Civil Rights

Want to Be a Doctor? A Scientist? An Engineer? An Affirmative Action Leg up May Hurt Your Chances

*By Gail Heriot**

The assumption behind the fierce competition for admission to elite colleges and universities is clear: The more elite the school one attends, the brighter one's future. That assumption, however, may well be flawed. The research examined recently by the U.S. Commission on Civil Rights provides strong reason to believe that attending the most competitive school is not always best—at least for students who aspire to a degree in science or engineering.[1]

Majoring in science or engineering can be difficult. As one Yale University student told the *Wall Street Journal*, the science course he took "scared the hell out of me." "In other classes, if you do the work, you'll get an A," he complained. "In science, it just doesn't work that way."[2]

Well . . . yes . . . the feeling that one is flailing about in science and engineering courses can be very disconcerting. Many students who start out with such a major switch to something easier. Others drop out or even flunk out. And it should surprise no one that those who wash out are disproportionately students whose entering academic credentials put them towards the bottom of their college class.[3] Not all stereotypes about science and engineering students are accurate. But the basic notion that they tend to be highly-credentialed and hardworking is largely on target. They have to be.

What some do find surprising is this: *Part of the effect is relative*.[4] An aspiring science or engineering major who attends a school where his entering academic credentials put him in the middle or the top of his class is more likely to succeed than an otherwise identical student attending a more elite school where *those same credentials* place him towards the bottom of the class. Put differently, an aspiring science or engineering major increases his chance of success not just if his entering credentials are high, but also if those credentials compare favorably with his classmates'.[5]

The reasons for this comparative effect are doubtless complex. But they are based on a common everyday observation: A good student can get in over his head and end up learning little or nothing if he is placed in a classroom with students whose level of academic preparation is much higher than his own, even though he is fully capable of mastering the material when presented at a more moderate pace. Discouraged, he may even give up—even though he would have persevered had he been in a somewhat less competitive environment.[6]

Science and engineering are ruthlessly cumulative. A student who has difficulty with the first chapter in the calculus textbook is apt to have difficulty with the second, third, and fourth chapters. Indeed, the subsequent courses in the mathematics curriculum may be a problem. By contrast, an English literature student who simply fails to read the Chaucer assignment is not necessarily at a serious disadvantage when it comes to reading and understanding George Eliot. Since quitting science and engineering is easy—ordinarily all one has to do is switch majors—the attrition rate is quite high. By senior year, there are significantly fewer science and engineering majors than there were freshmen initially interested in those majors.

Some call this comparative effect the "mismatch" effect.[7] And although there is reason to believe that it applies to other kinds of learning, science and engineering examples are perhaps the easiest to imagine: I have every confidence that I can learn basic physics, despite the fact that I have never taken a course in it and my mathematics skills are a little rusty. If I ever lose my job as a law professor, I suspect that I am fully capable of re-tooling as a physics teacher if that is where the available jobs turn out to be. But if I were thrown into the Basic Physics course at Cal Tech, with many of the very best science students in the world, I would be lost and likely learn little if anything. I would be mismatched.[8] On a good day I might make a few lame jokes about my unhappy situation; on a bad day I might even get a little testy about it. But I would be unlikely to come out of that class as competent in the basic principles of physics as I would have in a less high-powered setting.[9]

That doesn't mean, however, that those who aspire to a career in science or engineering must graduate from high school already prepared for the rigorous science curriculum at the world's most competitive science-oriented university. There are many careers in science and engineering. Many have been filled by latecomers to the field. It simply means that for those who are not already well-prepared when they begin to study science or engineering in earnest, the best strategy may be to avoid going immediately head-to-head with better prepared students.

The interest of the Commission on Civil Rights in mismatch centers mainly on its effect on members of under-represented racial minorities—primarily African Americans, Hispanics, and American Indians. Since admissions standards are frequently relaxed in order to admit a more diverse student body, minority students constitute a disproportionate share of the students with entering academic credentials towards the bottom of any particular class.[10] Obviously, however, there are other categories of students, such as athletes, children of alumni, and other special admittees, who should also be mindful of the risk of mismatch that comes with preferred treatment in admissions.

All such students have a dilemma to face. Should they accept the supposed "leg up" they have been offered? Or should they reject it and attend a school where such an advantage would have been unnecessary? The answer is likely to vary from student to student and may be a question of priorities. Which is more

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important—that student's desire to attend the most elite school or his or her desire to be a physician, engineer, or scientist?

The problem is that few students who receive a preference realize that their entering academic credentials are well below the institutional median. Fewer still realize that relatively low academic credentials are likely to handicap their ability to earn a degree in science or engineering at that institution and that their odds would be better elsewhere. Instead, they are recruited, indeed romanced, by colleges and universities who allow the scramble for a racially diverse campus (or a winning football team or happy alumni) to overcome their commitment to full and fair disclosure.

