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# Increasing the Number of African American PhDs in the Sciences and Engineering

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## *A Strengths-Based Approach*

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*Fifty years after Brown v. Board of Education, the percentage of African American students who receive PhDs in natural science, technology, engineering, or mathematics (STEM) fields remains disappointingly low. A multifaceted, strengths-based approach to intervention and research that holds great promise for increasing the number of African American students who achieve at the highest levels academically is described. This work began in 1988 with the development of the Meyerhoff Scholars Program for undergraduate minority STEM majors at the University of Maryland, Baltimore County (UMBC). If current PhD receipt rates of program graduates continue, UMBC will in all likelihood become the leading predominantly White baccalaureate-origin university for Black STEM PhDs in the nation. The program is described and outcome and process findings from its ongoing evaluation are highlighted. The parenting practices that helped these youths to overcome the odds and achieve at the highest levels prior to coming to college are also examined.*

**T**he *Brown v. Board of Education* (1954) Supreme Court decision was a transforming moment in American society. Many positive benefits followed, and many challenges remain. America has seen a number of highly visible anecdotal “firsts” among high-achieving African Americans (e.g., a secretary of state, chief executive officers of Fortune 500 companies, a national security advisor, an ivy league university president), and the number and percentage of Black college graduates have increased substantially since 1954. Notwithstanding this progress, one continuing and major challenge is the underrepresentation of African Americans among leading professionals in various sectors of society, including health care professionals, university professors, and research scientists (e.g., Barton, 2004; Cole & Barber, 2003; Wilson, 2000). The underrepresentation within critical leadership groups is not only socially unjust but detrimental to society’s long-term vitality. Increasingly, the pathway to enhanced representation in most leadership areas is through higher education, including graduate school. This is clearly the case in terms of increasing the number of African American scientists, the focus of the current article.

In the early 1950s, prior to the Supreme Court decision, only 139 Blacks with doctoral degrees of any kind were in the workforce. During the next five years, the number increased to 277, and by 1965–1969, to 586 (Blackwell, 1987). In 1975, when the government began keeping doctoral receipt statistics, African Americans received 3.7% of the PhDs granted to U.S. citizens and permanent residents. By 2000, the percentage had increased only to 5.8%, far below the 12.9% of the U.S. population who were African American. The underrepresentation in natural science (physical and biological sciences), technology (computer science), engineering, and mathematics (STEM) fields is even more severe. In 1975, African Americans received 1.2% of the STEM PhDs; in 2000, the percentage had increased only to 2.9% (this excludes psychology and social sciences). In 2000, only 14 African Americans earned doctorates in mathematics, 18 in computer science, 62 in all the physical sciences, 81 in all engineering fields, and 118 in the biological sciences (National Science Foundation, 2000, 2003).

Although a relatively high proportion of African American students enter college with the intention to major in STEM fields, relatively few graduate with STEM majors (Brown, 2000; May & Chubin, 2003). Included among those who abandon science majors and underperform in science and quantitative courses are African American students with high scholastic aptitude test (SAT) scores, impressive high school grade point averages (GPAs), and success in high school honors math and science courses (Grandy, 1998; Ramist, Lewis, & McCamley-Jenkins, 1994). African American students with strong academic credentials who underperform provide evidence that factors other than precollegiate preparation and native ability work

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to depress minority achievement and persistence (Bowen & Bok, 1998; Gándara & Maxwell-Jolly, 1999; Wilson, 2000). These factors include academic and cultural isolation, motivation and performance vulnerability in the face of negative stereotypes and low expectations, peers who are not supportive of academic success, and perceived and actual discrimination (Allen, 1992; Grandy, 1998; Nettles, 1988; Seymour & Hewitt, 1997).

Furthermore, even among those who persist and graduate with science majors, disproportionately few proceed to PhD programs in the sciences and engineering (Building Engineering and Science Talent [BEST], 2004). In part, this may reflect concerns about financial debt, inadequate advising, and lack of exposure to research. It may also reflect evolving career interests and inadequate performance in critical science courses (Brazziel & Brazziel, 2001; Brown, 2000). To reverse this trend, colleges and universities will need to intervene strategically to increase the number of minority students who persist in science majors, achieve at high levels, and proceed into PhD graduate and professional programs. In this article we describe the Meyerhoff Scholars Program, a nationally recognized model of an intervention program developed to achieve these goals (BEST, 2004), and we present the results to date of our process and outcome evaluation of the program.

