
# Factors that Influence Science and Engineering Graduate Student Diversity: Results of a Rice Faculty Survey

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This report can also be accessed at
http://ceee.rice.edu/Books/DV/facsurvey/index.htm

## I. Introduction

> *Imagine a young engineering faculty member at a research university, brought from another university as an associate professor with tenure because of his strong credentials in research. Soon after arriving he begins to work with several underrepresented minority students whose backgrounds are weak in relation to other students. Knowing that this university strongly supports diversity, and being a dedicated individual, the young associate professor works hard (and does a wonderful job) advising, mentoring, and directing the doctoral theses of several underrepresented minority students who eventually go on to receive Ph.D.'s. In fact, the quality of the students' research is excellent and exceeds the expectations of the department. Unfortunately, in the process this faculty member produces slightly fewer research papers than before. He eventually comes up for promotion to full professor, and the department turns him down, citing their disappointment at the decrease in productivity. But look at all the underrepresented minority students that have received doctorates since he has been here. Shouldn't that contribution to the department, coupled with the research that he has done, win him promotion? The answer from the department is a resounding "No". Intervention to the dean, on the faculty member's behalf, elicited a similar response: "Advise him to concentrate solely on his research and not accept any more minority students". What is the lesson here? Does this department value diversity? Does the dean? Does the university?*

Although this is a true story that took place in a particular university, it could have happened practically anywhere in the country. Research universities value and reward research over all other faculty activity. In Making a Place for the New American Scholar, Eugene Rice (1996) observed that research and scholarship are deeply entrenched and rewarded in research universities as more prestigious endeavors than teaching and service. Rice suggested that by isolating research from teaching and service, universities create academic hierarchies which lead to inappropriate and imbalanced standards for excellence.

Advising underrepresented minority students is one of the least prestigious endeavors in which faculty engage, and some who engage in it, like the faculty member described above, may do so at their peril. The university reward system was designed to promote research, not diversity. Yet well-meaning university administrators try to advocate for both, within a reward system and a faculty culture that is not intended to encourage the kind of effort required to foster graduate student diversity.

Measured against research productivity, the nation's attempts to increase the participation of underrepresented minorities in science and engineering have been largely unsuccessful. Over the last thirty years, numerous programs have been implemented with so little improvement that one wonders if the same increase would have occurred if none of these efforts had been expended (see Table 1). Given the huge growth in minority populations, especially Hispanic, during this same time period, minority participation actually may have declined proportionally rather than increased. Not only has the growth in minority science and engineering Ph.D.'s not kept up with the growth in the minority population, but very recent Hispanic and African immigrants received a disproportionately high percentage of the degrees earned. A Chilean, Nigerian, Argentinean, El Salvadoran, or even a Mexican national coming to this country to get a Ph.D. frequently gets counted as an American minority. What this means is that we may be doing no better, and possibly even worse than 30 years ago, at educating this nation's underrepresented minority youth to become scientists.

**Table 1: Earned science and engineering doctoral degrees, by race/ethnicity, and citizenship: 1977–99 (selected years)**

| Race/ethnicity | 1977 | 1981 | 1985 | 1989 | 1991 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **U.S. citizen or permanent resident** | | | | | | | | | | | | |
| Total | **14,881** | **14,654** | **14,065** | **14,592** | **15,914** | **16,573** | **18,187** | **18,996** | **18,639** | **18,402** | **18,268** | **17,428** |
| White | **12,875** | **12,573** | **12,169** | **12,501** | **13,323** | **13,737** | **13,889** | **13,902** | **14,008** | **13,829** | **14,026** | **13,656** |
| Asian/Pacific Islander | **745** | **827** | **809** | **986** | **1,180** | **1,610** | **2,989** | **3,671** | **3,095** | **2,539** | **2,148** | **1,951** |
| Black | **342** | **346** | **374** | **367** | **464** | **469** | **500** | **560** | **576** | **623** | **646** | **715** |
| Hispanic | **203** | **240** | **296** | **382** | **492** | **542** | **548** | **571** | **618** | **656** | **753** | **688** |
| American Indian/Alaskan Native | **31** | **28** | **41** | **53** | **56** | **43** | **64** | **69** | **97** | **79** | **96** | **117** |

**SOURCE:** ***Science and Engineering Indicators, 2002, National Science Board.***

Many university presidents make a strong commitment to encouraging student diversity, in some cases allocating significant resources to increase participation of underrepresented minorities in science and engineering. Even though this financial support is critical, it is not enough. Admitting and producing graduate students is done *not* at the administrative level, but at the faculty level. Faculty members determine graduate admissions and accept students into their research programs. Faculty members support students on their research grants, serve as research advisors, and make decisions about when a student's research merits the Ph.D. University faculties, not university presidents, determine who will be the next generation of scientists. Hence the faculty's deep understanding of, and commitment to, diversity is especially critical to the success or failure of diversity efforts at the graduate level.

Rice's Board and administration strongly support increasing campus diversity. At its September 1997 meeting, the Rice University Board unanimously adopted a resolution that states:

> Rice University is convinced that it can most effectively carry out its "Enduring Vision" in a learning community drawn from the full range of ethnic and cultural traditions represented in Houston, our nation and throughout the world.

Rice's president, Malcolm Gillis (1999) argues that diversity in higher education is a social and economic concern, not only for the underrepresented minority population, but also for the nation as a whole.