It is for this reason that the Commission on Civil Rights has recommended that schools inform the students they are attempting to recruit of the mismatch issue and its potential impact. Tuition for the 2010-11 academic year at the University of San Diego, for example, where I am on the faculty, will be $36,950. That, of course, does not include room and board or various fees. Many students are willing to incur such debt because they envision their future career will be in a well-paying field like medicine or nuclear engineering. When they graduate four years later with a less marketable degree, they may be saddled with a large debt that they would have been unwilling to undertake had they understood that the odds were stacked against their success in science or engineering. But no one told them.

At minimum, this is an issue that students should be informed of so that they, with assistance from their parents, high school teachers, and guidance counselors and other advisors, can decide for themselves how to proceed. But let's look at the evidence step by step.

A. Minority Students Are Indeed Under-Represented in Science and Engineering.

There is no segment of the labor force that proportionally reflects the nation's demographic profile. Physicians are disproportionately Jewish. Jockeys are disproportionately Hispanic. The wine industry employs more than its share of Italian Americans. Even within professions, disproportionality is the rule, not the exception. Among lawyers, litigators are often Irish American. Among physicians, radiologists are disproportionately Subcontinent Indian American.

Lack of proportionality is not necessarily the result of systematic discrimination. There are many ways in which one's family background, language, and cultural traditions directly or indirectly affect career choices. As a result, it would be hard to find a single profession or occupation that looks, as it is often put, "like America." The world is always more complex than that.

But science and engineering are special. For one thing, they are not single fields. Instead, obtaining an initial degree in a field of science or engineering is the gateway to a large number of respected professions and occupations—from aviation inspector to zoologist. These fields represent a significant portion of the most lucrative and dynamic sectors of the world economy. If African Americans, Hispanics, and American Indians are facing significant impediments in entering these fields, that is a situation that calls for attention.[11]

Using data from the National Survey of College Graduates conducted by the U.S. Census Bureau, UCLA law professor Richard Sander and senior statistician Roger Bolus have calculated the following racial gap in science among college graduates, including immigrants educated or partly educated abroad, age 35 and under:

Table I: How Significant is the Racial Gap in Science?[12]

Frequency Relative to Population	White	Black	Hispanic	Asian
Gen. Pop.	100	100	100	100
Bachelor's Degree Science	100	36	41	454
PhD Science	100	15	26	703

As the chart indicates, blacks and Hispanics are only 36% and 41% respectively as likely as whites to have a bachelor's degree in science or engineering. An Asian, by contrast, is more than four-and-a-half times more likely than a white to hold such a degree. Blacks are only 15% and Hispanics are only 26% as likely as whites to have a PhD in science. Asians, on the other hand, are more than seven times as likely as whites. The under-representation of blacks and Hispanics in science and engineering is real (although these figures are in part a reflection of the immigration of highly-qualified individuals from abroad).[13]

Of course, concern over under-representation in science and engineering is not new. On November 13, 1992, the popular magazine *Science* issued a special news report entitled "Minorities in Science." In it, the editors lamented:

> For 20 years, science has been wrestling with "the pipeline problem": how to keep minorities from turning off the obstacle-strewn path to careers in science, mathematics, and engineering. Thousands of programs have been started since the late 1960s to bring diversity to the scientific work force. But their results have been dismal . . . .[14]

One thing, however, is clear. The problem has not been an unwillingness to spend money. By 1992, the National Science Foundation had already spent over $1.5 billion on programs designed to increase the number of minorities in science or engineering. Officials at the National Institutes of Health estimated that they had pumped an additional $675 million into the system. Uncounted state, local, foundation, and industry programs contributed millions more.[15]

But the consensus of opinion has been that much of the money had been spent unwisely. In their eagerness to qualify for the vast grants available to educate future minority scientists and engineers, many colleges and universities admitted minority students with little background in science or mathematics. In the early days of affirmative action, "colleges took any person of color who wanted to become an engineer, regardless of their background," said Mary Perry Smith, a former Oakland schoolteacher and founder of California's Mathematics, Engineering, Science Achievement (MESA) program, which promotes minority student participation in those fields. "They

tried to turn students who barely knew algebra into engineers and it was a total failure."[16]

"The country cannot repeat the experiment of the last 20 years," said Luther Williams in 1992, then the assistant director of education and human resources at the National Science Foundation. Williams, who later went on to become provost of Tuskegee University, a historically black university with a reputation for emphasizing a science and engineering curriculum, was blunt: Those vast expenditures were "an incredible waste of financial and human resources."[17]

Perhaps Williams was being too harsh. Progress has been made, and it will continue—even though it is not as much progress as we would like. But if the problem is going to be solved, it will not be solved by more of the same thinking that has characterized the efforts of the last forty years. A re-examination of the assumptions behind those efforts is in order—even if it will step on a few well-entrenched toes.

