were U.S.-born Blacks. Albert and Jamal are non-U.S.-born Blacks. Albert relocated to the United States from Nigeria for both his undergraduate and graduate education. Jamal was born outside the United States and was raised and educated in Ghana for his K-16 education. The 17 undergraduate student participants consisted of 10 males and 7 females. All of the undergraduate students were enrolled in school full-time, except for Gladis, who was enrolled part-time and worked full-time for the transit system. Of the students, 5 were mathematics majors and the rest were engineering majors (civil, chemical, computer, electrical, and mechanical engineering). All except 3 of the undergraduate students planned to enroll in graduate school. The intended careers of these students also varied widely, with teacher/professor, entrepreneur, and engineers topping the list. In addition, 4 of the 16 students started careers before entering college, and 10 of the participants worked part-time while attending school full-time. Before enrolling in college, Denise was a flight attendant, Damon served in the United States Marines, Tinesha taught at a charter school, and Feya was an administrative assistant. Of the undergraduate students, 8 had been in college at least 6 years; 1 student had been in and out of college for over 20 years. Of the 5 students who changed their majors in college, 3 switched between engineering and mathematics disciplines. Lisa was a former elementary education major, and Tiffany entered college undecided.

Interviews

Primary data for this project were collected through videotaped recorded interviews. The use of digital video allowed for analysis of participants' words and actions, including gestures, intonation, pauses, and inflections; clipping of relevant segments; and organization of those segments into a series of frames and codes, keeping the images and/or voice of the participants intact (Crichton & Childs, 2005). It reduced the impact that the transcription process has on the content, because the transcription process itself flattens the potentially rich, three-dimensional quality of the original footage into a two-dimensional text format.

Semi-structured, life-story interviews were conducted with all 23 participants (average interview time: 86 minutes). Of these students, 6—Cory, Gladis, Lisa, Rob, and Valerie—were chosen for follow-up interviews. The 6 students were chosen specifically because of the variance in their individual recognitions (or lack thereof) of race, class, and gender as socially and personally significant factors, which operated to constrain (or

not) the life chances of people like themselves. At the time the initial interviews were scheduled, students also brought in documents that spoke to their mathematical and engineering experiences and success. The documents included old report cards, awards for mathematics or engineering achievements, and written documents regarding scholarships based on mathematics or engineering achievements.

The interview protocol consisted of a combination of semi-structured, open-ended questions as well as a two-page demographic questionnaire (see sample interview protocol in Appendix A in the online version of the journal). These questions were designed to elicit rich accounts of the students' experiences in the home, school, neighborhood, and mathematics classroom contexts. Additionally, this study explored their emerging identities—racial, mathematics, and otherwise—and the interconnections and co-constructions of these identities to inform the individual and collective senses of being Black (J. Spencer, 2008b). Each student was asked, more or less, the same series of questions to capture the variability across respondents (Patton, 1990). Measures were taken to increase the internal reliability of the interview data, such as asking more than one question about a particular construct, which additionally allowed observance of any inconsistencies in responses.

All participants completed the Multidimensional Inventory of Black Identity (MIBI), a quantitative measure of Black racial identity (Sellers, Chavous, et al., 1998; Sellers, Smith, et al., 1998). Analysis of the MIBI data can be found in McGee (2009).

Data Reduction and Analysis

Member checks were conducted with all participants in the form of reviewing the transcripts and initial coding associated with the aforementioned criteria, with 8 participants reviewing their transcripts. Tailored interview questions were designed for the 6 students who completed the second interviews.

The interview data were reduced through various levels of analysis and coding. During the coding process, performed by the first author, recollections of discrimination (racial, ethnic, gender, etc.), as defined from the students' perspectives, were extracted. Some of the initial codes included the following themes, which were categorized loosely around the students' beliefs and subsequent responses:

- Belief—Adamant defiance of racial stereotypes (*Stereotypes are not true*)

Action—attain high mathematics achievement to disrupt the stereotype in classroom and school situations (*Prove them all wrong*)

- Belief—Despair over the possible legitimacy of racial stereotypes (*Stereotype pain*)

Stereotype Management

Action—Brief (3-6 months to a year) lapse in academic and mathematics success or schooling (*Had to get away*)

- Belief—Admitting that racial stereotypes are here to stay (*It is what it is; permanence of racism*)

Action—Self-discovery/turning point that included positive explorations of Black identity (*I'm Black and I'm proud*)

Action—Self-discovery/turning point that included negative explorations of Black identity (*Those Black people . . .*)

- Belief—Need to surround oneself with likeminded people, spaces, and ideologies (*Need folk who believe in me*)

Action—Joined college organizations that prioritized the needs of African American students (*Black Power Organizations*)

Action—Joined college organizations that prioritized the needs of engineering and mathematics students (*We do math/engineering*)

Action—Seeking spaces that merged a focus on Black and disciplinary identities (*National Society of Black Engineers*)

- Belief—Strong desire to shield the next generation of Black and Brown students from negative racialized experiences (*Protect the next generation*)

Action—Students served as teachers/tutors for lower achieving, young Black/Brown students (*We serve as math teachers*)

- Belief—Males idealized competition, which was a gender-specific and accepted way of proving their abilities (*Competition, it's a male thing*)

Action—Males participated in math/sports competitions (*Competing to win*)

- Belief—Embodying parents' ideology of excellence in mathematics; perseverance despite obstacles (*My parents believe and thus, so do I*)

Action—Persistence in mathematics to make parents proud (*Doing math to make Mom/Dad proud*)

- Belief—Appreciating the beauty/love of mathematics/engineering (*I think I love it*)

Action—Maintain high achievement but for more self-directed reasons

- Belief—Wanting to be judged based on the same traditional standards of success (quizzes, exams, national tests) that others (Whites and Asians) are judged by (*Judge me fairly*)

Action—Adheres to traditional standards of maintaining mathematics/academic success (*Beating them at their own game*)

Also important to the coding and, highlighted by the actions taken behind the belief, the ways in which these students dealt with these biased experiences and how their responses impacted their academic (mathematics and engineering) achievements. Another set of codes was more situationally specific and focused on the types of strategies the respondents developed (inside and beyond the classroom) to legitimize themselves as high achievers in mathematics and engineering. Over time, many of the participants developed a toolkit to counter instances of racial bias (e.g., playing into the "Black and dumb" stereotype to beat opponents in a mathematics competition, attempting to answer every question in a math class, sitting at the front of the class to prove intellectual curiosity). The last set of codes focused on how students conceptualized their future life trajectories.