Similarly, to increase the numbers of well-prepared minority students, school systems and parents will need to increase their efforts to strengthen the academic preparation of students in the precollege years. The precollege ethnic achievement gap is alarmingly large. Of special note, the gap between Blacks and Whites is even greater between students from middle-income families with college-educated parents than between those in households of lower socioeconomic status (Miller, 2000; Thernstrom &

Thernstrom, 2003). Furthermore, science and mathematics are two of the areas of greatest disparity, beginning in the elementary school years and continuing through high school. To increase the pool of high-achieving minority students entering STEM fields in college, it is critical that both schools and parents address this issue, including a focus on students with high levels of aptitude (National Task Force on Minority Achievement, 1999; Thernstrom & Thernstrom, 2003). Following discussion of the Meyerhoff Program, we describe our research focused on how the parents of the Meyerhoff students raised them to overcome the odds and excel academically. The qualitative methodology employed allows a rich depiction of student pathways to success.

The work we report here has consistently been guided by a strengths-based model. That is, the Meyerhoff Scholars Program does not focus on remediating deficiencies, the hallmark of a deficits-based approach (cf. Ford, 2002; Maton, Schellenbach, Leadbeater, & Solarz, 2004). Instead, the program builds on the existing strengths of talented Black youth and transforms their academic and social environment. Both our program evaluation research and our descriptive research on parenting practices highlight factors that lead to academic success among Black youth. We assume that African American students have the potential to achieve outstanding academic success given high expectations and the proper environmental support. Furthermore, through extensive efforts to disseminate our work to policymakers, administrators, teachers, parents, and students, we are highlighting the positive academic potential of Black youth and countering the negative stereotypical images that too often dominate public attention.

## **Enhancing African American College Students' Success in the Sciences**

We begin with a brief review of factors that research indicates contribute to the success of minority college students in STEM disciplines. Next, we describe the Meyerhoff Scholars Program, designed to address each of these factors so as to enhance the academic success of African American STEM students at the University of Maryland, Baltimore County (UMBC). Finally, we summarize the results of our ongoing research into the effectiveness of the program.

### **Factors That Contribute to College Students' Success in the Sciences**

Four sets of factors appear necessary to enhance minority students' success in the sciences. We discuss these briefly here (see also Maton, Hrabowski, & Schmitt, 2000).

**Academic and social integration.** Academic and social integration appear critical to the success of African American STEM majors, including highly able students. Black students are more likely than White and Asian students to experience academic and social isolation on majority-White campuses and in science majors (Cole & Barber, 2003; Nettles, 1988; Treisman, 1992). Faculty contact outside the classroom and mentoring relationships with



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faculty, including with minority faculty when possible, can decrease academic isolation and contribute to positive outcomes (Allen, 1992; McHenry, 1997). Furthermore, a critical mass of highly able Black peers can enhance academic and social support and reduce perceptions of racism—contributing to STEM persistence and success (Fries-Britt, 2000; Gándara & Maxwell-Jolly, 1999).

**Knowledge and skill development.** Mastery of the subject matter and development of a number of critical skills using proven methods are essential for student confidence and success. For example, involvement in peer study groups has been shown to result in enhanced technical knowledge mastery and course performance for STEM minority students (Bonsangue & Drew, 1995; Treisman, 1992). Furthermore, strong study habits, time-management skills, analytic problem-solving capacity, and the willingness to use available university resources have been linked to positive outcomes (Gándara & Maxwell-Jolly, 1999; Gordon & Bridglass, 2004).

**Support and motivation.** Support and motivation represent a third set of factors linked to minority student success in STEM majors. Financial aid continues to be one of the cornerstones of support; it is difficult to succeed in these majors if the student has to worry about expenses or has to work (outside of STEM) to pay bills. Because of the rigor of STEM courses and the attractiveness of other majors, additional supportive and motivational resources are necessary. These include high faculty expectations, hands-on research experience, academically supportive friendship networks, involvement with faculty or staff, tutoring, and emotional support during times of stress and difficulty (Grandy, 1998; May & Chubin, 2003; Seymour & Hewitt, 1997).

**Monitoring and advising.** Ongoing monitoring and advising can help STEM students make wise aca-

demically decisions in selecting course work, preparing for graduate study, and preventing or countering the influence of academic or personal problems. Consistent monitoring can help ensure regular assessment of a student's academic and social situation and provide early warning signs each semester of emerging problems. Advising and feedback can provide students with valuable input about their strengths, weaknesses, and decision options. Taken together, personalized monitoring and advising can help ensure that students do not fall short because of inadequate counsel and support (Gándara & Maxwell-Jolly, 1999; Seymour & Hewitt, 1997).

