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Testimony before the U.S. Commission on Civil Rights
The Flaws in the Mismatch Theory

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U.S. Commission on Civil Rights Briefing on
Encouraging Minorities to Pursue Careers in Science, Technology, Engineering, and Mathematics

Picture the nation's research universities in the mid-1960s. Legal and discriminatory obstructions had allowed only a very few underrepresented minorities to gain admission to the nation's top science and engineering institutions. For instance, until 1964 when its board petitioned the courts for a change of its charter, Rice University had been constrained to educate only the "white inhabitants of Houston and Texas." Raymond Johnson then became the first African American student admitted to Rice and went on to earn his Ph.D. in mathematics in 1969.

His Rice Ph.D launched a very successful career including the chairmanship of the Department of Mathematics at the University of Maryland. Stories of early minority scientists and mathematicians produced in this country are amazing, but reflect a truly sad component in our educational history. The few that were produced in those early times invariably were so brilliant with so much potential in their fields that someone in their department would champion their admission, and of course these students were quite successful. But what about all of the other minorities who could have made it, yet had no champions? Certainly this has been a great loss to the country's productivity and leadership.

In the mid-1960s, affirmative action was born. America's universities began to use affirmative action policies to increase the participation of minority groups in higher education. Designed to level the playing field, university admissions policies attempted to normalize for differences in the quality of academic preparation. Admissions criteria were developed to identify students with the capacity to succeed but who were not identified through traditional admissions criteria. Yet these policies have been controversial throughout their history and have faced repeated legal challenges—with much of the controversy centering on whether affirmative action is reverse discrimination and unfair to white students rejected in favor of minority applicants who are perceived as "less qualified."

Recent controversy about the fairness of affirmative action now raises a very different question. Some are now claiming that affirmative action policies can be unfair to the minority students that they are intended to help. The current "Mismatch Theory" promoted by Panelists Rogers Elliott [1] and Richard Sander[2] , suggests that minority students are more likely to leave science and engineering when affirmative action has placed them into colleges for which they are not

[1] Elliott, Rogers, et. al. "The Role of Ethnicity in Choosing and Leaving Science in Highly Selective Universities." *Research in Higher Education.* Vol. 37, No. 6 (1996). http://www.springerlink.com/content/l662845727427n33/

prepared. They contrast this failure with the success that underrepresented minority students experience at less rigorous schools, especially at Minority Serving Institutions (MSIs), and suggest that minority students would be better served by attending less competitive schools where they can be more successful.

It is clear that what many, including several of my colleagues who are underrepresented minorities, want is a strong refutation of the Mismatch Theory as a whole--that it is totally wrong with no foundation or no basis. I claim that the Mismatch Theory is terribly flawed, that it could set underrepresented minorities back 40 years in science participation and achievements, but its flaw is not in its data but in the conclusions drawn by Professors Elliott and Sander. The mismatch theorists have focused light on a huge problem that I have been fighting at Rice for 20 years. The data they present are entirely credible to me because they reflect what I have seen at Rice. So I do not dispute the data. It is the recommendations they make based upon the data that are terribly flawed.

I should explain why I believe that I was asked to serve on this panel. I have been a mathematician at Rice University since 1970. I received a B.A. in mathematics from UCLA in 1961, and a Ph.D. in mathematics from UCLA in 1967. I have received numerous awards for my accomplishments as a mathematician: I was elected to the National Academy of Engineering, appointed to the National Science Board by President Clinton, and at Rice University promoted to the position of University Professor, of which there have been only six named in the history of the university. Upon first glance this appears to look like any traditional academic path to success. We make all kinds of assumptions about the background of such individuals, including the certainty and predictability of the path to success. In my case, most of those assumptions would be wrong**.** I was born in Los Angeles to parents who immigrated from Mexico. I attended a below-average high school in the Los Angeles Unified School District. I was not directed to college by my teachers or counselors although I had demonstrated strong mathematical talent. I started to work at a muffler factory where a co-worker recognized my talent and daily insisted that I go to college. I often think of how different my life would have been if this hadn't happened. I was very fortunate. I began at community college where I was strongly directed to UCLA, and away from less selective four-year colleges by two of my community college math professors. Little did I know that this advice would be critical to my career. I went on to get a Ph.D. because I saw other students with less mathematical talent than I had who were going on and felt that if they could, I could too. After receiving my Ph.D. from UCLA, I was directed and guided by David Sanchez, the only underrepresented minority faculty member in the UCLA Mathematics Department, to faculty positions at Wisconsin, Stanford, and Rice. This intervention and guidance was probably the most important in my entire professional life. At many junctures, my life could have taken a very different path rather than to University Professor. Like so many I could have easily fallen through the many dangerously wide cracks. I owe my success to my education at a research university.