Once all the interviews were coded, each code was reviewed for common and contrasting themes among and across participants, after which data were scanned "for categories of phenomena and relationships among the categories" (Goetz & LeCompte, 1981, p. 57). After numerous revisions, an assessment of categories and subcategories revealed the following groupings: attempting to prove the stereotypes wrong, always being on point, critical perceptions and attributions of Black behavior, cultural code-switching and "frontin," excelling in mathematics and engineering to be perceived as smart, and constructing self-directed and self-determined identities. These themes, which are not mutually exclusive, will be discussed in the following.

Results

... if there had ever existed in all human history a more corroding and devastating attack upon the personalities of men than the idea of racial discrimination. (Baldwin, 1945, p. 5)

Although there is much research showing that racial stereotypes or the threat of negative racial stereotypes adversely impact academic achievement and lead to academic disengagement, the students in this study utilized their exposure to stereotypes to maintain high achievement, though not without heavy psychological cost. Opposite to the effects of lower academic performance, for these students, higher academic performance and persistence was, at least in part, a response to the negative cultural views of Blacks.

Development of Stereotype Management

The participants entered primary school mostly naïve about racial stereotypes. Through school socialization they quickly realized the presence and power of racial stereotypes, particularly inside mathematics classrooms.

The most chilling stereotype revolved around Blacks having a lack of innate ability (due to their limited intelligence) to perform at a high level in mathematics. As a result, the students felt compelled to constantly prove that they were not the mathematically or academically inferior beings that their *minority* status implied for others.

Once the students realized that their mathematics achievements and abilities were perceived in negative ways, they began to craft an assortment of strategies to lessen the threat and effect of the stereotypes. Stereotype management encompasses the strategies high-achieving students develop and utilize to cope with the strain of being racially stereotyped while maintaining traditionally high standards of academic success. Stereotype management can be seen as a tactical toolkit for asserting their academic excellence in the face of "being stereotyped."

The burden of dealing with these racial stereotypes and the daily hassles and fears that come from functioning in racially stressful environments was, at times, emotionally debilitating (Solórzano et al., 2000), even while exhibiting mathematics academic success. Yet, over time, and with the incorporation of their own unique identities, the students developed complex protective tactics that helped them deal with the burden of being negatively perceived. These newer approaches revolved around self-definitions and assertions about Blackness, but with the consideration of the collective representation of their communities through their mathematics and engineering success.

Attempting to Prove the Stereotypes Wrong

Soon after they began their educational careers, the students learned the notion of Black inferiority and specifically Black inferiority in mathematics and science. As a result of societal, school, teacher, and peer expectations, the students became preoccupied with proving these racial stereotypes wrong and sought the acceptance of the groups or individuals who thought negatively of them or of Blacks in general. Of course, some students achieved in mathematics and science, during all levels of academic education, for a multitude of reasons and not solely motivated by racial stereotypes (e.g., parental expectations, personal affinity for the subject, desire to pursue a mathematics-based field, it was easy for them). Whether already exhibiting success in mathematics prior to hearing those messages or having been recently introduced to racial stereotypes about mathematics achievement and ability, the respondents expressed deep contempt for racial stereotypes and other forms of discrimination revolving around Blacks and mathematics. This was more evident for students who were raised in predominately White neighborhoods and schools. After some contemplation, the students decided that part of their academic mission was to prove the stereotype wrong by achieving in mathematics. The participants initially thought they would be able to create the conditions necessary to make stereotypes disappear, in

part through their high achievement in mathematics and engineering. The participants generated criteria by which to achieve and fight against the stereotype. The respondents operated within a broad set of motivators that included seeking the acceptance of others who project negative bias in their academic abilities, thus creating psychologically tenuous conditions.

The threat of being negatively stereotyped was an extra stress for these students. Rob, an applied mathematics PhD student, suggested that stereotypes about Black educational achievement are embedded within the culture that defines his group's status and identity against his own will:

So in American culture, the whole culture sends a signal that Black people can't do math and the school system is structured that way [to uphold this belief].

The pressure of stereotypes, his love of mathematics, and parental expectations drove Rob to develop a strong mathematics identity. Rob has long seen himself as an excellent mathematics student—according to him “one of the best.” But his self-confidence is accompanied by an extra levy at each and every academic tollbooth.

The vast majority of these students' motivations to succeed in mathematics centered around “proving them all wrong.” The *prove-them-wrong syndrome* was described by Moore et al. (2003) to explain the academic and social experiences, attitudes, and personality characteristics of persistent African American males pursuing engineering degrees. They found that the prove-them-wrong syndrome was born out of a psychological phenomenon that arises when the larger society projects an image of Black intellectual inferiority (Howard & Hammond, 1985). However, the students in this study eventually came to realize that no matter how much they achieve, racial stereotypes have unlimited durability and longevity. Succeeding to prove the stereotype wrong proved to be emotionally wearying, as constant attention was required to counter the constant threat of stereotypes. Albert, a master's-level applied mathematics student of Nigerian nationality who has returned home to work, explained that negative racial stereotypes about Blacks succeeding in mathematics was actually a driving force for him to achieve. Albert explained that even when no one uttered a word to him or gave him a “What are you doing here?” glance, he still felt overwhelmed by the presence of that stereotype in most of his mathematics classrooms.