> Well-educated graduates of U.S. colleges and universities generally will carry into the next century an array of skills well suited for the information age. Demands for their services will grow steadily, while calls for less well-educated, less adaptable labor are expected to shrink. While those with a larger repertoire of skills and a greater capacity for learning can look forward to lifetimes of unprecedented economic fulfillment, the poorly educated face little better than the dreary prospects of lives of quiet desperation in the coming decades. Moreover, these trends will surely reverberate down through successive generations, as parents lacking full access to higher education will experience diminishing capacities for financing higher education opportunities for their children, and so on through the next generation and the next. These circumstances are guaranteed to lead to growing misdistribution of income and wealth, and worsening social fissures.

**(Source:** http://www.acenet.edu/hena/issues/1999/03_29_99/opinion_diverse.cfm**)**

These commitments are reflected in Rice's success at the undergraduate level. Rice's underrepresented minority undergraduate population currently stands at 18.1%, even under Hopwood[1] constraints. After the Hopwood decision, Rice administrators looked for creative ways to recruit and fund minority students, yet remain within the confines of Hopwood. University policy can directly control *undergraduate* recruitment and admissions through centralized staff and committees.

At the doctoral level, Rice's success over the years at producing minority graduates has varied greatly from department to department. Some departments have never produced a minority Ph.D., whereas others have produced several and/or have several students nearing graduation. Between 1998 and 2001, only nine departments (Anthropology, Applied Math, Chemistry, English, Geology, History, Mechanical Engineering, Physics, and Psychology) produced any minority Ph.D.'s. Over four years, a total of twenty-four minority Ph.D.'s came from the nine departments. The successes were generated by entrepreneurial, committed faculty members in those departments.

**Table 2: Number of minority Ph.D. recipients, 1998-2001, Rice University.**

| Department | African-American | Hispanic |
|---|---|---|
| Anthropology | | 2 |
| Applied Math | 2 | 3 |
| Chemistry | 2 | 1 |
| English | 3 | |
| Geology | 1 | 1 |
| History | 1 | 1 |
| Mechanical Eng. | | 1 |
| Physics | 1 | |
| Psychology | 1 | 3 |
| Totals | 12 | 12 |

**SOURCE:** ***Rice Office of Institutional Research, 2003.***

In an evaluation of Rice's successful underrepresented minority graduate retention program, researchers identified the critical elements of its success (Alexander, 1998). In that study researchers found that it was critical that the program director be an established senior faculty member with credibility with other faculty and the ability to advocate on students' behalf when needed. If we are to understand the factors that influence the commitment of faculty to that goal, we must understand the culture within which faculty operate, and in particular, fully appreciate the reward system that influences that culture.

To determine faculty beliefs and practices regarding diversity, Rice University commissioned a study by the University of Wisconsin-Madison's Learning through Evaluation, Adaptation, and Dissemination (LEAD) Center. As part of Rice University's National Science Foundation-funded Alliance for Graduate Education and the Professoriate evaluation, LEAD surveyed Rice's science and engineering faculty to determine: (1) their views of diversity as an institutional, departmental, and individual goal; (2) their opinions of the effectiveness of Rice's efforts to increase diversity; and (3) their recommendations for new strategies that Rice and research funding agencies might implement.

[1] In March 1996, the Court opinion in the case of Hopwood vs. Texas held that race/ethnicity cannot be used as an explicit factor in admissions decisions. In Texas, that ruling was subsequently extended in an opinion by State Attorney General Dan Morales to also encompass financial aid programs based on race. However, in 2003, a five-to-four decision by the United States Supreme Court supported the policy of the University of Michigan's law school that takes race into account to achieve diversity among its student body.

Questions that we hoped to answer through conducting this study included: How much does Rice's faculty know about or believe in the administration's commitment to diversity at the graduate level? Does the faculty share the university's commitment to diversity? Do they think that those who devote time and effort to promoting increased participation of underrepresented minorities are rewarded for their efforts? Do their departments (the real operating bodies of universities in graduate student production) support diversity? How well does the university's reward system align with its stated commitment to diversity, and, consequently, how effectively does it motivate faculty to work towards that goal? What could the university do to encourage faculty to increase diversity? How important and effective is the reward system of external research funding agencies? What could these agencies do to encourage faculty to promote diversity?

**Methodology:** Data used in this paper comes from two sources: (1) a survey conducted in January 2002 with 97 (45%) of Rice University science and engineering faculty and (2) a set of interviews with 14 Rice University faculty members in July 2000. See Appendix 1 for a discussion of methodology and demographics information for the faculty survey respondents.

## II. Findings

### A. Key findings from faculty survey:

- 64% said that increasing the number of underrepresented minority graduate students was a priority for them (14% high and 50% medium); 82% said it was a high or medium priority for Rice administrators;
- 56% expressed concerns about the lack of academic preparation of underrepresented minority students;
- 33% said they can't find qualified minority applicants, and 67% said that difficulty with recruitment of underrepresented minority graduate students posed a serious challenge to promoting diversity in graduate education at Rice;
- 34% felt that underrepresented minority students require a lot of time and effort (and they may not succeed), and 45% thought that difficulty with retention of underrepresented minority graduate students posed a serious challenge to diversity in graduate education at Rice;
- 53% said that maintaining high departmental national rankings are either "of considerable concern" or "of concern" in admitting more underrepresented minority graduate students;
- Only 4% said that the National Science Foundation's Criterion 2[2] had had a strong impact on their decision to support an underrepresented minority graduate student on a research grant, and 62% said it had little or no impact on their decision.

More details on these and other findings from the faculty survey are given in the sections that follow.

### B. How committed to increasing participation of underrepresented minorities are these faculty members?

The survey posed a series of questions about faculty members' perceptions of their own, Rice's, and their departments' commitments to the goal of increasing participation of minorities in graduate programs.