### ***The Meyerhoff Scholars Program at UMBC***

The Meyerhoff Scholars Program at UMBC was developed in 1988 in response to the low levels of performance of well-qualified African American STEM majors. Baltimore philanthropists Robert and Jane Meyerhoff provided initial program funding. The program developers, led by UMBC's then vice provost (and since 1992 UMBC's president),<sup>1</sup> sought to develop a comprehensive, multicomponent program that addressed the broad range of factors linked to minority student success described above. In 1996, the program was opened to non-African American students with an interest in the advancement of minorities in STEM fields. Currently, between 50 and 65 Meyerhoff students are selected each year (depending on available funding); the majority are African Americans. The program is situated on a campus with a diverse student population (34% minority), with more than half of the undergraduates and 60% of the doctoral students pursuing STEM degrees. The Meyerhoff Scholars Program incorporates 14 different components, briefly described here (for a more detailed description, see Gordon & Bridglass, 2004).

**Financial aid.** The Meyerhoff Program provides students with a comprehensive financial package including, in many cases, tuition, books, and room and board. This support is contingent upon maintaining a B average in a STEM major.

**Recruitment.** The top 100–150 applicants and their families attend one of the two recruitment weekends on the campus.

**Summer Bridge Program.** Meyerhoff students attend a mandatory Summer Bridge Program before the beginning of the freshman year and take courses in math, science, and African American studies. They also participate in STEM-related cocurricular activities and attend social and cultural events.

**Study groups.** Group study is strongly and consistently encouraged by the program staff, as study groups are viewed as an important aspect of success in STEM majors.

**Program values.** Program values include support for academic achievement, seeking help from a variety of sources, peer supportiveness, high academic goals (with

<sup>1</sup> The president of UMBC is Freeman A. Hrabowski III, one of the authors of this article.

emphasis on PhD attainment and research careers), and giving back to the community.

**Program community.** The Meyerhoff Program provides a familylike social and academic support system for students. Students live in the same residence hall during their first year and are required to live on campus during subsequent years.

**Personal advising and counseling.** The program employs full-time advisors who monitor and support students on a regular basis. Staff focus not only on academic planning and performance but also on any personal problems students may have.

**Tutoring.** The program staff strongly encourages Meyerhoff students to either tutor others or be tutored to maximize academic achievement (i.e., to get As in difficult courses).

**Summer research internships.** Each student participates in multiple summer research internships at leading sites around the country, as well as at some international locations.

**Faculty involvement.** Key STEM department chairs and faculty are involved in the recruitment and selection phases of the program. Many faculty provide opportunities for student lab experience during the academic year to complement summer research internships.

**Administrative involvement.** The Meyerhoff Program is supported at all levels of the university, including ardent support from the president (the program co-founder).

**Mentors.** Each student is paired with a mentor who is in a science profession.

**Community service.** All students are encouraged to take part in a community service activity, which often involves volunteer work with at-risk youth in Baltimore.

**Family involvement.** Parents are included in social events and kept advised of their child's progress.

### **African American Students' Success in the Meyerhoff Scholars Program: Outcome Analysis**

The current research focuses on Meyerhoff students who are African American. Our most recently published outcomes, encompassing the first four (1989–1992) entering program cohorts, indicated that the Meyerhoff students were significantly more likely than two comparison samples to graduate in STEM majors and attend STEM graduate schools (Maton et al., 2000). One comparison sample consisted of African American students who declined the offer to enter the program and began STEM course work at another university (the “declined” sample). The second included comparably talented African American STEM majors attending UMBC before the program existed (the “historical” sample). Whereas the students in the Black historical sample achieved significantly lower science GPAs than their Caucasian and Asian peers, Meyerhoff students achieved comparable or higher science GPAs than their Caucasian and Asian peers.

Our most recent evaluation data encompass the first 10 cohorts (entering 1989–1998) of African American Meyerhoff and declined students (Maton & Hrabowski, 2004). The declined students primarily attended Tier 1 and Tier 2 undergraduate institutions. The Meyerhoff students had comparable math SAT scores (means of 645 and 649, respectively) and significantly (statistically) lower verbal SAT scores (573 and 605, respectively) and high school GPAs (3.62 and 3.71, respectively; the weighting of advanced placement/honors courses varied across high schools).