Teachers and school administrators often exhibited lowered expectations, provided fewer opportunities for exposure to Black mathematics role models, and offered less encouragement toward the enrollment of Blacks in advanced mathematics courses (Johnson & Kritsonis, 2006). The perception of lowered expectations had real consequences for the participants. Tinesha, a biomedical engineering master's student who is currently in a PhD mathematics education program, notes:

I came to realize, like, these people [teachers and her peers] don't expect too much of me in this class, and so I've always had kind of like this idea, even when I was younger, you know, if you tell me that I can't do something, then I want to prove to you that I can. And so for the rest of the time in all my upper-level classes, that was my goal. I might be the only Black person here [in her upper-level engineering class], but I'm certainly not the dumbest. And so, like, I took that attitude from that point on in all my math classes, my physics classes, uh, my upper-level engineering classes . . . I sat at the front of the class. Like, I didn't come in and come to the back of the class. I sat at the front of the class.

The reactionary strategies may have temporarily deflected particular racially charged instances, but the students found themselves working too hard and too long to prove the stereotype wrong, and the rewards were few and not liberating. Valérie, a biochemical engineering PhD student, who plans to teach at an historically Black college or university (HBCU), demonstrates the difficulty she had in proving her worthiness and her attempts to break misconceptions of what she and others describe as a “double-negative” (i.e., the compounded plight of being Black and female):

Um, I think if that's the way they feel it's hard to change their way of thinking other than show them that I'm as qualified to be here as they are. I think they might have this misconception, that's ok: *I got here because they needed to fill affirmative action quotas*. But if I come here and do what I have to do and show them that we are on the same standings, I feel like that should be able to break that misconception, and sometimes it will. But sometimes you just can't change people.

Most respondents shared in Valérie's observance of being labeled an *affirmative action student*. Even when they obtained the prestigious title of “smart,” they were still subjected to the other stereotypes associated with the Black race (i.e., lazy, a thief, drug addict, poor, promiscuous, smart but still partly here because of quotas, etc.).

Always Being On Point

The students utilized numerous strategies to attempt to combat the damage that stereotypes inflicted on them. In particular, the male students spoke overwhelmingly of always having to be “on point,” namely, on top of things, in control of the situation. Living in a nation where extremely biased views of Black men persist, Black male students are especially challenged by societal stereotypes, and according to Jimmy, negative stigmatization faced by Black males impedes their educational opportunities. Rob agreed with the general consensus, stating that Black males do not get the educational assistance they need because “in most cases the teacher can't teach somebody she is afraid of.”

Mike, a mechanical engineering undergraduate student who aspires to be a pastor, felt the pressure and stress of always having to be "on point because I understand that some people think that Black people are stupid at math." As Mike discussed the disparities that existed inside his mathematics classroom, he complained that the White students often cheated and received no punishment whatsoever. Then he spoke of the day that he was accused of stealing. On this particular day, Mike re-entered his classroom after going to the bathroom and was accused of stealing a White female's cell phone. Mike was quick to note that he passed all of his mathematics exams with 85% or better and had turned in all his homework on time. Yet, he understood that his mathematics achievements did not excuse him from the damaging stereotype that *all Black men are thieves*. As a result of his experiences, Mike contemplated dropping out of school and felt a sense of despair because of this and other race-based adversities.

Olu, an electrical engineering undergraduate student who aspires for a career in management, developed hostility over racist incidents, and his method of retaliation was mostly fighting, which almost got him kicked out of college. For college, Olu moved from his majority-Black community in a large metropolitan city to a majority-White university in a rural majority-White surrounding community. Olu had to struggle against everyday racism (Essed, 1991), which he understood as "What the hell are you doing here?" Olu described his experience when first entering an upper-level mathematics classroom as a dichotomy between invisibility and the "hyper-visibility" demonstrated by at first shocked looks from his peers and then sudden invisibility, quietness, and withdrawal. There were also more overt forms of racism, like when a roommate of Olu's called him an "affirmative action student."

Valerie expressed that being on point (i.e., "Always getting that A!") was driven by proving that being Black does not equate with underachievement:

Even when I came to Ivy [University] I felt that some people didn't think that I was qualified to be here. Ok, you can think that and then I'm gonna go ahead and do my work and show you that that's not the case. Like I know what I want to do and because I'm Black, it can't prevent me from doing that. If anything, it should enrich my experience as it has and give[n] me an even more of a driving force to go out and achieve my goals, because I know that I'll be one of a handful and trying to increase that number is something that I want to do and not let other people determine that.

Cory, a mathematics undergraduate student who plans to become a mathematics professor, discussed the presence of stereotypes without the necessity of an event happening in order to activate them. For Cory and many of the other students in this study, simply walking into a high-level mathematics class was stereotype priming in itself:

Even if they don't say it [what's this Black guy doing in this upper-level mathematics class], I think it to myself sometimes, I think it's motivation for me to do better. I mean, when I walk into a class I'm like "Oh yeah okay, now I get to prove something to these people." I mean basically it's the motivation to myself.

The respondents in this study endured the burden of "always being on point" to rescue themselves from being judged as less worthy or less capable of academic excellence. For example, Rob's numerous experiences of what he describes as racism at his predominately White university left him feeling devalued, and for the first time, he considered that his admittance might have been based on affirmative action. This experience, along with a "bunch of [other] racist experiences," ultimately caused Rob to discontinue his education at this predominately White university. We see here how students stress over and internalize the mainstream view of their success potential and identity. The devaluing of their academic abilities caused the participants to feel an acute awareness of their Blackness and caused them to stay on guard, always prepared for the next racial assault. However, they maintained their commitment to succeeding in their studies.

Critical Perceptions and Attributions of Black Behavior

As we stated earlier, stereotype management emerged among students as a result of their evolving and developing senses of, assertions of, and negotiations of what it means to be Black. There was not only ongoing self-monitoring and self-reflection but also monitoring and reflection on other Blacks. These reflections on others could be quite harsh and often focused on behaviors that they believed could serve as fuel for perpetuating racial stereotypes.

Gladis, an applied mathematics student who aspires to be a mathematics professor, blamed "poor Black people" for limiting themselves and not being open to "things outside of our neighborhoods." She stated that, "I think that there are a lot of intelligent Black people capable of doing a lot of things, but we don't, we don't venture too far out of our comfort zones." Gladis had no qualms about critiquing some Blacks for not moving outside of the "comfort zones" of their neighborhoods.