#### 1. Comparing perspectives on university, department, and individual commitment

[2] Criterion 2 is the second review criterion for all NSF-reviewed grant proposals. Specifically as it relates to diversity: "How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)?"

Table 3 compares the priority level that faculty attributed to the Rice administration, their departments, and themselves towards the goal of increasing minority representation. Two thirds reported that they and their departments rate this as either a high (23%) or medium (59%) priority, and view the administration as giving even more priority to the goal than either their department or themselves.

**Table 3: Faculty respondents' rating of the priority for the Rice administration, their department, and themselves for increasing the number of underrepresented minority graduate students (in all tables that follow, percentages were calculated based on the total number of question respondents).**

| Level of priority | Rice Administration | Departments | Individual Faculty |
|---|---|---|---|
| | N (%) | N (%) | N (%) |
| High priority | 22 (23%) | 13 (13%) | 13 (14%) |
| Medium priority | 57 (59%) | 51 (53%) | 48 (50%) |
| Low priority | 13 (13%) | 26 (27%) | 24 (25%) |
| Not a priority at all | 5 (5%) | 7 (7%) | 11 (11%) |
| Total | N=97 (100%) | N=97 (100%) | N=96 (100%) |

## 2. Faculty view of department's stance on increasing diversity

In order to understand faculty members' perceptions about, and experience in, their own department with respect to the goal of increasing diversity at the graduate level, we asked faculty respondents to characterize their department's stance. Twenty-four percent of respondents thought that their department had formally defined this as a goal (the responses represent a total of 11 out of 15 departments surveyed), and 33% said that they thought that their department had never formally discussed this issue (represents a total of 13 out of 15 departments surveyed). However, text comments indicated that the responses might have been skewed by the question of whether their department had "formally defined" [this issue] as a departmental goal. In fact it appears that some of the departments had indeed informally made this a goal. Therefore, there appears to be more departmental commitment than these numbers would represent. However, the data highlights the fact that there are conflicting perceptions of this issue by faculty members within the same department.

**Table 4: Faculty View of Department Stance Toward Increasing Minority Graduate Participation by department. (n=91)**

| Departments | Number of faculty members that chose departmental stance | | | | | |
|---|---|---|---|---|---|---|
| | Dept defined as formal goal | Dept decided shouldn't be a goal | Dept never considered this a goal | Dept never formally discussed | Other | Total |
| Biochemistry & Cell Biology | 7 | 1 | | 1 | 5 | 14 |
| Bioengineering | | | | 1 | 3 | 4 |
| Chemical Eng | | | 1 | 3 | 1 | 5 |
| Chemistry | 3 | | 2 | 2 | 3 | 10 |
| Civil Eng | | | | 2 | | 2 |
| Computational & Applied Math | 2 | 1 | | 2 | | 5 |
| Computer Science | 2 | | | 1 | 1 | 3 |
| Ecology & Evolutionary Biology | | | 1 | 3 | 1 | 5 |
| Electrical & Computer Eng | 2 | | 2 | 2 | 3 | 9 |
| Environmental Science & Eng | 1 | | | | | 1 |
| Geology & Geophysics | | | | 2 | 1 | 3 |
| Mathematics | | | 1 | 1 | 2 | 4 |
| Mechanical Eng & Material Sci | | | | 4 | 1 | 5 |
| Physics and Astronomy | 2 | | | 6 | 8 | 16 |
| Statistics | 3 | | | | 1 | 4 |
| **Grand Total** | **22** | **2** | **7** | **30** | **30** | **90** |

### 3. Individual perspective

We asked faculty survey respondents to rate the level of concern they placed on certain factors in their decision-making process in accepting graduate students into their research group (see Table 4). The most significant concerns ("of concern" or "of considerable concern") in whether to accept a student were:

- 76% said that the pressure to be competitive in being able to renew their grant.
- 70% said that they consider the pressure to select students who will progress rapidly with regard to publications and finishing their degree.

These two factors far outweighed concerns about faculty members' own interest in increasing the number of underrepresented minority graduate students (32% rated this "of concern" or "of considerable concern"), or the pressures to do so (8% rated this "of concern" or "of considerable concern"). These findings indicate that Rice's faculty respondents feel much more pressured to make progress on their research than they do to increase the number of underrepresented minority students.

**Table 5: Faculty respondents' rating of items related to accepting and supporting new graduate students in their research group**

| Item choices related to the support of graduate students | Ratings N (%) | | | | |
|---|---|---|---|---|---|
| | Not of concern (1) | Somewhat of a concern (2) | Of concern (3) | Of considerable concern (4) | Mean (S.D.) |
| The pressure on you to be competitive in being able to renew your grant (n=89) | 4 (5%) | 17 (19%) | 33 (37%) | 35 (39%) | 3.11 (.87) |
| The pressure on you to support students who will make rapid progress with regard to publications and in finishing their degree (n=90) | 6 (7%) | 21 (23%) | 30 (33%) | 33 (37%) | 3.00 (.94) |
| Retaining graduate students to the completion of their degree (n=88) | 8 (9%) | 22 (25%) | 27 (31%) | 31 (35%) | 2.92 (.99) |
| Your own interest in increasing the number of underrepresented minority graduate students (n=87) | 19 (22%) | 40 (46%) | 21 (24%) | 7 (8%) | 2.18 (.87) |
| The pressure to increase the number of underrepresented minority graduate students (n=85) | 36 (42%) | 42 (49%) | 6 (7%) | 1 (1%) | 1.67 (.66) |
| Having to decide among underrepresented minority student, a foreign student or a non-underrepresented minority student (n=85) | 58 (68%) | 16 (19%) | 8 (9%) | 3 (4%) | 1.47 (.82) |

In addition, we asked faculty members to indicate what strategies they had implemented to promote diversity (See Table 5). Only 26% said that they have defined increasing and retaining underrepresented minority graduate students in their lab or research group as a goal, and 20% said that it had never occurred to them to make this a goal.