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[2] Sander, Richard, 2005. "A Systemic Analysis of Affirmative Action in American Law Schools," *Stanford Law Review* 57 (2) 367-484.

While at Rice, I have served as dissertation director or co-director for many successful minority doctoral recipients in science, technology, engineering, and mathematics (STEM). Some of them, perhaps most of them, would fit the pattern of the Mismatch Theory, entering Rice less prepared than the majority of their fellow Rice students. Also, I have taught many underrepresented minority Rice undergraduates, and again, some, perhaps most, fit the pattern of the Mismatch Theory. Over the years, I have been frustrated at the number of Rice's underrepresented minority students who migrate from science and engineering to humanities or social sciences where they have experienced more success.

Selective research universities recruit some of the nation's most capable minority students who enter intending to pursue a career in science or engineering, and then lose disproportionate numbers of them to other disciplines. I agree with Sander and Elliott that admission of minority students without retention is of negative value. This is what I have, for years, called the "loss of the precious few." Where I strongly part with Sander and Elliott is in what we should do about it. Sander and Elliott say that we should steer students to less challenging schools where they are more successful. According to them, this will be better for the students and better for the nation because it will increase the numbers of underrepresented minority students receiving degrees in science and engineering. I say we should insist that elite research universities put into place programs that have proven successful at supporting students so that they *are* successful. Simply stated, in a "sink or swim," non-mentoring, non-supportive environment, which is what we see at many of our elite research schools, those with poorer preparation will rarely succeed, minority *or* majority. Why are we not demanding from public and private universities that receive federal funds that which is critical for the health of the nation--quality education of all our citizens? Why are we letting them off the hook as they conveniently build an ever increasing base of foreign STEM graduate students and faculty[3]?

Creating a Permanent Underclass

What is wrong with Sander's and Elliott's resolution of this problem? Why do I find it a huge mistake? In my opinion, nothing can do more to establish minorities as a permanent underclass in science and engineering than this.

If the goal is *just* to produce larger numbers of underrepresented minority scientists, then the Mismatch Theory is a great idea, but numbers of degrees alone are not a good measure of success. Underrepresented minorities must be competitive with the overall population; how else can we break the stereotype? The distribution cannot be skewed toward weaker schools. Steering minorities to lesser schools reminds us of the separate but equal mantra. It turns out that separate but equal is always separate, but never equal. But this is worse. This assumes from the start separate and *weaker*. This would take us back to the pre-to-mid '60s where only the very rare minority student who has been prepared well and tests well under traditional admissions criteria would be admitted to the nation's research institutions.

Race and ethnicity should not dictate educational destiny. Steering capable students to lesser schools puts a cap on their potential achievements. Top research universities choose faculty from

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3 Tapia, Richard A. "True Diversity Doesn't Come From Abroad." *Chronicle of Higher Education*, p. B34. September 28, 2007.

Ph.D.s produced at top research universities. If we underrepresented minorities are ever to be an equitable presence as faculty at our top-level schools, then our students must be schooled at those same institutions. Leadership in science and engineering comes from top research institutions. MSIs do some things very well. Their students speak warmly of how confident and supported they felt in their experiences there. Research universities should learn from them how to nurture that kind of confidence, but Ph.D.s produced at MSIs will not become faculty at top research universities. We need minorities who will become national STEM leaders, and these have to be produced by institutions that are recognized as giving credibility to the scientific accomplishments of the individual.