Chrissy, an electrical engineering master's student, stated the following about other middle-class Black youth in her home neighborhood:

I'm just sick of it and sick of them. Their parents have the means to give them whatever it is they need to be successful and they still decide to hang out on the street corners and do nothing. It's a shame that they just wasted their parents' money like that. I have almost totally given up on them.

A few of the students in this study blamed Blacks for their own lack of opportunities to pursue the "American Dream" (i.e., getting a college education, working for corporate America, buying a house, etc.).

Anita, an electrical engineering undergraduate who is interested in becoming an energy lobbyist, spent most of her K-12 schooling attending predominately Black schools and lived in mostly Black and economically deprived neighborhoods. To try to "escape" the potential ridicule she faced in school because of her dark skin and African features, she specifically decided to attend a majority White university:

I applied to Howard, I applied to Purdue, and I applied to Medium University. I got in all of them. Howard offered me a full scholarship but I didn't go because the first thing that was in the back of my mind was if I went to an all Black school I [was going to] get picked on a lot. And I didn't like it. Another thing about when I was growing up around Black kids, you know they had this thing about you dark, your nose is too big, you know, look at your hair, you don't have good hair and I didn't wanna be around that in college.

Although Howard University offered Anita a full scholarship, just the thought of being ridiculed for her physical features was enough of a potential threat for her to pursue a different college institution with a racially diverse college student population. In hindsight, after learning about the nurturing environment that HBCUs offer, including ample opportunities for increased Black self- and group esteem and increased knowledge of the Black culture, Anita now wishes that she could have seen past her early racialized traumas and attended Howard. Furthermore, she speculates that the racism that she experienced at Medium University far exceeded her expectations of the racism that she envisioned she would experience at Howard.

We note that this kind of criticism and reflection on the "condition of Blacks" is not unique to these students. It is rooted in the history of collective Black struggle and is very much consistent with self-help efforts that suggest that Black communities themselves are at least partly responsible for analyzing and improving their conditions, even if it means "calling out" other Blacks. In our view, this form of Black-on-Black critique is not itself a form of reifying stereotypes. We also see these critical stances as an attempt by some of the students to resist stereotypes and to offer fuller conceptions of Blackness by calling for other Blacks to move and think beyond the immediacy of their circumstances. For many of these students, Black life and possibilities for Black people extended beyond those immediate realities even if it meant confronting and managing stereotypes in these expanded contexts. Blacks *not* pursuing mathematics, science, and engineering or other areas where they are few in number could simply serve to confirm the stereotypes. This is not an argument that suggests that Blacks should abandon their communities. Rather, we believe these

students, because they are functioning in contexts where Blacks are few and far between, see a need for other Blacks to exist and thrive, as well as to disprove the stereotypes.

Cultural Code-Switching and "Frontin"²

Three students (Chrissy, Cory, and Lisa) reported being accused of acting White (Fordham & Ogbu, 1986). However, Cory had to deal with this "a lot." Cory remembers having "only a few" Black friends throughout his life. Although he went to a high school that at the time was 30% Black, his honors and AP classes kept him isolated from the Black school population. Cory spent a large amount of time ("24/7") with his high school mathematics club, in which he was the only Black student consistently in the club. In college, his social life included living in his predominantly White fraternity house on campus and playing soccer.

I guess when I was younger it bothered me. I guess I reached a point where I understood that you're gonna be what you're gonna be and all you can do is be you, so acting White, acting Black is just kind of silly.

Although Cory dismisses these accusations as "silly," he recognized from even his most early schooling experiences that schooling practices privilege the White, middle-class student. Cory appeared to have embraced the ideology of the dominant culture and has been socialized to thrive within the White, heterosexual, middle-class, male, academic domain. As a result, Cory had been offered very little opportunity to develop relationships with other Black people, besides his immediate family. As a result of dealing with a multitude of stereotypes about Blacks and mathematics underachievement, many of the respondents purposefully adopted the everyday language (spoken and unspoken) of the dominant culture as an adaptive technique throughout their educational career.

It is important to note that most of the students who emulated behaviors deemed as highly acceptable in White middle-class academic culture did so under the premise that they were performing these behaviors and not actually identifying with them. For example, in contexts where there were a large number of non-Black students, the participants felt additional pressure to hyper-accentuate certain characteristics that were valued by their mostly White teacher and peers. These characteristics were outside of the characteristics that they deemed as part of their identity.

Although the majority of the examples presented next speak more to college experiences in general than to the particulars of what happens specifically inside the mathematics or engineering classrooms, the students did, however, separate their mathematics or engineering experiences from the larger college context. For some students, what happened outside of their classrooms was as racially charged as those that happened in smaller

(sometimes safer) classroom spaces. Here are some examples of how they "fronted" to maintain the appearance of conformity:

- Avoided wearing certain clothes that were associated with being threatening: "One day I wore this sharp red and blue Nike jump suit and a couple of White dudes said, 'You are confusing me. Are you Bloods or Crips?' [street gangs known for representing their gang status by their colors]."
- Smiling a lot to appear friendly and approachable: "I'm large, Black [referring to both his dark-skin complexion and racial identity], and male, and I intimidate most Whites, and for that matter some Black people. So my mom told me that I would have to walk through life with a big goofy smile on my face or the world would be scared of me."
- Excessive nodding to show that they understand the lesson (even when they do not): "[In my mathematics class] sometimes it seems like they are watching me to make sure I get it or that I belong. It's like they are waiting for me to [#\$%] up. So I just nod no matter what. . . . Then at an inconspicuous hour I go find the TA [teaching assistant]."
- Avoiding questions about their personal life for fear of exposing (or overexposing) the racial and class divisions: "When we came back [from summer break] they [White classmates] would talk about vacationing in the Hamptons. I thought to myself, all I did was work. I got outta there real quick."
- Walking into the first day of a higher level mathematics or engineering class with the book outside of the book bag so (hopefully) no one would ask "Are you in the right class?": "I walked into the class [Calculus III] and they [classmates] just looked shocked. Then a girl slivered up to me and asked if she could see my [Calculus III] book. . . . Now, I always walk in [on the first day of class] with my book in my hand and I slam it down on my desk!"