**Table 6: Faculty View of their Own Strategies to Increase Minority Graduate Participation**

| Items about labs and underrepresented minority graduate students | N | % |
|---|---|---|
| I have advised underrepresented minority graduate student/s | 60 | 62% |
| I have funded from my research grant underrepresented minority graduate student/s | 37 | 38% |
| I have wanted an underrepresented minority graduate student in my lab, but no qualified applicants were available | 32 | 33% |
| I have defined increasing and retaining underrepresented minority graduate students in my lab or research group as a goal. | 25 | 26% |
| I have provided activities that support retention. | 20 | 21% |
| It has never occurred to me to make increasing and retaining underrepresented minority graduate students a goal | 19 | 20% |
| Other | 7 | 7% |
| I have decided that increasing and retaining underrepresented minority graduate students should not be a goal | 4 | 4% |
| I have refused admission to underrepresented minority applicants into my research group | 0 | 0% |

***This survey question asked respondents to "check all that apply".**

In addition to asking faculty members to rank the level of priority they themselves would attribute towards the goal of increasing minority representation (see Table 2), faculty members were asked about their perceptions of the optimal percentage of their department's graduate students that should be underrepresented minorities (see Table 6). Note that 35% of faculty respondents said that 0-10% of their program's graduate students should be minority (with 16% saying optimally there should be no minorities.)

**Table 7: Faculty respondents' perception of the optimal percentage of their department's graduate students that should be underrepresented minority**

| Optimal % minority makeup | N | % |
|---|---|---|
| 0% | 15 | 16% |
| 1-10% | 19 | 19% |
| 11-20% | 35 | 36% |
| 21-30% | 17 | 18% |
| 31-40% | 7 | 7% |
| 41-50% | 3 | 3% |
| 99% | 1 | 1% |

## C. Perceived challenges to increasing participation of underrepresented minorities at Rice

A key finding of the survey was the level of concern expressed by faculty members about the qualifications and preparation of underrepresented minority graduate students and the impact of this factor on their commitment to diversity.

### 1. Academic preparation of underrepresented minority students

Faculty members were asked what factors pose serious challenges to Rice's goal of increasing participation of underrepresented minority graduate students. As seen in Table 7, finding and retaining well-prepared graduate students were considered the biggest challenges with regards to diversifying Rice's graduate programs. In fact, 67% identified "recruitment", 56% "academic preparation," and 45% "retention" as significant challenges—all factors that are closely tied to the issue of students' incoming preparation. In a related survey item, where faculty members were asked about various types of interactions and activities

with underrepresented minority graduate students, 33% said that they had wanted an underrepresented minority graduate student in their research lab but had found that there were no qualified applicants available (see Table 5).

**Table 8: Factors that pose challenges to Rice's goal of increasing participation of underrepresented minority graduate students**

| Challenge Items | N | % |
|---|---|---|
| Recruitment | 65 | 67% |
| Academic preparation | 54 | 56% |
| Retention | 44 | 45% |
| Financial support | 29 | 30% |
| Faculty culture | 19 | 20% |
| Admissions | 17 | 18% |
| Other | 1 | 1% |

***This survey question asked respondents to "check all that apply"**

Open-ended survey questions gave faculty respondents the opportunity to describe in some detail the nature of their concerns. In particular, when asked, "As it relates to your own professional career, what steps might Rice University take that would encourage you to engage yourself more fully in mentoring and supporting (on your grants) underrepresented minority graduate students?" It is interesting to note that 33% again raised concerns about the preparation and the availability of qualified minorities. Many of the faculty members that raised these concerns simply stated that they would take minority students if there were qualified candidates available. For example, a representative comment came from one faculty member who responded to the question of what steps Rice might take to encourage faculty to take minority students, by stating,

> None. They are simply not part of the qualified applicant pool.

Another faculty member responded:

> Our department is a special case since we have so many underrepresented minority students, and frankly, most are under-prepared. I have produced a high percentage of the female researchers in my area, and I have had minority Ph.D. students as well. I have found this to be a rewarding experience, but many of the underrepresented students we get these days opt for the less demanding advisors. The pity is that there are not more minorities prepared for a rigorous graduate program. I believe that is the main issue, and I am not wise enough to see how to correct it. I am convinced that ability is not the issue.

In addition to stating that there were no qualified minority applicants available, faculty members raised the issue that the problem was rooted in K-16 education and that graduate education was not the time to address these problems. One faculty member said:

> Most of the minority students arrive with poor preparation, and though one may be able to fill gaps, rarely can one make up 16 years of neglect. The real issue is K-16 education, not the lowering of expectations at the grad level. So if Rice can attract prepared students, I will support them.

Another major concern raised by faculty respondents was, that when under-prepared minority students are admitted, they are more likely to fail, and therefore are not helped in any way by being admitted under different standards. This perspective is illustrated by the following survey response:

> Rice already has a very active minority recruitment activity, particularly, in the area of [*X field*]. Although some very good students have been obtained this way, the general quality is far below the level appropriate for graduate study. This is demoralizing both to the students who are prepared for graduate study and those students who are not, but who are admitted anyway. Those who are prepared are demoralized because classes are often taught at a lower level of intensity in order to accommodate the students who are not prepared. The students who are admitted even though they are not prepared are essentially invited to fail. Every year, students are admitted with obvious deficiencies in background and ability and then they are thrown into an environment that they cannot handle. The unfortunate consequence is either a lowering of standards in the course work, or student failure.