Below is a list, which is not exhaustive, that I quickly generated with a few examples of people that I know who received their Ph.D. in science or engineering from an elite research school and who have gone on to assume national scientific leadership.

National Leaders in Science and Mathematics who are Underrepresented Minorities

Name	Ph.D. Inst.	Current Leadership Position
African Americans		
Shirley Ann Jackson	MIT	President, RPI
Freeman Hrabowski	Illinois	President, University of Maryland Baltimore County
Shirley Malcom	Washington	Head of Education Programs, AAAS
William Massey	Stanford	Professor, Princeton
Arlie Petters	MIT/Princeton	Professor, Duke
Sylvester Gates	MIT	Professor, Maryland Director, Center for String and Particle Theory
Mexican Americans		
Hector Ruiz	Rice	Executive Chairman of AMD
Rodrigo Banuelos	UCLA	Head, Mathematics Department, Purdue University
Francisco Cigarroa	UT/Harvard	President, The UT Health Science Center San Antonio
Richard Tapia	UCLA	University Professor, Rice University
Carlos Castillo-Chavez	Wisconsin	Regent Professor, Arizona State

Where is the list of individuals with Ph.D.s from lesser universities who have outstanding scientific accomplishments or outstanding scientific leadership accomplishments?

The Systems are Broken

Consider three systems that prepare minority students: A) K-12 schools, B) MSIs, and C) research institutions. For very different reasons, none of these adequately promote equitable representation in science and engineering. But consider, which problem is easier to solve?

A. Transform urban K-12 schools that educate the vast majority of underrepresented students so that they prepare students equally to the best K-12 schools,

B. Bring MSIs up to the academic excellence of research institutions, so that capable minority graduates will be competitive with students from elite schools in the industrial job market, professional leadership positions and graduate and professional school, or

C. Design and implement programs at the most selective research universities so that capable minority students have the same retention rates and confidence levels in science and engineering as those at minority serving institutions.

Clearly C has the most viable solution.. A by-product of this solution is the added bonus of enhanced training and opportunities and a greater likelihood of ascending to leadership positions. It has taken more than a century to build the sophisticated machinery of research universities.

So What Do We Do Now?

Solving the three problems described in A, B, and C above would require a giant overhaul of the entire systems. While we should keep such an objective in view, we cannot wait for this change. There are things that we can do short term that I believe will have a significant impact on improving the representation of underrepresented minorities in STEM careers and leadership positions across the full spectrum of opportunities. My recommendations are as follows.

Recommendation for Dealing with Problem A

Talented underrepresented minorities should be identified early in their education (elementary and middle school) and motivated and directed to attend the best magnet secondary schools in the city. This activity would involve working with the parents and the school districts to facilitate and implement these plans. This recommendation has been influenced by the following experience. At the present time at Rice University I am working with three outstanding minority Ph.D. candidates in mathematics and in computer science. All three have distinguished themselves in their research and in their academic accomplishments, including being awarded prestigious National Science Foundation graduate fellowships. Two are African American and one is Mexican American. All three were born and raised in the minority areas of large U.S. cities. However, each was directed to a STEM magnet school in their city, performed well, and was encouraged to apply to selective research universities for undergraduate training. All three attended Rice as undergraduates, where I met them and encouraged them to attend graduate school (not necessarily Rice). They received excellent high school and undergraduate preparation and are now outstanding graduate students. I expect to hear in the somewhat near future that they are excellent STEM faculty at research universities in the country.

Recommendation for Dealing with Problem B

Many MSIs are open admissions (all who apply are admitted) and also try to be all things to all people. I have a colleague who teaches chemistry at a local Historically Black College and University. He says that in his introductory classes he has some outstanding students and some students who are extremely poorly prepared, and that there is no way that he can do justice to either group of students when they are all in the same class. His level of frustration is extremely high. I recommend that MSIs adopt a magnet secondary school format. They should develop excellent undergraduate courses in selected disciplines and only allow selected, well-prepared students to take these classes. In this way the best students will be well prepared for graduate work in the appropriate discipline at a research university. The details involved in implementing this suggestion would require more thought, but I believe that the direction is correct.