B. There is No Problem with Lack of Interest in Science and Engineering Among Minority Students. It is Disproportionate Attrition that is the Cause for Concern.

The problem with minority under-representation in science and engineering is not the result of lack of interest among college-bound African Americans, Hispanics, and American Indians. Study after study has found just the opposite.[18] Indeed, if anything, such students are slightly more interested in pursuing science and engineering degrees than white students. For example, Professors Alexander W. Astin and Helen S. Astin of UCLA's Higher Education Research Institute examined a sample of 27,065 students enrolling as freshmen at 388 four-year colleges in 1985. They found that the rate of initial interest in majoring in a biological science, a physical science, or engineering was, in descending order, 52.6% for Asians, 35.7% for Chicanos, 34.5% for American Indians, 34.2% for African Americans, and 27.3% for whites.[19] If there is a problem with lack of interest in science and engineering, it is with college-bound whites, not college-bound African Americans, Hispanics, and American Indians.

These findings were consistent with later efforts to study the issue. When Dartmouth College psychology professor Rogers Elliott and his co-investigators looked at a sample of 4687 students enrolling at four elite colleges and universities in 1988, they found that 55% of the Asians, 44.2% of the African Americans, 44% of the Hispanics, and 41.4% of the whites were initially interested in majoring in science.[20] Similarly, Richard Sander and Roger Bolus, in analyzing all students enrolling in the University of California between 2004 and 2006, found that 57.1% of Asians, 40.5% of African Americans/Hispanics, and 34.7% of whites declared an intention to major in science or engineering.[21]

To be sure, that doesn't mean that there is no point encouraging even more under-represented minorities to aspire to careers in science and engineering. Programs that are proven to encourage such interest might be money well-spent. But if one wants to understand the root of the problem, one must look elsewhere.

And some researchers have. Their work has shown that the problem for minority college students comes a little further down the pipeline. While African Americans, Hispanics, and probably American Indians have high rates of initial interest relative to whites, they are less likely to follow through with that interest. Somewhere in college, the aspiration to graduate with a degree in science or engineering dies. Astin and Astin report, for example, that while 68% of Asians and 61% of whites in their sample followed through on their intention to major in biological science, physical science, or engineering four years later, only 47% of African Americans and 37% of Hispanics did the same. The rest had apparently changed majors, dropped out, or flunked out.

Consequently, while one might expect, given their level of interest, that African American college students would be somewhat over-represented among science and engineering college graduates, they turn out to be under-represented instead. Hispanics are a special case. With them, English mastery is sometimes a problem. One would therefore expect very high perseverance in science and engineering, since transfer to a discipline that requires skill in English can be daunting. All other things being equal, over-representation in science and engineering should be expected for a language-based minority. But for Hispanics attrition rates in science and engineering were also unusually high.

Similar results were obtained by Rogers Elliott and his co-investigators. In their study, they found that 70% of Asians persisted in their ambition, while 61% of whites, 55% of Hispanics and 34% of blacks did.[22] Others had similar findings.[23]

C. Students with Low Entering Credentials in Science, Both in Absolute and in Comparative Terms, Are More Likely to Leave Science and Engineering.

It is tempting to ask the question "What accounts for disproportionate minority attrition?" first. But that temptation should be avoided. Instead, the first question should be "What accounts for student attrition in general?" Once that preliminary question is answered, the question about disproportionate minority attrition essentially answers itself.

It is no secret that entering science credentials—like Math SAT score and the number and grades received for high school courses in mathematics and science—are strongly correlated with persistence in science.[24] Since African American, Hispanic, and American Indian students tend as a group to have lower entering science credentials, they are almost certain to have a higher attrition rate.[25]

It would be wonderful if the disparities among races, including the disparities between Asians and others, could be eliminated overnight by improving the performance of the lower-performing groups. For that matter, it would be nice if disparities between individuals could be eliminated and everyone could perform better in mathematics, science, and all subjects. And there is no doubt that improvements can be made.

But if there is one thing that we have learned during the many decades that this problem has been receiving attention, it is that few improvements can be made quickly. The mismatch problem, however, may be a partial exception. Matching students to the right college or university for their level of

developed academic ability could increase the number of science and engineering majors in fairly short order.

As three independent studies have now concluded, absolute credentials are not the only thing that matters in keeping students in science and engineering. Relative credentials are also important. A student whose entering credentials are at the bottom of the class at the school he attends is less likely to persevere in his quest for a degree in mathematics or engineering than a student with identical credentials who attends a school where those credentials place him higher in the class.

The first of these studies was that published by Rogers Elliott and his co-investigators in 1996.[26] The single most important culprit they found was the "*relatively* low preparation of black aspirants to science in these schools."[27] The Elliott team was careful to put the emphasis on "relatively." It wasn't just entering credentials demonstrating high developed ability at science that mattered, but comparatively high credentials. A student who attended a school at which his Math SAT score was in the top third of his class was more likely to follow through with an ambition to earn a degree in science or engineering than was a student with the same score who attended a school at which his score was in the bottom third. The chart at the bottom of the page was presented.