The percentage of Meyerhoff students who had graduated from or were currently attending STEM PhD or MD/PhD programs (29.1%;  $n = 86$ ) was 5.3 times greater than the percentage of declined students (5.5%;  $n = 8$ ), a dramatic and statistically significant difference (covariates controlled). An additional 41.9% of Meyerhoff students ( $n = 124$ ) had graduated from or were currently enrolled in medical school or STEM professional or master's programs, compared with 50.7% of declined students ( $n = 74$ ). Finally, 29.1% ( $n = 86$ ) of the Meyerhoff students did not enter STEM graduate or medical school programs, compared with 43.8% ( $n = 64$ ) of the declined students.

Of note, the percentage of Meyerhoff students attending PhD programs has increased dramatically in recent years. Among the first four student cohorts (entering 1989–1992), 18.3% ( $n = 19$ ) graduated from or are currently attending STEM PhD (or MD/PhD) programs. For the next three cohorts (1993–1995), the percentage increased slightly to 23.3% ( $n = 27$ ). However, the percentage more than doubled, to 52.6% ( $n = 40$ ), for the three most recent cohorts (1996–1998). (Less time to drop out is unlikely to be the primary explanation of the dramatic increase.)

Five Meyerhoff students received PhDs between 2000 and 2002; an additional 10 students received their PhDs in 2003. The 1989–1992 entering cohorts of Meyerhoff students accounted for 13 of these PhDs. This represents a PhD completion rate to date of 52% for the 25 students from these cohorts who entered PhD programs (slightly above the reported national average of 50% for PhD students; Lovitts, 2001). Taking 52% as the estimated PhD completion rate for the 70 students who entered PhD programs from the 1993–1998 Meyerhoff cohorts, at least 36 PhD recipients can be expected from these six cohorts, an average of 6 students per cohort.

To place this latter number in context, if six Meyerhoff students from these cohorts receive their STEM PhD over each of the next five years, UMBC would likely become one of the top 10 baccalaureate-origin universities for Black STEM PhD recipients in the nation (cf. National Science Foundation, 2004). Furthermore, if the total of 10 PhDs received in 2003 by Meyerhoff students is maintained through 2007, UMBC would likely become the leading predominantly White baccalaureate-origin institution of Black STEM PhDs.

### **Process Evaluation Findings**

Surveys and interviews have been administered periodically to assess student and faculty perspectives on the

program (Maton et al., 2000). Meyerhoff and declined students also recently completed Supports and Stresses scales. The Supports scale contains 15 items ( $\alpha = .83$ ), each rated on a 5-point scale (1 = *not at all helpful*, 5 = *very helpful*). The Stresses scale contains 12 items ( $\alpha = .76$ ), also rated on 5-point scales (1 = *not at all stressful*, 5 = *very stressful*). Meyerhoff students perceived significantly more support (3.7 vs. 3.3) and less stress (2.7 vs. 2.9) than declined students. Means on specific items are reported below.

Analysis of the process evaluation data reveals five factors that appear especially important: program community, financial support, program staff, research internships and mentors, and campus academic environment. Each is briefly summarized here.

**Program community.** Being part of the Meyerhoff Program community has consistently been rated by students as a key program component (mean rating across four administrations = 4.2 on a 5-point scale). Study groups, an aspect of program community, were viewed as significantly more helpful by Meyerhoff students (4.2) than by declined students (3.6). Meyerhoff students also rated isolation from other minority students as a significantly lower source of stress (1.4) than did declined students (1.6). Of the students interviewed over the years, 85% described program community as key to their success, as revealed in the following interview excerpt:

Number one in my book is the support. Having other smart, talented African Americans around you at all times is an asset. In high school I didn't have that.

**Financial support.** Another consistently highly rated program component is financial support ( $M = 4.4$ ). Meyerhoff students rated financial support as significantly more helpful (4.7) than did declined students (4.0). Meyerhoff students rated finding enough time to study—perhaps linked to financial support—as significantly less a source of stress (3.1) than did declined students (3.6). In interviews, financial aid was often described as facilitating sustained academic focus.

**Meyerhoff Program staff.** Program staff have been consistently identified by students as central to their academic success (mean rating = 4.2). Meyerhoff students rated the academic advising they received as significantly more helpful (3.9) than did the declined students (3.1), as well as the personal counseling received from staff or faculty (3.7 vs. 3.1, respectively). In interviews, students characterized the program staff as encouraging, supportive, and concerned with both their personal and academic lives. A representative quote makes the point:

Meyerhoff Program staff will tell you if you're not doing well. . . . If you have a problem, they will listen to it. They'll push you to get good grades, and if you get good grades, you will be rewarded.