Recommendation for Dealing with Problem C

The challenge is to admit underrepresented minority students in larger numbers in science and engineering at the nation's research institutions and then support them to be successful. The research schools must be held accountable for both admission and retention of minority students in their chosen disciplines through the completion of their degrees.

To address admissions, we must evaluate our admissions criteria. I refer to this as second stage affirmative action. Is it excluding individuals with talent to succeed? At Rice in both graduate and undergraduate admissions we have successfully turned to what I call the Threshold Approach. We pick a threshold level at which students will be successful that has been determined from years of experience of working with all students. Actually the threshold level is a fuzzy interval of scores. Those students with scores significantly above the threshold are deemed equivalent as far as the test score goes and the score is dismissed and admission decisions are guided by other factors. Students with scores significantly below the threshold value are not accepted, and those students with scores near the threshold value are looked at with extra care. My experience has been that there is no predictive value at the high end of the test score. For example there is essentially no value in favoring a student with a combined SAT score of 1500 over one with a combined score of, say, 1300. The same can be said for a graduate student whose GRE score is in the 95th percentile versus one whose GRE score is only in the 85th percentile. However, I have never seen an undergraduate student at Rice succeed in math, science, or engineering with a combined SAT score below 900.That is, there is much more predictive information at the low end of the scale than there is at the high end of the scale. Indeed, each year Rice rejects a good number (say five or so) of undergraduate applicants who have earned perfect 1600 SAT scores,. Of course the Rice admissions officers feel that some of the high-scoring SAT students were lacking in other significant evaluation components. The misuse of standardized test scores guided by the belief that there is predictive power at the upper level of the scale is one of the worst enemies of underrepresented minorities. I have seen underrepresented minority students graduate from Rice with honors, and yet they entered with modest SAT scores, albeit, the highest scores in their minority school. At Rice this is particularly true of Hispanic women.

Following these guidelines, we have produced a very large number, probably the largest number in the country, of underrepresented minority doctoral recipients in mathematics, science, and engineering. In the last ten years approximately one thousand STEM Ph.D.s have been produced in the country and Rice has produced more than 60 of these doctoral students. One year the National Science Foundation informed Rice that in that year we had produced approximately half of the nation's doctoral recipients in the mathematical sciences. The Mathematics Departments at the University of Iowa, through the leadership of David Mandersheid, Cornell University, and Arizona State also have good Ph.D. productivity rates for underrepresented minorities in mathematics; in the latter two situations the champion has been Carlo Castillo-Chavez. Again, success comes from strong commitment, aggressive support, and a champion. These successes demonstrate that it is possible to produce minority Ph.D.s at a high rate at research universities. We now offer a success at the undergraduate level, as well. Due to the

Texas Top 10% Rule[4], the Mathematics Department at the University of Texas Austin has the highest percentage of underrepresented minority undergraduate mathematics majors (nearly 30%) of any research university in the country. With innovative support programs they retain minority students through graduation at a rate above the majority student rate.

My summarizing point here is that underrepresented minorities need not be sent to MSIs to succeed. With support and caring we can succeed at the best schools in the country. Indeed, many of us have. And more of us will.

The Consequence of the Mismatch Theory

I suspect that many faculty and administrators from research universities would breathe a big sigh of relief when they read about the Mismatch Theory. It certainly lets them off the hook, doesn't it? What it does is reduce expectations and set the country's research institutions back to pre-1964. It ignores all that we have learned about educating minorities and guarantees the formation of a permanent science underclass in America. A two-tiered America is certainly not healthy for the country.

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[4] Created to avoid the impact of *Hopwood v. Texas*, the case banning the use of race as a factor in admissions, 1997's Texas House Bill 588, guarantees Texas students who graduate in the top ten percent of their high school class automatic admission to all state-funded universities.