According to the authors, the bottom line was this: A student with an SAT Math score of 580 "who wants to be in science will be three or four times more likely to persist at institutions J and K, where he or she is competitive, than at institutions A and B, where he or she is not."[28]

For some this is counter-intuitive. The more prestigious the school, they believe, the more adept it should be at graduating future physicians, scientists, and engineers, no matter what their entering credentials. But instructors everywhere must pitch the material they teach at a particular level. They can pitch to the top of the class, to the middle, or to the bottom, but they can't do all three at the same time. At elite colleges and universities pitching to the bottom of the class is uncommon—especially in the science and engineering departments. The whole point of these institutions is to teach to the top. That is the reason that students, who may have been positively mismatched in high school, are willing to travel thousands of miles and incur significant debt to attend them. If they were to abandon that practice and resolve to teach to the bottom of the class, they would no longer be elite institutions.[29]

The extraordinary record of Historically Black Colleges and Universities was one source of evidence cited by the Elliott team in favor of their conclusion. With only 20% of total African American enrollment, these schools produce 40% of the African American students graduating with natural science degrees, according to the National Science Foundation. These students frequently go on to earn PhD's from mainstream universities. The National Science Foundation reports, for example, that of the approximately 700 African Americans who earned a doctorate in science or engineering between 1986 and 1988, 29% earned their undergraduate degree from an HBCU. For biologists the figure was 42%, and for engineers it is was 36%.[30] Even those who have mixed feelings about HBCUs (and I am such a person) must admit this is impressive.

Why have HBCUs been so successful? Unlike at mainstream institutions with their high levels of affirmative action, African American students at HBCUs are not grouped at the bottom of the class. Roughly half of African American students at HBCUs will be in the top half of the class. Many will be honor students. As a result, systematic mismatch is just not an issue.[31]

The problem is not that there are no minority students capable of doing honors work at mainstream college and universities. There are many. But there are not enough at the very top tier to satisfy the demand for diversity. And when elite universities like Cal Tech, MIT, or the Ivies lower their academic standards in order to admit a more racially diverse class, schools one or two tiers down feel they must do likewise, since the minority students who might have attended those schools based on their own academic record are instead attending the more elite schools. The problem thus cascades downward

Table II: Percentage of Earned Degrees in the Natural Sciences as a Function of Terciles of the SAT-M Distribution in Eleven Institutions[32]

	Tercile 1		Tercile 2		Tercile 3	
Institution	% Degrees	SAT-M	% Degrees	SAT-M	% Degrees	SAT-M
Institution A	53.4	753	31.2	674	15.4	581
Institution B	57.3	729	29.8	656	12.9	546
Institution C	45.6	697	34.7	631	19.7	547
Institution D	53.6	697	31.4	626	15.0	534
Institution E	51.0	696	34.7	624	14.4	534
Institution F	57.3	688	24.0	601	18.8	494
Institution G	62.1	678	22.6	583	15.4	485
Institution H	49.0	663	32.4	573	18.6	492
Institution I	51.8	633	27.3	551	20.8	479
Institution J	54.9	591	33.9	514	11.2	431
Institution K	55.0	569	27.1	472	17.8	407
Medians	53.6		31.4		15.4	

to the fourth and fifth tiers, which respond similarly. As a result, a serious gap in academic credentials between minority and non-minority students is created at all competitive levels at mainstream universities—a gap that results in seriously disappointing grades for many minority students, especially in science and engineering classes where good grades are hard to come by.

At least one HBCU faculty member—Professor Walter Pattillo, Jr. of North Carolina Central University—intuitively grasped the mismatch problem even before the Elliott team was able to demonstrate its existence empirically. As then-chairman of the biology department, he vented his frustrations to *Science* in 1992: "The way we see it, the majority schools are wasting large numbers of good students. They have black students with admission statistics [that are] very high, tops. But these students wind up majoring in sociology or recreation or get wiped out altogether."[33]

Neither Professor Pattillo nor the Elliott study received attention from mainstream college or university administrators. Admissions policies at competitive schools continued to emphasize recruiting minority students even if their entering credentials would put them towards the bottom of the class. Instead, emboldened by their perception that the Supreme Court had given a constitutional green light to racially preferential admissions policies in *Grutter v. Bollinger* (2003),[34] selective schools ramped up those policies.[35] The supposed beneficiaries of these policies were not informed.