A subset of faculty who responded to a question about how to encourage them to support minority students, raised concerns about unqualified minority students, but still indicated that they were willing to work with these students with the assistance of the administration. They made suggestions for types of assistance that the university could provide, including: special services to assist underrepresented minority students, like mentoring and (for those who needed it) tutoring programs, as well as additional financial support for these students so that the faculty don't have to support them solely through research grants. The following three faculty responses are representative of this perspective:

> My (limited) experience with under-represented minorities has been that it is very difficult for them to succeed in the type of research I supervise because of insufficient quantitative skills. So, for me, the most useful thing would be support in the form of separate mentoring or tutoring in mathematics and cognate quantitative skills.
>
> ****
>
> I am happy to work with and mentor any student who really wants to work. If we are to relax our admissions standards for minority students, there is a good chance the student would not succeed. I am quite willing to give a motivated applicant a lot of leeway, but I would like to see the University underwrite the student's support. I think a good start would be 50%.
>
> ****
>
> My experience with minority graduate students has been fairly limited and not very positive. I have mentored three black students in my time here. All three received a Ph.D. degree, but two of the three caused me considerable trouble. If we plan to recruit minorities they need to be well qualified. If we recruit weak students, then Rice needs to provide special programs and more resources to deal with their weaknesses and with the fact that they might take significantly longer to earn a Ph.D. than other students.

**2. Perception that Minority Students Require Extra Time and Effort**

Given the views of Rice's faculty members about the academic preparation of underrepresented minority graduate students, it is not surprising that, when asked about the perceptions of their departmental colleagues, 34% of faculty respondents said that underrepresented minority graduate students were generally thought of as requiring a lot of time and effort, and only 27% said they were prepared for graduate work (see Table 8). Almost 2/3 believed that the preparation of these students depends on the quality of the undergraduate institution that they attend. Only 6% responded that underrepresented minority students "possess talent in the field of study."

**Table 9: How respondents say department generally views underrepresented minority graduate students***

| Items related to underrepresented minority graduate students | N | % |
|---|---|---|
| Preparation depends on quality of the undergraduate institution | 61 | 63% |
| Requiring a lot of time and effort | 33 | 34% |
| Prepared for graduate work | 26 | 27% |
| Lacking in research experience | 26 | 27% |
| Under-prepared for graduate work | 25 | 26% |
| Hard workers | 19 | 20% |
| Other | 11 | 11% |
| Possessing talent in the field of study | 6 | 6% |
| Having adequate research experience | 5 | 5% |
| Not hard workers | 4 | 4% |

*** "Check all that apply" survey question**

### 3. Belief that admitting more minority students will jeopardize national departmental ranking

The impact on the department of admitting students whom faculty perceived to be unqualified, raised concerns for a high percentage of faculty survey respondents. When asked how much of a concern maintaining the quality or ranking of the department was in considering admitting more underrepresented minority graduate students, 53% of faculty said that it was either "of concern" or "of considerable concern," with another 23% indicating that it was "somewhat of concern" (see Table 9).

**Table 10: Level of concern about maintaining departmental rank (or quality) in admitting more underrepresented minority graduate students (n=90)**

| Level of concern | N | % |
|---|---|---|
| Of concern | 26 | 29% |
| Of considerable concern | 22 | 24% |
| Somewhat of concern | 21 | 23% |
| Not of concern | 21 | 23% |
| Total | 90 | 100% |

(Data does not total 100% because of rounding)

One faculty member expressed concern for the department in this way,

> [*Faculty member X*] is very successful at attracting and retaining such students to our dept. This is tolerated to the degree that it does not overwhelm the dept.

In interviews conducted with a subset of science and engineering faculty members, a few of the interviewees discussed how increasing racial diversity is not a priority for their departments because of a concern that concessions they might make in order to admit minority students would potentially jeopardize their national ranking. One faculty member stated that:

> Because the department's really been focused on trying to maintain their national ranking they've been very concerned about any sacrifices made in quality. So we've actually had a fair number of minority students, but there's been no willingness to make any kind of concessions to give someone a chance who maybe looks a little questionable, but maybe has promise.

Another faculty member expressed concern about the long-term impact of lowering admissions standards for minority graduate students. This individual suggests that minority candidates may need remedial work to get to the level of other students:

> I'm worried that there seems to be a willingness to lower standards below what I think is the right threshold, and I think in the long run that's going to do a disservice of the identification of this program with weak students. …when the person emerges with a Ph.D. they're not comparable to what a Ph.D. would normally look like, and then people start making a linkage based on what they see and they say, "well you know, if so and so is a minority member and they've come out of this program, you should be skeptical of how well prepared they are." I think we ought to be able to get our minority candidates to exactly the same level of performance, they may need some remedial help, we've got to get them to the same level of performance as our other students.

It is important to note that not all faculty members in the survey or in interviews expressed concerns about departmental ranking and about the preparation of underrepresented minority graduate students.

**D. What are the incentives?**

If many of Rice's faculty members feel that underrepresented minority graduate students are unprepared for graduate work and therefore require extra work and effort for faculty, and that this poses a potential problem for the "quality" of the department, what is the incentive for them to help with promoting diversity? Several survey questions were designed to ascertain whether faculty felt that university or external funding agencies rewarded such activity.