We reiterate that most of the students in this study utilized these tactics to circumvent racialized beliefs that were prevalent in their majority White school environments. The students reinforced the fact that these strategies were in no way part of their self-defined identities. Although these techniques worked well, they caused emotional distress. Students discussed the emotional preparation required to perform these tasks that they deemed necessary to remain successful. Some students, as a result of being fed up with having to respond to racism in ways that compromised their identities, switched to more racially diverse universities or graduated in these historically White institutions and then, for example, purposely pursued employment at historically Black institutions.

Three students (Mike, Olu, and Jamal) in the study rejected the notion of responding to forms of racism by engaging in behaviors that were deemed acceptable; they deliberately acted out stereotypical notions and constructions of what it means to "be Black" and male (e.g., sagging baggy jeans, hat cocked to the side, white tee, Timberland boots, Afro or cornrow hair style, "hard" walk, slang talk, big medallions around the neck, etc.).³ For example, Mike purposely admits to "acting Blacker than ever" in ways

that were aligned with the negative demeaning stereotypical view of what it means to be young, Black, and male. He intentionally follows a set of societal expectations that define Blackness in simplistic and one-dimensional ways, such as style of dress:

I never felt more Black than when I first got to college. In fact, I began to act more Black. When I was in high school I was strongly against what dominant society has taught us about African Americans, which is too urban. I always felt that I needed to show them the picture. I didn't want to look like them [stereotypically urban Black] 'cause, you know, everything attributed to African Americans was negative, and I wanted to show people it wasn't just that. But in my first year of college I changed. Grown-out Afro, baggier clothes; then everything I wouldn't wear in high school I began to wear in college. I was wearing Timberland boots, you know, really baggy jeans; Hat cocked to the side. All these things I would say were attributed to African Americans I would do in school 'cause I felt like I needed to. And if I didn't do it, it felt like I was separating myself out, like I wasn't being true.

Mike realized that he showcased a Blackness that is not defined by his own criteria. Mike believed that his college community looked at him as an uneducated Black male, so he vowed to hyper-accentuate a socially constructed dominant perception of Black maleness. Mike confessed that his resistive stance continued to perpetuate the stereotype; however, over time and reflection he was able to manipulate and manage the stereotype on his own terms and for his own purposes. As a senior in college at the time of the study, Mike celebrated his Blackness by invoking his own definition through dress (e.g., slightly baggy jeans with a belt, polo shirt, short fad haircut, trimmed goatee, no hat, and his "Tims" [Timberland boots]) and career aspirations. Mike has decided that his commitment to helping others can be best served through ministry. After receiving his BS in mechanical engineering, Mike is now enrolled in divinity school to become a full-time pastor. Although Mike graduated magna cum laude in mechanical engineering, he admits that his racialized experiences in college played a role in his decision to embrace "self-leadership" and pursue a more humane purpose in life.

None of the participants suggested that they wanted to divorce themselves from being Black. Even the three students who showed the highest rate of assimilationist behavior expressed value and comfort in being Black. Although they perfected strategies for success, a majority of the students in this study stated that their preoccupation with racial stereotypes had created contradictory identities (guided by societal negative expectations vs. self-guided expectations) by being consumed with proving their value to an educational system that devalued them daily.

Excelling in Mathematics and Engineering to Be Perceived as Smart

The majority of the students in this study admitted to gravitating toward mathematics and engineering to be perceived as smart. The respondents recognized that excelling in mathematics meant being the beneficiary of privileged status and having access to the educational opportunities they needed to get ahead. As a result of receiving early mathematics accolades and teacher recognition, the students were often chosen to be speakers for school events, nominated for special academic projects, selected student ambassadors for partnerships with outside institutions, interviewed for high school newspapers, recipients of special recommendations from guidance counselors for college scholarships, and so on. These students recognized from an early age that being perceived as smart in math was going to help them get the education that they deserved.

When Rob first decided that he was going to be what he refers to as a "math genius," it had less to do with his love of math and more to do with the recognition of being seen as smart:

I actually became very aware from an early age that math was an intimidating subject and that I better get good at it because if you're good at math, people will assume you're smart. And that's all I wanted to be: [assumed as] smart.

Eventually, Rob did develop a love of mathematics and more self-oriented reasons for excelling in mathematics, but only after maturity, coupled with being tired of continually trying to prove that he was mathematically smart.

Tinesha found clever ways to showcase her talents inside her college engineering classes. Sometimes she would "accidentally" leave her quiz paper on her desk just so another student could "find it" and report her stellar results to the class. When I asked Tinesha why she engaged in such behaviors, she admitted to using her high engineering scores as a way to validate her smartness.

The respondents who attended the historically White universities in the study were often picked last to participate in mathematics and engineering labs or study groups. Anita was the only Black female in an engineering lab and being picked last provoked her to score a 100 on the first lab exam:

So nobody would pick me 'cause I'm like the only Black one, right? So as soon as the first exam would come back and I got 100 on mine [and the other students in the class said] "Oh, how did you do that? How did you do that first problem? Here, could you show me how to—how did you get that beaker to—how did you set your lab up?" And I would just be looking like, "Yeah [laughing]." It would just be funny because I would be like, "Wow, these people are shallow." I mean I would just be looking like, "Well, whatever." I would help them, you know. If they asked me, I would help them. 'Cause

you know I felt like that was a way for people to know that, you know, I am smart.

Although Anita knew that her classmates' newfound interest in her was superficial, she still decided to help them because, she said, assisting them further proved her smartness.