Around that time, however, the tide of opinion among social scientists studying the issue was beginning to turn, even as it remained frozen among college and university administrators.[36] One of the milestones was the publication of *Increasing Faculty Diversity: The Occupational Choices of High Achieving Minority Students* in 2003. The long-term project was funded by the Mellon Foundation, which had been and remains one of the nation's most zealous institutional backers of race-based admissions policies. The authors' mission was to determine why more minority students are not attracted to careers in academia. Their conclusions, reached after extensively questioning 7,612 high-achieving undergraduates at thirty-four colleges and universities, pointed to mismatch as a significant culprit:

> The best-prepared African Americans, those with the highest SAT scores, are most likely to attend elite schools, especially at the Ivy League. Because of affirmative action, these African Americans (those with the highest scores on the SAT) are admitted to schools where, on average, white students' scores are substantially higher, exceeding those of African Americans by about 200 points or more. Not surprisingly, in this kind of competitive situation, African Americans get relatively low grades. It is a fact that in virtually all selective schools (colleges, law schools, medical schools, etc.) where racial preferences in admission is practiced, the majority of African American students end up in the lower quarter of the class. . . .
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> African American students at the elite schools . . . get lower grades than [African American] students with similar levels of academic preparation (as measured by SAT scores) . . . at the nonelite schools. . . . ***Lower grades lead to lower levels of academic self-confidence, which in turn influence the extent to which African American students will persist with a freshman interest in academia as a career. African American students at elite schools are significantly less likely to persist with an interest in academia than are their counterparts at nonelite schools.***[37]

A year after Cole & Barber's research became public, a second study on science and engineering mismatch was published. University of Virginia psychologists Frederick L Smyth and John J. McArdle used a different methodology and database from those of Elliott and his co-authors. But they reported findings that "are consistent" with the earlier article's conclusion that "race-sensitive admissions, while increasing access to elite colleges, was inadvertently causing disproportionate loss of talented under-represented minority students from science majors."[38]

Indeed, Smyth & McArdle went further. They developed a model that attempts to measure how many more minority students would have succeeded in their goal of a science or engineering degree if race neutral admissions criteria had been employed. They wrote:

> According to our model . . ., if all the [Science-Mathematics-Engineering]-intending underrepresented minority students had enrolled in similarly functioning colleges where their high school grades and math test scores averaged at the institutional means among [Science-Mathematics-Engineering] intenders, 72 more of the women and 62 more of the men would be predicted to persist in [Science-Mathematics-Engineering] (45% and 35% increases, respectively).[39]

Smyth & McArdle's recommendation was clear: "Admission officials are advised to carefully consider the relative academic preparedness of science-interested students, and such students choosing among colleges are advised to compare their academic qualifications to those of successful science students at each institution."

The latest contribution to the literature on science and engineering mismatch is *Do Credential Gaps in College Reduce the Number of Minority Science Graduates?*[40] Using a number of sophisticated methodologies, Sander & Bolus arrive at conclusions like those of Smyth & McArdle and the Elliott team.

Sander & Bolus studied data obtained from the multi-campus University of California. All UC campuses are quite selective. But some are more selective than others. The flagship campus at Berkeley is highly selective, as are the UCLA and UC-San Diego campuses. At the other end of the spectrum, the campuses at Riverside and Santa Cruz are easier to gain admittance to, but nonetheless hardly "easy."

Employing what they call the "distance method," Sander & Bolus measured the distance between each student's entering academic index and the median academic index of all science and engineering-interested students at that campus. This allowed the authors to compare not just students with equal academic indices attending different UC campuses, but also make comparisons based on the magnitude of mismatch.[41]

They found that students who are "mismatched" at one UC campus are at a greater risk of failing to attain their initial goal of a science or engineering degree than otherwise identically-credentialed students attending a less selective campus of that same university at which they were not mismatched. And the greater the mismatch, the greater the problem.

Not satisfied with confining their analysis to the "distance method," Sander & Bolus also employed what they dubbed the "first choice/second choice" method. This approach involves looking at pairs of students who were admitted to two different UC campuses, one more elite and the other less elite. In each pair, one student chose to attend the more elite school and the other the less elite. The results were the same: Mismatched students are at a disadvantage in science and engineering.[42]

"Minority attrition in science is a very real problem, and the evidence in this paper suggests that 'negative mismatch' probably plays a role in it," they wrote. The approaches they took yielded consistent results: "[S]tudents with credentials more than one standard deviation below their science peers at college are about half as likely to end up with science bachelor degrees, compared with similar students attending schools where their credentials are much closer to, or above, the mean credentials of their peers."[43]

D. Conclusion.

Decades ago, well-meaning administrators at selective college and universities resolved to "do the right thing" by extending preferential treatment to under-represented minorities in admissions. One of the consequences of that policy has been systematically low college grades for most of the supposed beneficiaries of that preferential treatment.[44]

No serious supporter of affirmative action denies this. William G. Bowen and Derek Bok, authors of *The Shape of the River: Long-Term Consequences of Considering Race in College and University Admissions* and long-time advocates of race-based admissions policies, candidly admit that the credentials gap has serious consequences: "College grades [for affirmative action beneficiaries] present a . . . sobering picture," they wrote. "The grades earned by African-American students at the [schools we studied] often reflect their struggles to succeed academically in highly competitive academic settings."[45]

The long-term social and educational consequences of decades of race-based admissions policies and the artificially low grades for minorities those policies produce are only now beginning to be studied. The evidence examined by the Commission on Civil Rights focuses only on the effects on science and engineering majors. It suggests that, as a result of race-based admissions policies, we now have fewer, not more, physicians, dentists, engineers, scientists and other science-oriented professionals than we would have had under a policy of color-blindness.