**Research internships and mentors.** Summer research internships were consistently viewed by students as important contributors to their success ( $M = 4.2$ ) and received significantly more positive ratings from Meyerhoff

students (4.2) than from declined (3.7) students. In the interviews, a number of Meyerhoff students indicated that these experiences have contributed to their desire to pursue the PhD and provided them access to leading researchers.

**Campus academic environment.** The students interviewed spoke positively about the campus academic environment, including relationships with faculty. Furthermore, the STEM faculty interviewed reported that their perception of the capability of African American students has been greatly influenced by the Meyerhoff students. Meyerhoff students, compared with students in the declined sample, reported significantly lower levels of stress related to perceived fairness of faculty (2.1 and 2.5, respectively) and to faculty accessibility (2.0 and 2.3, respectively). They also reported significantly greater networking opportunities at the university (3.9) than did declined students (3.0). Several positive features of the academic environment are revealed in the following interview excerpt:

It seems like everybody thinks that if you are a Meyerhoff, then you must be smart. I get that from teachers and people who just work here. . . . They seem to admire you a lot . . . and have a genuine sense of caring for your education.

In summary, the Meyerhoff Program appears to provide both high expectations and strong support for students. In this regard, it represents in some ways a continuation of the students' precollege experience in their families, to which we now turn.

### ***Raising Academically Successful African American Youth: Overcoming the Odds***

An extensive body of research points to the many contextual factors that decrease the likelihood that able African American youth will achieve their academic potential. These factors include perceived racism, negative peer influence, inadequate schools, concern about "acting White," isolation experienced in primarily White academic contexts, media influence, and single-parent households. The problems are not limited to lower income Black youth; as noted previously, African American youth born to middle-class families are even more likely to lag behind their peers on various indices of school success (Miller, 2000; Thernstrom & Thernstrom, 2003).

We conducted two studies to identify the parenting and contextual (neighborhood, peer, school, societal) factors related to the outstanding academic achievement of the Meyerhoff students during their early years. We obtained retrospective accounts of the students' precollege years from in-depth interviews of students and their parents. The first study sample included 60 African American males and their parents (Hrabowski, Maton, & Greif, 1998; Maton, Hrabowski, & Greif, 1998). The second study sample included 66 African American females and their parents (Hrabowski, Maton, Greene, & Greif, 2002). Brief questionnaires supplemented the interviews in both studies.

The interview protocols focused on diverse areas of family life. Mothers, fathers, and their sons or daughters were asked identical or comparable questions. Questions

from the interviews with the sons and daughters included the following: What are the most important things your parents have done in terms of helping you succeed academically? So many African American youth do not make it academically—Why did you do so well? The interviews lasted one to four hours. The thousands of pages of transcribed interviews from the two studies were coded thematically.

**Overview of findings.** The findings revealed a complex tapestry of family processes and contexts involved in each youth's journey to outstanding academic achievement. Challenges, parenting practices, and pathways to success, to some extent, were different for males and females and for children with different temperaments and strengths and weaknesses. Different types of households—single-parent noncollege educated, single-parent college educated, two-parent noncollege educated, and two-parent college-educated—differed somewhat as well.

Nonetheless, a number of common themes emerged. Specifically, the combined importance of determined and persistent parental academic engagement, strict discipline, child-focused love, and community connectedness appeared important to counteract potentially negative contextual influences of neighborhood, peers, schools, and society. We provide here a brief review of each of these themes, with illustrative quotes included.

**Determined and persistent academic engagement.** The parents appeared determined to help their children succeed academically, against the odds. This determination was manifest in very high expectations and a persistent engagement in diverse facets of their child's education. This included an overarching emphasis on the importance of education, a consistent focus on high levels of performance, involvement in preschool educational activities, engagement with teachers, advocacy for appropriate academic placements, providing structure and help with homework, and arranging placements in summer educational programs. Two quotes, the first from a son and the second from a daughter, illustrate several of these themes:

[My mother] always told me that I was smart and that I would do something [and] be someone. . . . When you tell a person that over and over and over again, then eventually they start to believe it.

I come from a single-parent home. My sister and I were the only two in my family. . . . My mom had always pushed us. . . . She was very involved in our school; she knew what was going on. . . . My mom never allowed me to fall short.