**1. University reward system**

Faculty members were asked what they thought the Rice administration did to provide support for increasing and maintaining the number of underrepresented minority graduate students. Only 12% said that Rice provided formal recognition for faculty participation in activities related to increasing the number of underrepresented minorities in Rice's graduate programs. An even smaller percentage (4%) indicated that Rice considered mentoring minority students or diversity efforts as a factor in its reward system. When asked how effective certain factors would be in increasing and maintaining the number of underrepresented minorities in Rice's graduate programs, 54% of faculty respondents said that consideration in the university reward system would be either "very effective" or "effective." Forty-nine percent said that formal recognition would be either "very effective" or "effective" as incentives for working toward this goal.

In response to the need to provide support the incentive for mentoring, in 2003, Malcolm Gillis instituted the Presidential Mentoring Award. The inaugural award and its accompanying $3000 were presented to Professor Yin Zhang of the Computational and Applied Mathematics Department. In presenting the award, Dr. Gillis said,

> Women and minorities often lack role models and face more than the usual hardships in advancing in either academia or industry. This award recognizes Rice faculty who are committed to helping women and minority students reach their fullest potential.

**2. External funding agencies and rewards**

When asked whether funding agencies reward researchers for the recruitment of underrepresented minorities 54% percent of those responding said "no". Faculty members who responded affirmatively that funding agencies reward researchers were asked what types of rewards were provided (Table 10). Additional funding and higher rating on grant proposals were the two categories that the majority of the respondents selected.

**Table 11: Types of rewards provided by funding agencies to encourage the recruitment of underrepresented minorities to faculty respondents (n=36)**

| Item choices: rewards | N (%) |
|---|---|
| Additional funding | 29 (81%) |
| Higher rating of proposal | 16 (44%) |
| Increased time frame for producing research results | 0 (0%) |
| Other | 7 (19%) |

Faculty members were asked to rate how effective the current granting agency reward system is in motivating them to recruit underrepresented minorities into their research programs. Fifty-two percent of those responding (n=48) thought that the current additional funding provided was either "effective" or "very effective." Fifty percent of those responding (n=38) said that providing higher ratings on proposals was either "effective" or "very effective" in motivating them to recruit underrepresented minorities.

**Table 12: Faculty respondents' rating of how effective current rewards from agencies are in motivating them to recruit underrepresented minorities into their research program**

| Item choices on rewards | Ratings N (%) | | | | |
|---|---|---|---|---|---|
| | Not effective (1) | Somewhat Effective (2) | Effective (3) | Very effective (4) | Mean (S.D.) |
| Additional funding (n=48) | 10 (21%) | 13 (27%) | 12 (25%) | 13 (27%) | 2.25 (1.35) |
| Higher rating on proposals (n=38) | 12 (32%) | 7 (18%) | 13 (34%) | 6 (16%) | 1.62 (1.42) |
| Increased time frame for producing research results (n=30) | 14 (47%) | 7 (23%) | 8 (27%) | 1 (3%) | 1.02 (1.16) |

When all survey respondents were asked what rewards *would* encourage them to recruit underrepresented minorities (Table 12), the majority said that both additional funding and higher ratings on proposals would motivate them. Additionally, 36% of respondents commented that providing an increased time-frame for producing research results would serve as an incentive to recruit underrepresented minorities to their research program.

**Table 13: What factors would encourage faculty respondents' to recruit underrepresented minorities to their research program* (n=97)**

| Item choices on rewards | N | % |
|---|---|---|
| Additional funding | 64 | 66% |
| Higher rating on proposals | 49 | 51% |
| Increased time frame for producing research results | 36 | 37% |
| Other | 12 | 12% |
| No reward would cause me to consider it | 6 | 6% |

***Check all that apply survey question**

Research proposals submitted to the National Science Foundation are evaluated through two sets of review criteria. One criterion relates to the intellectual merit of the proposal while the other, known as "Criterion 2," involves establishing the broader impacts of the proposed activity (also called the "Broader Impacts Criterion").

NSF describes Criterion 2 with the following set of questions for Principal Investigators:

- "How well does the activity advance discovery and understanding while promoting teaching, training, and learning?
- How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)?
- To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?
- Will the results be disseminated broadly to enhance scientific and technological understanding?
- What may be the benefits of the proposed activity to society?"

In an effort to ascertain the impact of Criterion 2 on faculty members' decisions to support underrepresented minority graduate students on their NSF grants, we asked survey respondents to explicitly provide an impact rating of this criterion (see Table 13). Sixty-two percent of those who responded to this question said that Criterion 2 had little or no impact on their decision to support underrepresented minority graduate students on a research grant, and only 4% said that it had a strong impact.

**Table 14: Impact that Criterion 2 had on faculty respondents' decision to support an underrepresented minority graduate student on a research grant (n=78)**

| Level of impact | N | % |
|---|---|---|
| Strong impact | 3 | 4% |
| Some impact | 20 | 26% |
| A little impact | 12 | 15% |
| No impact at all | 37 | 47% |
| Never applied for an NSF grant | 6 | 8% |
| Total | 78 | 100% |

## III. Conclusions and recommendations

The purpose of conducting this survey of science and engineering faculty members at Rice University was to try to understand the factors involved in faculty members promoting diversity at the graduate level. It was the authors' hope that the findings would contribute to the dialogue about how to increase the representation of minorities in the fields of science, math, and engineering nation-wide. The authors believe that the data presented from this survey can be generalized to other research institutions in the U.S.