While there are still a few unanswered questions, it is time for students to be advised of the issue and allowed to make their own decision about their future. Indeed, it is long past time. If higher education were held to the same standards of consumer disclosure as other businesses—from securities brokerage houses to children's toy manufacturers—this information would have been disclosed long ago.

Endnotes

1 Apart from the considerations discussed in this report, there may indeed be something special about the education available from America's most academically competitive colleges and universities. It should be noted, however, that some of the most sophisticated research available suggests that when it comes to increasing one's income, elite schools are not exactly the ticket. *See* Stacy Berg Dale & Alan B. Krueger, *Estimating the Payoff to a Highly Selective College*, 117 Q.J. Econ. 1491 (2002). Graduates of Ivy League institutions are indeed high earners. But, if this research is correct, this is simply a reflection of the fact that very talented students attend those schools. If the same students had attended less prestigious schools, they would have done on average just as well financially—or so this research suggests.

2 Dana Milbank, *Education: Shortage of Scientists Approaches a Crisis As More Students Drop Out of the Field*, Wall St. J. (September 17, 1990).

3 *See infra* at Part C.

4 *See infra* at Part C.

5 As one early researcher on this topic put it, there is an academic advantage to being a "big frog" in the "frog pond." James A. Davis, *The Campus as a Frog Pond: An Application of the Theory of Relative Deprivation to Career Decisions of College Men*, 72 Am. J. Socio. 17 (July 1966). This article was written well before the concept of mismatch came to be associated with the controversy over affirmative action and was not focused specifically on science and engineering. Davis found that college GPA is more strongly correlated with career choice than is quality of institution. In other words, while students take both their college grades and the academic quality of the school they are attending into account in evaluating their career choices, they tend to place more emphasis on college grades than is justified. A student at the bottom of his very elite class will tend to underestimate his abilities, while a student at the top of a class at a mediocre school will tend to over-estimate them. Davis concludes:

> [T]hese ideas have some implications for educational policy. At the level of the individual, they challenge the notion that getting into the "best possible" school is the most efficient route to occupational mobility. Counselors and parents might well consider the drawbacks as well as the advantages of sending a boy to a "fine" college, if, when doing so, it is fairly certain he will end up in the bottom ranks of his graduating class.

Id. at 30-31.

6 While the observation that a student is more likely to learn in a classroom where his academic credentials are not at the bottom of the class is common sense, it is not necessarily true in all contexts. Take, for example, a school with 100 first graders. If one were to divide the class into thirds according to their achievement test scores, it is not necessarily the case that all three groups would learn more than if they were divided into three groups at random. Students with behavioral problems may tend to be over-represented in the group of students with the lowest scores for the simple reason that their behavior has interfered with their own learning. Concentrating them in one group may create havoc in the classroom that interferes with the ability of all students, not just those with behavioral problems, to learn.

7 *See, e.g.*, Thomas Sowell, Inside American Education: The Decline, the Deception, the Dogmas (1993).

8 Mismatch may be positive or negative. If a typical Cal Tech freshman were to take a Basic Physics class designed for law professors like me, many of whom have never excelled at science, she would likely learn less than she would have in a class with her fellow Cal Tech students. Coasting through a "Basic Physics for Dilettantes" course, she would be the victim of positive mismatch, while I am negatively mismatched in the hypothetical.

9 The empirical studies discussed in Part C do not distinguish among the reasons that mismatched students might drop out of science and engineering more often than non-mismatched students with similar credentials. They simply record that they disproportionately do so. Is it just because they perceive that they aren't doing well relative to other students and hence lack confidence in themselves? Or are they actually learning less than their similarly-credentialed counterparts who persevere in science or engineering at somewhat less elite institutions? Or both? There is, at present, no national examination for science and engineering achievement that would allow researchers to determine whether college students who were mismatched and dropped out of science or engineering actually learned less than their counterparts at less elite schools

who took similar courses. The intuitive answer is that they did and that their self-confidence was also shaken in the process. But it is unnecessary at this point to draw a distinction. The law school experience is clearer, since law students must pass a bar examination in order to practice law. There is empirical evidence that mismatched law students are less likely to pass the bar examination than their non-mismatched counterparts at less elite schools. Richard Sander, *A Systemic Analysis of Affirmative Action in American Law Schools*, 57 Stan. L. Rev. 367, 393 (2004).