**Strict limit setting and discipline.** Strict discipline emerged as a second consistent theme. The sons and daughters emphasized that their parents instilled in them a well-defined sense of right and wrong. They believed that this focus on values positively guided their development and helped them to handle potential problems as they arose. A number recalled their parents using physical punishment to enforce rules during childhood. They also indicated an awareness that the punishments received were not random but had been directed at teaching them to do the right thing in preparation for a sometimes racist and dangerous world where mistakes, such as juvenile pranks, can have serious

consequences. The following two quotes, the first from a son and the second from a daughter, illustrate some of these themes:

My parents instilled at an early age the difference between right and wrong. . . . My mother is 5 feet tall. I was 6 feet tall in middle school. My mother was a teacher in the [city] school system for 25 years. She didn't take anything from anybody. She would not hesitate to stand up on a chair and yell at me. She did not play games. If I did something wrong, I was in trouble.

I wasn't the type of kid who got grounded—I was disciplined hands on. My mom didn't send me to my room. She didn't let me get away with stuff. . . . I was scared my mom would find out if I did something, so I just didn't do it. No behaviors to hide, because I can't hide.

**Child-focused love, support, communication, and modeling.** Many of the sons and daughters emphasized the high levels of love and support they received from their parents—they were a primary focus of their parents' lives. Mothers in particular were viewed as providing nurturance, comfort, guidance, and understanding. Most who had a relationship with their father spoke positively about that relationship. Parents were seen as "being there when needed" and as having strong faith in their son or daughter. Open lines of communication with their parents were generally present, allowing discussion of such difficult issues as sex, drugs, and crime. The love and encouragement received appeared to foster a belief in self and the power to achieve important personal goals, even in the face of great challenges. The two quotes below, the first one from a daughter and the second from a son, illustrate several of these themes:

A lot had to do with my mother. . . . She was supportive and encouraging. I could talk to [her] about anything. She trusted me, and I recognized that. She just set the expectations, and I just did it. My mom set a Christian example. Everything else falls in line after that. I always had the utmost respect for her.

Society does not portray Black men as being intelligent or being successful. My dad was an excellent role model of that successful figure.

**Community connectedness and resources.** Beyond the nuclear family, the influence of extended family members, church, extracurricular activities, peers, and teachers was emphasized by both parents and students. In terms of extended family, grandmothers and aunts were seen as especially influential and as contributing to academic focus. Church attendance was often a regular, shared family activity, and for some, the church was a crucial source of support. Parental support for extracurricular activities, ranging from sports to dance to chess, was highlighted as critical. Positive peer influence was consistently emphasized, especially at the secondary school level. Finally, a number of students described a particular teacher who took a special interest in them and motivated them to excel. Several of these themes are illustrated in the following quotes, the first from a mother of a son and the second from a daughter.



He got a lot of support. . . . Extended family . . . his grandparents would come 600 miles for a program . . . his church, his minister. . . . The support was important because he was one of those lost Black males. . . . If he had to depend on his school he would have been lost by the wayside.

The kids around my neighborhood were real bad. I had to separate myself from them after a while. After middle school, I only hung out with my best friend, who lived right up the street. Just us two, we never really hung out with the neighborhood kids, because they were just going downhill.

The common themes above notwithstanding, the tapestries of the sons' and daughters' lives were quite diverse in terms of the specific challenges faced (e.g., troubled neighborhoods, isolation in schools, negative peer influence, perceived racism) and the strategies that helped them meet these challenges. The qualitative methodology adopted illuminated the rich and varied routes to outstanding academic achievement in the face of many obstacles to such success.

## Discussion

Our work over the past 15 years is based on a strengths perspective. Our findings suggest the feasibility of transforming the academic environment to increase the likelihood that African American students will succeed in difficult STEM majors and enter STEM PhD programs. Meyerhoff students were five times more likely to enter STEM PhD programs than comparison students. Furthermore, our scholarship highlights the contributions of determined parental academic engagement, strict discipline, child-focused love, and community connectedness to outstanding achievement in the precollege years in the face of difficult contextual challenges. We now examine the findings, discuss limitations, and consider future directions.