### A. Well-prepared minority students are in short supply

The most striking factor that emerges from the survey is the strong belief among science and engineering faculty members that finding well-prepared underrepresented minority students is difficult and poses a serious challenge to the goal of diversifying graduate education. Is this a misconception, or are minority students in general receiving a weaker preparation than majority students? Obviously, some minority students are extremely well prepared for graduate studies by any criteria at some of the finest schools in the country, but we must prepare ***more*** of our nation's underrepresented minority students so that they can be identifiably strong by traditional assessment measures – undergraduate grades, board scores, etc. Until then, we must learn to assess the talent and potential for graduate work of students who may have a weaker preparation (e.g. a couple of C's on an undergraduate transcript that can be explained by extenuating circumstances) or who don't score as well on traditional admissions criteria. Even though many of the surveyed faculty members saw under-preparation as a challenge to diversity at the graduate level, it is important that faculty not turn away from potential solutions because they see this as a "K-16 problem,"

rather than something that they, with a little more support from the university and funding agencies, could also help to address. Elsewhere Tapia points out that misusing traditional admissions criteria, especially standardized tests, prevents the nation from tapping into a large part of its human resources' creativity and leadership (Tapia, 1998).

Consider another story. A student comes to a strong university as an undergraduate from a weak high school in the barrio. Because of under-preparation, the student makes a couple of C's in his undergraduate courses. A faculty member has him in his classes, gets to know him well enough to see his talent and creativity, and encourages the student to go on to graduate school. The student applies to several elite schools, but because of his board scores and undergraduate GPA, only his undergraduate school accepts him. The student excels in graduate school, excels in industry, and eventually becomes an extremely well-respected scientist. This minority scientist easily could have been lost through our traditional evaluation system if there hadn't been a faculty member at his undergraduate institution that believed in him, encouraged him, and advocated for him. Once again, this is a true story that happened at a particular university, but there are many students who fall into this category all over the country, and the nation cannot afford to lose them over the twenty years that it will take to "fix" the K-16 educational system of underrepresented minority students.

**B. Faculty must be rewarded for this effort**

To make up for lack of preparation, students with weaker academic backgrounds must take undergraduate course-work without stigma, and faculty must be prepared to work with them longer and harder. If we ask faculty to do this, then the university must reward this activity. Our survey's results clearly show that many faculty members feel they need more support from the university and greater recognition from its reward systems if they are to succeed in supporting the university's diversity goals. If the university values diversity, then the reward system must reflect it as a priority. Yet it appears that a misalignment exists between universities' value and reward systems. It is time to take a serious look at the university reward system to determine if it is outmoded—designed for another purpose—and in need of incorporating the university's commitment to diversity.

It is also clear that external research funding agencies need to do more to reward this activity, since at least for these faculty members, measures like NSF's Criterion 2 have had little impact according to the survey. NSF leadership must be aware that faculty members believe that Criterion 2 is at most a tie-breaker, that if the quality of two proposed research projects is equal, then winning on Criterion 2 may break the tie. If Criterion 2 is going to have any real impact, then NSF leadership must make a strong commitment that NO research proposal will be funded that does not rate highly on Criterion 2 even if it proposes stellar research. In addition, NSF leadership must ensure that its review panels also understand this and are committed to it.

Faculty buy-in is absolutely critical to the success of increasing participation of underrepresented minorities in graduate education. Malcolm Gillis, president of Rice University, said, (American Council on Education, 1999, pg.3) "Anything that diminishes an institution's ability to recruit a diverse student body should be a matter of serious concern." In this light, the nation must look for ways to address the obstacles that diminish faculty members' capacity to create a diverse next-generation of scientists.

There is no reason to believe that Rice University culture is unique among the nation's research universities. One of the authors, Richard Tapia, has over 30 years of research experience at several major research universities and—through his research and other professional activities—has been associated with faculty and graduate departments throughout the United States. It is the authors' view that those factors that we have identified as influencing faculty at Rice are pervasive at other U.S research universities. We encourage you to survey your own faculty. Indeed, we recommend that the NSF undertake a similar survey on a national scale.

## Appendix 1
### Methodology and Demographics

### Faculty Survey

A survey of full-time faculty members in Rice University's schools of natural science and engineering was conducted in January 2002 as part of the evaluation for Rice's National Science Foundation Alliances for Graduate Education and the Professorate Program. A major goal of the survey was to acquire data on faculty perceptions, not particular facts about departments or Rice University. The survey sample was solicited through a letter from Dr. Jordan Konisky, Vice Provost for Research and Graduate Studies at Rice University. The letter was sent to 222 faculty members in all departments in the schools of science and engineering (at that time a total of 15 departments) requesting that they fill out a web survey. A second request was sent out two weeks later to those who had not filled out the survey. Ninety-seven faculty members from 15 total departments filled out the survey, with a resulting response rate of 44%. Table 1 below provides the response rate by department.

**Table 1: Survey response rate by faculty members' department**

| Department Name | N | Response rate |
|---|---|---|
| Biochemistry & Cell Biology | 14 | 61% |
| Bioengineering | 4 | 25% |
| Chemical Engineering | 5 | 56% |
| Chemistry | 11 | 65% |
| Civil Engineering | 2 | 14% |
| Computational & Applied Mathematics | 6 | 40% |
| Computer Science | 4 | 25% |
| Ecology & Evolutionary Biology | 5 | 71% |
| Electrical & Computer Engineering | 9 | 43% |
| Environmental Science & Engineering | 2 | unknown |
| Geology & Geophysics | 3 | unknown |
| Mathematics | 4 | 29% |
| Mechanical Engineering & Material Science | 6 | 40% |
| Physics and Astronomy | 17 | 49% |
| Statistics | 5 | 71% |
| **Total** | 97 | 44% |

### Demographics of the survey respondents

The sample of 97 faculty members was composed of 82 men (85%) and 15 women (15%). Ninety-one percent of the sample was White, 3% Hispanic, and 6% Asian or Pacific Islander. Table 2 shows the ethnic breakdown by gender.