10 While the Supreme Court case of *Gratz v. Bollinger*, 539 U.S. 244 (2003), was pending before the Supreme Court, much publicity was centered around the fact that the University of Michigan routinely added the equivalent of an entire letter grade to the admissions index of under-represented minority students. An African American student with a high school grade point average of 2.95 would thus be preferred to an Asian American student with a high school grade point average of 3.94 (just shy of straight As) all other things being equal. The *Gratz* case rejected such a formulaic approach, but it did not reject the size of the preference granted to minority students. And indeed, the evidence suggests that the size of the preference grew at the University of Michigan in the period following the *Gratz* decision. *See infra* at note 35.

The University of Michigan's policies were not more over-the-top than other universities. Lawsuits filed against the University of Georgia, the University of Texas, and the University of Washington prior to the Supreme Court's decision in *Gratz* brought to light similar practices. Hopwood v. Texas, 78 F.3d 932 (5th Cir. 1996), *cert. denied*, 518 U.S. 1033 (1996) (law school); Smith v. University of Washington, 233 F.3d 1188 (9th Cir. 2000) (law school); Johnson v. Board of Regents, 106 F. Supp. 2d 1362 (S.D. Ga. 2000), *aff'd*, 263 F.3d 1234 (11th Cir. 2001) (undergraduate admissions). *See also* Robert Lerner & Althea Nagai, Ctr. for Equal Opportunity, Racial and Ethnic Preferences in Undergraduate Admissions at Six North Carolina Public Universities (May 28, 2007) (finding similar preferences at competitive North Carolina universities).

Some of the most discriminatory policies are at professional schools. At law schools, for example, the average black student has an academic index that is more than two standard deviations below that of his average white classmate. Richard Sander, *A Systemic Analysis of Affirmative Action in American Law Schools*, 57 Stan. L. Rev. 367, 393 (2004).

11 In addition, many have asserted that there is a shortage of Americans trained in science and engineering and that this shortage will likely get worse. If a particular segment of the population is under-represented in these fields, it is only prudent to look into what can be done to increase their participation. Nat'l Sci. Found., Future Scarcities of Scientists and Engineers: Problems and Solutions (1992).

12 Richard Sander & Roger Bolus, Do Credentials Gaps in College Reduce the Number of Minority Science Graduates?, Working Paper 2 (Draft July 2009) (using data from 2003) [hereinafter "Sander & Bolus"].

13 Unlike African Americans, Hispanics in science and engineering do not appear to be under-represented relative to Hispanics in other college disciplines, such as the humanities. *Id.* Relative to their initial interest, however, they are under-represented. Ordinarily one would expect a language minority to be over-represented in science and engineering, since those disciplines do not require the same language skills as the humanities.

14 Elizabeth Culotta & Ann Gibbons, *Minorities in Science: Two Generations of Struggle: Special Report Overview*, 258 Science 1176 (November 13, 1992).

15 Calvin Sims, *What Went Wrong: Why Programs Failed*, 258 Science 1185, 1185 (November 13, 1992).

16 *Id.* at 1187.

17 *Id.*

18 Smyth & McArdle, *Ethnic and Gender Differences in Science Graduation at Selective Colleges with Implications for Admission Policy and College Choice*, 45 Res. Higher Ed. 353, 357 (2004) (calling this finding "consistent" and citing a number of studies dating back to the late 1970s) [hereinafter "Smyth & McArdle"].

19 Alexander W. Astin & Helen S. Astin, Undergraduate Science Education: The Impact of Different College Environments on the Educational Pipeline in the Sciences 3-9, Table 3.5 (1993) [hereinafter "Astin & Astin"].

20 Rogers Elliott, A. Christopher Strenta, Russell Adair, Michael Matier & Jannah Scott, *The Role of Ethnicity in Choosing and Leaving Science in Highly Selective Institutions*, 37 Res. Higher Ed. 681, 692-93 (1996) [hereinafter "Elliott"].

21 Sander & Bolus, *supra* note 12, at 3. Sander and Bolus also report that among the University of California students enrolling from 1992 to 2006, 52.6% of Asians declared an intention to major in science and engineering, as did 37.5% of Blacks/Hispanics and 34.7% of whites. *Id.*

22 Elliott, *supra* note 20, at 694. *See also* Nat'l Sci. Found., Future Scarcities of Scientists and Engineers: Problems and Solutions (1990) (finding persistence rates of 43% for majority students and 21% for minority students); T.L. Hilton, J. Hsia, D.G. Solorzano & N.L. Benton, Persistence in Science of High Ability Minority Students (1989) (reporting that 54% of Asian, 44% of white, 36% of black, and 29% of Latino high school seniors who had intended to attend college and major in science or engineering were doing so two years later).