### *Intervention in the University Environment*

Our results to date suggest that a well-designed university-based intervention can increase the numbers of African American undergraduate students who proceed to STEM PhDs. The program addresses key factors identified in the research literature that limit the performance of capable minority STEM students in predominantly White universities, including inadequate academic and social integration, knowledge and skill development, support and motivation, and advising and monitoring (Brown, 2000; Seymour & Hewitt, 1997; Wilson, 2000). Our process evaluation data suggest that the program overcomes these barriers by providing a powerful program community, financial support, program staff who provide continuous advising and monitoring, summer research internships with leading researchers, and, perhaps most unique, a positive campus academic environment. These components are consistent with state-of-the-art practice in the field (BEST, 2004; May & Chubin, 2003).

In our view, it is the combined influence of these components that contributes to the positive outcomes observed. Such outcomes might not be possible if only a handful of program components were present (BEST,

2004). This hypothesis needs to be tested in future research. Involvement of research faculty is especially critical, because it takes researchers to produce fellow researchers. In addition, the sustained, high-level administrative support the Meyerhoff Program enjoys appears central to its success. Lacking high-level university commitment, implementation of program components may be lackluster, sustainability lacking, and program impact limited.

The discussion above assumes that the Meyerhoff Program accounts for the students' success at UMBC. There are, however, alternative explanations. One is that talented students like those in the Meyerhoff Program would have succeeded without the program. This explanation is belied by the lower rates of STEM PhD program entrance for the comparison samples, however. A second possibility is that the comparison students were less interested in pursuing the PhD from the start, and this is why they declined the Meyerhoff Program offer. A third is that the Meyerhoff students succeeded not because of the program but because they were more academically qualified than other STEM students on the UMBC campus (Elliott, Strenta, Adair, Matier, & Scott, 1995). These explanations appear unlikely to fully explain the findings (cf. Maton et al., 2000) but are worthy of future empirical investigation.

Several potential downsides to the program exist. For example, the constant programmatic pressure to succeed and the focus on pursuing the PhD may negatively affect some students. Furthermore, the program, by providing special resources and status to a subgroup of African American students, has the potential to lead to resentment or backlash on the part of equally capable STEM students not involved in the Meyerhoff Program and students and faculty in non-STEM disciplines. Finally, the program can be criticized for making the PhD and research careers a priority over the MD and nonresearch careers. Each of these potential problems has surfaced to some extent in our ongoing research and is worthy of careful attention. Overall, however, the distinct benefits of the program appear to us to outweigh the limitations.

Our future research plans include examining key moderating and mediating variables that influence program outcomes, the impact on UMBC students, faculty, and staff of the presence of a large number of high-achieving African American students, program impact on non-African American participants, and continued examination of outcomes through receipt of the PhD and into the workforce, with special focus on selection of research careers. Concerning the latter, our hope is to learn which factors impede and which ones contribute to success and to generate ways in which the Meyerhoff Program can continue to support students in graduate school. A parallel study of the experiences, challenges, and supports for students in PhD programs in psychology is about to begin. Finally, we are currently evaluating the UMBC Graduate Meyerhoff Fellows Program, a program initiated in 1996 that aims to replicate key Meyerhoff Program components (e.g., financial support, program community) for UMBC minority graduate students.

## **Raising Academically Successful African American Children**

The Meyerhoff Program builds on the academic and personal strengths of the students. Our research suggests that these strengths stem in part from being raised in families characterized by extremely high levels of determined parental academic engagement, strictness, child-focused love, and community connectedness. Taken together, the parenting practices appear to counteract potentially negative contextual influences. Aspects of the findings are consistent with various strands of prior research (Gándara, 1995). These include the importance of educational socialization, high expectations, parental involvement, and parenting style for the achievement of youth in general (e.g., Christenson, Rounds, & Gorney, 1992) and assertive school involvement, stringent supervision, parental support, peer academic support, and linkage to community resources for African American achievement in particular (e.g., Connell, Spencer, & Aber, 1994; Steinberg, Dornbusch, & Brown, 1992). The current research suggests as well that only extremely determined parenting efforts may be sufficient to counteract fully the neighborhood, peer, and societal challenges of growing up Black in America.

Although the findings suggest a critical parental influence, an alternative explanation is that personal characteristics of the sample, not parenting practices per se, account for the outcomes. For instance, the sample contains a high proportion of college-educated parents. Educated Black parents may have highly successful children primarily because they live in more affluent neighborhoods and send their children to better schools than other Black parents. However, as mentioned earlier, the achievement gap between middle-class Blacks and Whites is at least as great as for lower income populations. Or, above-average levels of intellectual capability may account for the academic success achieved, and the parenting practices described followed from rather than led to this capability. Although these and related possibilities cannot be ruled out, it is unlikely that they fully account for the findings (Maton et al., 1998). Nonetheless, given the retrospective research design and the absence of comparison samples, the current findings are only suggestive. Future research is necessary to examine the complex interplay among the various contributors to high levels of academic success among Black youth.