Constructing Self-Directed and Self-Determined Identities

While stereotype management provides a path of academic and mathematics success, it appeared to lack the sophistication needed to sustain critical self-consciousness. For example, the students' reactive stances and positions seemed to be in direct competition with their self-definitions. The agency it took to prove their intellectual self-worth often undermined their abilities to create a self-guided identity. When the students operated under the main premise of stereotype management, proving the deficit perspectives wrong, they seemed to suffer from being unable to indulge in a personal sense of self-defined success. The students began to question their strategies and motivations for achieving in mathematics and to define and judge themselves and others by self-defined criteria.

Harpalani (2007) has identified the counter-stereotypic identity hypothesis as follows:

Individuals who defy stereotypes related to their group membership, such as high academic achieving Black students, employ specific beliefs and coping strategies related to the domain in which they defy the stereotype (e.g., intellectual ability), resulting in greater identity salience for *that* domain. (p. 3)

The results of this study indicate that students never really succeeded in completely *defying* racialized stereotypes. This was an unrealistic expectation. However, they did admit to enjoying fleeting moments when they felt like they made some significant process in reducing the effects of the stereotype; for example, when a teacher or a group of students openly acknowledged and believed in their intellectual talents. However, these acknowledgements were often the result of viewing the students as anomalies ("freaks of nature") and not applicable outside a minute number of Black individuals. For example, Cory's White fraternity brothers joked that Cory "must have some White in him" as a way to explain his mathematics success. These students spent a great deal of time convincing one mathematics classroom, for example, of their academic abilities, but soon found that stereotypes were mostly nontransferrable from one classroom to another. As a result of not being able to ultimately defy the enduring power of racial stereotypes, the respondents, exhausted over the external assaults on their intellect, appeared to actively search for more internally driven reasons to pursue mathematics and engineering excellence.

Over time, the students realized that their scholastic accomplishments should be motivated by their own expectations of themselves and like-minded individuals and not by negative societal expectations and stereotypes. They understood that operating within imposed standards is at times necessary, yet they carried out those standards in concert with their own intrinsic desires. The participants revised their identities in ways that honored who they were and asserted themselves to be, all the while functioning at high academic levels.

The students eventually began to incorporate more personalized reasons to maintain success, particularly as they developed in age and maturity. As college students, they were able to skillfully navigate success within the confines of societal bias without being guided by self-limiting or self-doubting criteria. Most of the students did not live by simplistic definitions of what it means to be or act "smart," instead they lived by what felt right to them. As a result of *being sick and tired of being sick and tired* (Fanner Lou Hammer's epitaph, 1977), the students proactively sought out safe havens in which they could affirm their identities and abilities. It is clear that an awareness of one's identity caused the students to not only be concerned with the things that matter to them (e.g., self-improvement), but they also developed a strong sense of self-worth and educational responsibility for the next generation of students.

Many college students chose their career goals in engineering, and to a much lesser extent in mathematics, based on the potential financial opportunities their fields of study would afford them (Sumner & Brown, 1996). Yet for most participants in this study, personal happiness came first and money second, and sometimes even third, on their lists of priorities. The mathematics students in particular acknowledged the undesirable pay in their desired mathematics-based careers, the long hours, and the amount of mathematics knowledge required to be considered "expert" in the field. Yet, their unconditional love of mathematics was more of a motivator than materialistic aspirations. For instance, Cory switched his major from engineering to mathematics but not without consideration of the "\$20,000 a year in salary I may lose along with a guaranteed job." However, he made the switch from engineering to mathematics for more intrinsic reasons:

Honestly I feel it's because [mathematics] is not really a career choice that makes a lot of money. But then when I made the switch to math it actually took me a while because I had to keep thinking to myself "what am I going to do when I graduate?" I mean doing math, your fields are pretty limited. You can do education or you can work with the government or you can become an actuary. But I love math so much I didn't even care. Actually I asked an actual math teacher before I made the switch what he thought about doing an applied math major and his response to me was "I hope you like math," "Yeah, I do," and he said, "No, I hope you like math a lot." I understood what he meant. I had to make that decision that I may not

know where I'm gonna end up when I'm done with this, but this is what I love to do.

The respondents not only performed in their fields to achieve academic success, they engaged in mathematics, engineering, and science problems in their spare time, often for the fun of it. They truly enjoyed their majors and could not imagine doing something else. Lisa called it a healthy obsession. When Lisa compared herself to her classmates, particularly in high school, she often felt out of place. When her classmates were preoccupied with romantic relationships, name brand clothes, and the latest rapper's business and were more than satisfied with "never doing another mathematics problem again," Lisa was invested in blending mathematics and physics together into one discipline. Her passion and love of both mathematics and science helped her to balance the other non-school issues in her life and gave her a sense of purpose.

These students have deliberately chosen to follow their passion over all the temptations that often exist for academically successful students. Although many of the participants have chosen diverse career paths, they ultimately decided that what is best for them, financially, emotionally, academically, and career-wise, is do what they love.

Succeeding to Serve as a Role Model

Mathematics and engineering to some extent have been positioned as culture-free, yet this field, perhaps more than any other, can be implicated in the production and consumption of racial meanings, particularly as these meanings are related to who is perceived to be competent and who is not (Bishop, 1990; Kantner, 2008; Martin, 2006a). Mathematics assessments and the use of race-comparative analyses have often contributed to societal meanings for Blackness and ideas about whether Blacks can succeed in mathematics and other math-based fields like engineering.

Participants in this study responded to those meanings by embracing the idea that they could serve as role models. Not only did the participants have goals that included teaching mathematics and engineering, but they desired to teach in a way that values the racial, ethnic, and cultural backgrounds of the students they teach. Imparting their own stories and sharing their strategies for success would allow aspiring Black engineering and mathematics students to be true to their own selves and persist in spite of stereotypes that threaten to mitigate their achievements.

We note that 18 of the participants envisioned their future as role models primarily by becoming mathematics or engineering instructors. Hakeem, an undergraduate mathematics student, was so haunted by the desire to teach mathematics to Black youth that he decided to pursue a bachelor's in mathematics after receiving his bachelor's degree in accounting:

I was getting ready to take the CPA [exam]. Repeatedly, and it seemed like almost every day I'm hearing these stories about the children and something in math. They need someone to teach the math, our Black kids are hurting. And this kind of touched my heart and I was like, wow, I know I'm an accounting major but I was just, gee, but if the kids aren't getting any help? I said I can reach out to those kids by teaching [in] high school.