23 Smyth & McArdle, *supra* note 18, at 361-63.

24 Astin & Astin, *supra* note 19, at 3-9, Table 3.5; Elliott, *supra* note 20, at 694; Smyth & McArdle, supra note 18, at 357; Sander & Bolus, supra note 12.

25 *See id. See also* William G. Bowen & Derek Bok, The Shape of the River: Long-Term Consequences of Considering Race in College and University Admissions (1998).

26 Elliott, *supra* note 20.

27 *Id.* Among the credentials that mattered most were number of science courses taken, average grades in high school science courses and SAT-Math score.

28 *Id.* at 702. This estimate, of course, was based on the assumption that the student started out with a desire to major in science or engineering. Whether a student with no particular plans to major in science or engineering is more likely to graduate with a science or engineering degree if he attends a school at which he is properly matched is a more complex matter. As the Elliott team demonstrated, students with higher SAT Math scores are more likely to begin college with a desire to major in science. Consequently, institutions A-E likely have more students interested in pursuing science than Institutions F-K and thus would naturally be expected to award a higher proportion of science degrees, since that is what their students desire. And indeed they did. The Elliott team reported that Institution A-E were about twice as likely to award science degrees as Institutions F-K, with about 28% of the first group's bachelor's degrees being in science and about 15% of the second group's. Nevertheless, as they point out, "a 54% chance of getting one of the 15% of the degrees that are in science is nearly twice as good as a 15% chance of getting one of the 28% of degrees that are in science." *Id.* at 702.

29 In theory, intensive remedial instruction is supposed to bridge the gap between the top and the bottom. But not every theory works out in reality. The educational experience at elite institutions is meant to be a full-time job and then some. With only twenty-four hours in a day, something has to give. Every hour a minority student spends in a remedial classroom, sometimes struggling to stay on top of material other students are having less trouble with, is an hour other students can spend getting a deeper understanding of that material. The game of catch-up is thus never-ending.

30 Elizabeth Culotta, *Black Colleges Cultivate Scientists*, 258 Science 1216 (November 13, 1992) (hereinafter "Culotta").

31 The Elliott team members were particularly impressed that HBCUs are able to graduate large numbers of students in science and engineering despite entering credentials that were significantly lower than those ordinarily found at elite institutions. Students at Xavier University, for example, were reported to have SAT Math scores averaging around 400, yet half of the class was majoring in science. If elite schools could do the same with minority students (or with students in the bottom third of the class generally), it would be astonishing. In fact they do the opposite. They are able to award far fewer science or engineering degrees to African Americans than one would expect given the number of African American students in their classes. Elliott, *supra* note 20, at 700.

32 *Id.* at 701.

33 Culotta, *supra* note 30, at 1218.

34 539 U.S. 306 (2003).

35 Althea K. Nagai, Ctr. for Equal Opportunity, Racial and Ethnic Preferences in Undergraduate Admission at the University of Michigan (October 17, 2006); *see also* Fisher v. University of Texas, 645 F. Supp. 2d 587 (W.D. Tex. 2009).

36 *See* Russell K. Nieli, *The Changing Shape of the River: Affirmative Action and Recent Social Science Research*, 17 Acad. Questions 7 (2004).

37 Stephen Cole & Elinor Barber, Increasing Faculty Diversity: The Occupational Choices of High Achieving Minority Students 124, 212 (2003) (citations omitted) (emphasis supplied).

38 Smyth & McArdle, *supra* note 18, at 373.

39 *Id.*

40 Sander & Bolus, *supra* note 12.

41 *Id.* at 14-20.

42 *Id.* at 20-23.

43 *Id.* at 23-24.

44 The figures for law school grades are available and particularly instructive: In elite law schools, 51.6% of African-American law students have first-year GPAs in the bottom 10% of their class as opposed to only 5.6% of white students. Nearly identical gaps exist at law schools at all levels (with the exception of historically minority schools). At mid-range public schools, the median African-American student's first-year grades corresponded to the fifth percentile among white students. For mid-range private schools it was seventh. With disappointingly few exceptions, African-American students were grouped toward the bottom of their class. Moreover, contrary to popular belief, the gap in grades did not close as students continued through law school. Instead, by graduation, it had gotten wider. Richard Sander, *A Systemic Analysis of Affirmative Action in American Law Schools*, 57 Stan. L. Rev. 367, 427-36, Tables 5.1, 5.3 & 5.4 (2004). I am not aware of anyone who disputes these figures, and indeed some critics of Sander's work appear to have conceded their accuracy. *See* Ian Ayres & Richard Brooks, *Does Affirmative Action Reduce the Number of Black Lawyers?*, 57 Stan. L. Rev. 1807, 1807 (2005) ("Richard Sander's study of affirmative action at U.S. law schools highlights a real and serious problem: the average black law student's grades are startlingly low.").

45 William G. Bowen & Derek Bok, The Shape of the River: Long-Term Consequences of Considering Race in College and University Admissions 72 (1998).