**Table 2: Gender and ethnicity of faculty survey respondents**

| Ethnicity | Female | Male | N | % |
|---|---|---|---|---|
| White | 13 | 75 | 88 | 91% |
| Hispanic | 0 | 3 | 3 | 3% |
| Asian or P. I. | 2 | 4 | 6 | 6% |
| Total | 15 | 82 | 97 | 100% |
| Percent | **15%** | **85%** | **100%** | |

Faculty survey respondents were predominantly from the United States (73%). The remaining respondents were from 22 countries other than the United States.

With respect to the rank of faculty responding to the survey, 56% were full professors (see Table 3).

**Table 3: Faculty respondents' rank at Rice University**

| Rank | N | % |
|---|---|---|
| Professor | 54 | 56% |
| Associate professor | 11 | 11% |
| Assistant professor | 32 | 33% |
| **Total** | 97 | 100% |

The average number of years that the faculty survey respondents had been at Rice University was 14 years, with a median of 11 years (see Table 4).

**Table 4: Faculty respondents' years at Rice University**

| Years at Rice | N | % |
|---|---|---|
| 0-7 | 40 | 41% |
| 8-15 | 21 | 22% |
| 16-23 | 11 | 11% |
| 24-31 | 15 | 16% |
| 32-39 | 8 | 8% |
| 40-47 | 2 | 2% |
| **Total** | 97 | 100% |
| **Mean (SD)= 14.3 (12.1)** | | |

It is also interesting to note that 61% of faculty survey respondents had no minority graduate students currently working in their research labs (see Table 5).

**Table 5: Percentage of minority graduate students in the labs of faculty respondents**

| % of minority graduate students in faculty members' lab | N | % |
|---|---|---|
| 0% | 59 | 61% |
| 1-10% | 1 | 1% |
| 11-20% | 7 | 7% |
| 21-30% | 3 | 3% |
| 31-40% | 1 | 1% |
| 41-50% | 4 | 4% |
| 51-60% | 0 | 0% |
| 61-70% | 1 | 1% |
| 71-80% | 0 | 0% |
| 81-90% | 0 | 0% |
| 91-100% | 5 | 5% |
| Blank | 16 | 17% |
| **Total** | 97 | 100% |

## Faculty Interviews

A set of interviews was also conducted with fourteen Rice University faculty members in July 2000 as part of the evaluation for Rice's National Science Foundation Alliances for Graduate Education and the Professorate Program (AGEP). These interviews were conducted with faculty from the schools of natural science and engineering that had agreed to serve on the Executive Committee for the Alliances for Graduate Education and the Professorate Program. Open-ended interviews were conducted by telephone and, in all but one case, were tape-recorded.

## Appendix 2

### Survey Instrument

A copy of the questions asked on the survey can be read on the Web at the following URL.

http://ceee.rice.edu/Books/DV/facsurvey/facsurvey.htm

**Appendix 3**
**Bibliography**

**References Cited in this Paper:**

Rice, Eugene R. (1996). *Making a Place for the New American Scholar*, Working Paper Series, American Association for Higher Education.

National Science Board. (2002). Science & Engineering Indicators 2002: *Higher Education in Science and Engineering, Graduate S&E Students and Degrees in the United States*. NSB 02-1. Ch. 2. Available online: http://www.nsf.gov/sbe/srs/seind02/c2/c2s3.htm

Gillis, Malcolm (1999). *Diverse Campuses Benefit Students and Institutions*: Opinion column published by American Council on Education. Available Online: http://www.acenet.edu/hena/issues/1999/03_29_99/opinion_diverse.cfm

Alexander, B. B., Foertsch, J. A., & Daffinrud, S. M. (1998). *The Spend a Summer with a Scientist program: An evaluation of program outcomes and essential elements for success*. (Vol. 7). Madison: University of Wisconsin-Madison, LEAD Center. Available Online: http://www.cae.wisc.edu/~lead/pages/products/sas.pdf

Tapia, Richard (1998). *Assessing and Evaluating the Evaluation Tool - The Standardized Test*, NISE Forum: Assessment and the Promotion of Change, Washington, DC (February 1998).

## Appendix 4
### Resource List (Web Sources):

American Association for the Advancement of Science, Making Strides
http://ehrweb.aaas.org/mge

American Indian Science and Engineering Society
http://www.aises.org

Center for Excellence and Equity in Education
http://ceee.rice.edu

Commission on Professionals in Science and Technology
http://www.cpst.org

Diversity Works
http://www.aacu-edu.org/Initiatives/diversity.html

GEM Consortium (National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc.)
http://www.nd.edu/~gem

Hispanic Association of Colleges and Universities
http://www.hacu.net

Hispanic Engineer & Information Technology
http://www.hispanicengineer.com

Leaders Growing Leaders
http://endowment.pwcglobal.com

National Action Council for Minorities in Engineering
http://www.nacme.org

National Society of Black Engineers
http://www.nsbe.org

Science's NextWave
http://www.nextwave.science.org

Society for the Advancement of Chicanos and Native Americans in Science
http://www.sacnas.org

Society of Hispanic Professional Engineers
http://www.shpe.org

**Appendix 5**
**Charts and Tables**