Hakeem spoke of a sense of responsibility to impart what he knows to the next generation of Black students. Valerie shared a similar goal as she aspires for a PhD in biochemical engineering:

My ultimate career goal is to become a professor in engineering and like ideally I would like to go back to [an HCBU] and be that Black female engineering professor. I'd rather be a role model, and show them like I said "you could achieve this, you could become a professor." I want to be a role model and help other younger people who are in engineering who need a face to put with that goal they are trying to achieve. That's my goal.

Valerie was very explicit in where and who she wants to teach. She realized the benefit of students seeing someone who looks like her doing what it is that she wants to do. Valerie attended an historically Black university for her undergraduate degree in chemical engineering and had only one Black female engineering professor her entire college career. This professor served as Valerie's role model and she feels the same commitment to give back.

Engineering careers can be very lucrative, and two students (Anita and Tinesha) wanted to use their anticipated financial gain to build engineering institutions within their home communities. Also implicated in their motivations was the unique plight that Black men face in education and in their life chances to succeed. Anita, who has a son, understands the complexities of educating this population of students:

What I really want to do is open a school for Black boys in the city. I know that with engineering I can kinda have a way to get money. But right now I'm interviewing with this school here called [College Pathways Academy] and it's a school for Black boys in [a predominantly Black low-income neighborhood in an "urban" city]. . . . I've always wanted to open a school for Black boys and here's this opportunity for me to teach at a school for Black boys. I'm like, wow, maybe this could be my chance to go after that.

The percentage of young Black males graduating from high schools across urban America has received a great deal of attention (Garibaldi, 2009; Thomas & Stevenson, 2009). For example, only 35% of Black male students graduated from high school in Chicago and only 26% in New York City (The Schott Foundation for Public Education, 2006). Only a small portion of those who graduate high school attend college, and nationally, only 22% of

Black males finish college. Anita understood the bitter seeds of low expectations and apathy that are dominant in the lives of many Black male students. As Anita sadly acknowledged, Black males are far more likely than Black females to be celebrated for almost anything other than educational attainment. The role models typically held up for Black male youth, such as entertainers and athletes, rarely associate higher education as critical to success. For Anita, the outcomes that currently exist for Black males require leadership, which she desires to provide.

The respondents realized their future and current roles as mathematics and engineering teachers would not just include the imparting of facts, algorithms, and theorems, but the development and advancement of Black students and their communities. These students yearned to help Black and other youth of color navigate the terrain of mathematics and engineering in ways that would create personal self-confidence and civic responsibility. Lisa, an undergraduate mathematics and physics student, is raising her son in an environment where math is loved and not something that should be feared:

I was so determined for him [Lisa's son] to know that math is a beautiful, beautiful thing. But I didn't want him to get this sense of . . . I think there might be this fear like that's in not just Black people, Black children, but in schools where they . . . it's like they're teaching children to be afraid of math and science. I don't know what's going on, really. And they think well, oh, that's ok, that when will you have to use this anyway?

These participants, as role models, wanted to demonstrate approaches for succeeding in mathematics and engineering in academic contexts. The respondents accepted an additional sense of responsibility to work as hard as they could to be in a better position to act as role models and mentors to Black youth and to their own families.

Discussion

One of the questions that initially guided this study was: How do a select group of Black mathematics and engineering college students develop success-oriented belief systems and identities and interpret high achievement outcomes? Stereotype threat theory suggests that students are limited in their ability to respond effectively to these stereotypes. However, we believe that stereotype theory does not adequately address how students deal with ubiquitous stereotypes that they encounter daily and across time. The stereotypes that emerge in experimental conditions may or may not have the same cumulative effect as the racial micro-aggressions that students encounter in their daily lives. How students build up their defenses and coping mechanisms, over time, is also not explained in most accounts of stereotype theory.

Based on the data presented here, we suggest that many academically successful mathematics and engineering students respond by engaging in stereotype management. That we focused on mathematics and engineering was particularly important due to the even more pronounced stereotypes that exist about the abilities and competencies of Blacks in these domains. The respondents had learned, starting as early as their elementary school experiences, that excelling in mathematics and mathematics-related disciplines was not expected. This fueled their drive to excel in ways that allowed them to challenge racial stereotypes and assert their meanings for being Black. The participants' motivations to prove others wrong helped them in achieving their success. As a result, the students had to continually *battle* for the right to be treated as a high-achieving mathematics and engineering student (Smith, 2004).

We agree that studies of experimental, *situational* responses to stereotypes are important. However, we also suggest that it is important to take into account the nature of the responses at various points in a given life. As the respondents in this study began to understand racism more deeply and to assert their own definitions and meanings for Blackness, their responses showed developmental progressions, highlighted by many students' decision to not extend energy trying to eliminate the stereotype; students realized that the stereotypes simply existed and that they could fight a battle that made little sense to them or they could formulate and work toward achieving much more meaningful goals like serving as a role model for other students who could then enter these domains as a way to provide a counter to the stereotypes.

During the periods of late high school and early college, most of the students were developing more sophisticated and self-determined strategies to deal with racism, but also to succeed academically in mathematics and engineering. The respondents' focus was not just on personal contentment and success, but on their sense of responsibility *as Blacks* to help other Black students.

An important distinction regarding the high-achieving students in this study and those in the larger literature on stereotype threat was that most, but certainly not all, of the students in this study did not buy into racial stereotypes as being true. As the students initially experienced the daily burdens and tensions associated with defying racial stereotypes, they grew to the point of being motivated to manage them in ways consistent with their goals. Olu described that constant sense of not wanting "to be judged as stupid or assumed ignorant for the skin I wear." This strain, complicated by frequent spasms of emotional and moral confusion, manifests itself into "a second schooling" filled with strategies to soften the damage of being racialized as inferior. The shift from proving stereotypes wrong to building a more self-defined identity in which managing stereotypes plays a minimal role

and toll demonstrates the power of identity-related coping mechanisms in reducing the toxic and educational costs of racial stereotypes.