The psychological mechanisms involved in these youths' pathways to success represent another important focus for future investigation. Although not the focus of our research per se, different students spontaneously indicated a variety of psychological factors that appeared critical: belief in self, perseverance, spirituality, larger purpose, self-discipline, concern for parent's approval, future orientation, ethnic identity, isolation from deviant peers, and connectedness to a larger, purposeful community. These are variables that may make the difference in maintaining a sharp academic focus when many varied threats to such a focus are present.

Our two books that present detailed findings from the two studies have reached a relatively large audience; over 22,000 copies have been sold to date (see Hrabowski et al., 1998, 2002). Furthermore, one of us (Freeman A. Hrabowski, an African American president of a predominantly White university) has had the opportunity to present the findings to large audiences of influential educators around the country on numerous occasions, including at research universities and colleges and at national, state-wide, and local meetings of school boards, superintendents, and teachers. He has also repeatedly presented these ideas to groups of Black parents. On the basis of the questions asked at these presentations and the large number of signed book copies purchased following them, educators and Black parents around the country appear intensely interested in new insights and strategies to help African American youth perform at higher levels and to hear that success can be achieved.

## **The Relevance of STEM PhDs to the Brown v. Board Supreme Court Decision**

One result of the *Brown v. Board of Education* (1954) decision has been a dramatic increase in the percentage of African American college students enrolled in predominantly White institutions; the Meyerhoff students represent a small portion of the over 80% of Black students who now attend such institutions (American Council on Education, 2002). A critical challenge is to ensure that these students succeed. In 1903, W. E. B. DuBois, in his classic book, *The Souls of Black Folks*, argued that the fate of Blacks in America rests in part on the development of a highly educated, influential Black leadership. This still appears to be the reality today, 100 years later.

We view the future scientists of the United States as one component of the Black leadership to which DuBois referred. They will become the future professors, researchers, mentors, administrators, and respected community leaders. Through role modeling, teaching, research, and influencing policy, they can directly contribute to the well-being of African Americans in the United States and to the vitality of society more generally. Furthermore, given the increasing diversity of the American population and the challenges related to international student recruitment in the aftermath of September 11, 2001, the health and vitality of the science and technology workforce will depend increasingly on finding ways to increase the number of minority scientists, including African American scientists (BEST, 2004).

Some might argue, however, that in light of the crippling poverty facing many Black families and the underperformance of African American students in the public schools, increasing the number of African American scientists is a relatively minor and unimportant goal. Relatedly, targeting scarce resources to support high-achieving African Americans, rather than increasing the pool of potential scientists by enhancing public education more generally, may be viewed as an "elitist" strategy. We understand the point of view reflected in these arguments. However, we believe that it is vitally important for policy,



scholarship, and program development to focus on all facets of the educational pipeline, given the substantial ethnic discrepancies that exist at every juncture. It is not an either/or situation (BEST, 2004; National Task Force on Minority High Achievement, 1999).

Furthermore, the approaches used at UMBC to enhance the success of the Meyerhoff students and the approaches used by their parents to raise them may have direct applicability to efforts focused on the general African American population. That is, the Meyerhoff Program approach may prove effective for students of varying levels of ability, in various disciplines, and at various levels of education. Similarly, the parenting practices of the parents of Meyerhoff students may be academically advantageous across the spectrum of youth ability. These possibilities appear worthy of empirical examination, and to the extent they bear fruit, they may represent an important benefit of our focus on a select population of African American students.

Most important, the strengths-based philosophy that underlies our work needs more prominence in the educational arena. If the emphasis of many scholars on the deficits of Black youths and their families is to be counteracted, it is critical to focus on their respective strengths and to understand how these strengths are developed and nurtured. Similarly, to counterbalance the focus of much educational programming on "fixing" Black students, additional emphasis needs to be placed on programs that build on Black students' capabilities. Finally, to broaden psychology's focus on understanding and changing individuals, additional attention needs to be paid to understanding and strengthening the environments in which African American youth are embedded. By adopting a strengths-based approach to scholarship, program development, and social policy, researchers, program developers, and policymakers together can help fulfill the 50-year-old promise of *Brown v. Board of Education*.

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