We were not able to uncover definitive answers to *how* these students developed their resilience. However, the analyses presented here and in McGee (2009) suggest that the range of risk and protective factors that support or constrain resilience among these students are multifaceted, contextual, and grew out of each student's life and academic experiences. Some of the resilience developed from the students' own growing sense of agency and self-efficacy, where they realized they were able to change their individual circumstances and determine the direction of their lives in the face of stereotypes. Prior studies of successful Black students in mathematics have confirmed these agency- and efficacy-related outcomes (e.g., Ellington, 2006; Martin, 2000, 2006; Martin & McGee, 2009; Moody, 2003). Many students (e.g., Rob, Mike, Denise, Tiffany, Lisa) directly cited significant racialized events that set in motion a serious attitude and behavioral change. Referring back to the beginning of the article, some students were motivated by racist encounters with teachers and administrators. Other students (e.g., Chalmus, Chrissy, Cory, Rich) had more affirming experiences with teachers and community leaders who believed in the academic and life potential of these students. We also inferred that some students developed their resilience from the presence of various protective factors in their lives. These included supportive academic and social organizations (i.e., National Society of Black Engineers). In the context of these organizations, students could see real examples of Black success in STEM disciplines. Some students (Mike, Cory, Gladis, Jamal, Albert, Olu) also cited early family socialization experiences as contributing to their maintaining their focus on success.

We also found that stereotype management also helped students to maintain strong senses not only of their racial identities but also of their disciplinary identities. That is, the students continued to see themselves as doers of mathematics and engineering despite the racial micro-aggressions and racial stereotypes. This is an important point because we believe that to weather the storm of these insults and assaults, students must articulate and act on strong Black identities but must also continue to see themselves as connected to the discipline and not as outsiders who do not belong. In addition, maintaining strong disciplinary identities helped to foster high academic achievement. We believe that additional studies of how Black students simultaneously construct their disciplinary (i.e., math, engineering, and science) and racial identities are needed (Martin, 2007, 2009b; McGee, under review; Stinson, 2009; Atwater, 2000; Ellington, 2006, etc.). Moreover, we believe the approach in this study can be extended to examine the multiple identities (race, gender, class, etc.) that students construct along with their disciplinary identities to better understand how students manage stereotypes associated with various aspects of those identities.

Summary and Implications

We have presented the finding that stereotype management is a necessary activity for Black students who counter stereotypes about Blacks in mathematics and engineering. This analysis adds another layer to the understanding of racial stereotypes. Racial stereotypes are powerful, but they are not deterministic. The "threat in the air" described by Steele and colleagues (Steele, 1992, 1997, 1999; Steele & Aronson, 1994, 1995, 1998) may hover and linger, but our data show that Black students can effectively manage these threats. The fact that they can manage them in mathematics and engineering, domains where to be Black is to be considered less capable than Whites and Asian students, is even more insightful.

This study and the uncovering of stereotype management confirms significant dynamics for high-achieving Black mathematics and engineering students: (1) the role and impact of racial and mathematics identity on mathematics and engineering achievement, (2) the racialized nature of mathematics and engineering learning and participation, and (3) high achievement in mathematics and engineering in spite of daunting obstacles.

We cannot ignore the role and prevalence of racial stereotypes in the experiences of Black mathematics and engineering students. It may be the case that many Black students are lost to mathematics and engineering as a result of these racialized encounters and messages. Yet the stories of the students in this study show that mathematics and engineering success can be achieved even in the face of racial stereotypes through the process of stereotype management. Although stereotype management comes with some costs (as a result of responding to racial determinants operated to constrain the life chances of Black students), it is a powerful tool that students utilized to help make sense and deal with their racialized experiences. The concept of stereotype management implies the need for further studies that integrate considerations of identity formation processes and the racialized nature of students' mathematics, engineering, and life experiences.

Intervention efforts to reduce the marginalization Black students experience in mathematics and engineering education often do not interrogate the racial micro-aggressions that these students face on a daily basis and over time. Efforts designed to help students manage these stereotypes are needed. Furthermore, we propose more explicit attention to helping students positively co-construct their identities (racial, mathematical, engineering, and otherwise). Additionally, fostering intergroup conversation from students who experience marginalization in similar and unique ways (e.g., the LGBT community, newly marginalized groups such as Arab Americans, and underexplored marginalized groups such as Asian female mathematics and engineering majors) can bring to light how students experience various stereotypes and the strategies—successful and unsuccessful—that they use to manage these stereotypes.

College support programs are in a unique position to prepare Black students and their families for the challenges they might confront in historically White universities. For example, support program personnel could work in conjunction with students and faculty to better understand how racial stereotypes manifest themselves in department and classroom contexts and within particular majors. Programs like Emerging Scholars, which provide academic support to mathematics and science students on many college campuses, could expose students to the literature on stereotype and learn from their students how these stereotypes are managed. These strategies could be shared with students outside of this program.

Stereotyping is a real and persistent form of racism. But students cannot stop at this fact. Their dreams and aspirations can be achieved both in light of and despite the presence of stereotypes. We believe that the analysis presented here serves as a call to the education community that it should not underestimate the resilience of Black students against these stereotypes.

Notes

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¹For this article we are not measuring the racial identity of the participants (however, we do in the larger study); we are explicating how issues of mathematics and engineering achievement and African American identity interact among a select group of high-achieving African American college students, majoring in math and engineering.

²*Frontin'/fronted* is a term that was used overwhelmingly by the majority of the participants. Unlike biculturalism, which is often positioned as moving seamlessly from one culture (dominant) to another (one's own home culture) with ease, *fronted* is different and encountered with quite a bit of personal agony. Summing up the students' definitions of *frontin'*, it is a performance or demonstration of an act that is socially acceptable by the dominant culture but creates a series of self-sacrifices to one's own personal identity.

³These descriptors were generated by the students, not the authors.

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