

Merit Criteria, Eligibility and Diversity in the NSF Graduate Research Fellowships*

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Abstract

For nearly fifty years, the National Science Foundation has awarded merit-based Graduate Research Fellowships to outstanding students who are early in their graduate studies in NSF-supported fields. This paper looks at three aspects of the program: the introduction of NSF's two merit criteria, changes in eligibility guidelines, and diversity in the program. It then considers the impacts of some recent changes in the program. While the impacts are positive, considerable outreach is still needed.

I. Introduction

Since its first competition in 1952, the objective of the Graduate Research Fellowship Program (GRF) of the National Science Foundation (NSF) has been to support the vitality of the human resource base of science, mathematics, and engineering in the United States and to reinforce its diversity.^{1,2} From 1978 to 1999, the Minority Graduate Research Fellowship competition (MGF) was also administered. The GRF program application and review processes are managed by Oak Ridge Associated Universities (ORAU) under contract from NSF³.

Periodically, policy reviews are conducted to evaluate how well the program supports its objective. This paper considers four changes that benefit both the quality and diversity of the applicant pool. The first change was to provide additional funding to encourage participation by women in the engineering and computer science fields, resulting in the Women in Engineering and Computer and Information Science (WECS) component of GRFP. The second change we consider is the introduction of the new NSF Merit Review Criteria that address both intellectual merit and broader impact. This has changed the very basis on which panelists view scholarship and the measures thereof. The third

(*Any views expressed are those of the authors and not necessarily those of the National Science Board or the National Science Foundation)

change came after the 2000 GRFP competition, when a policy review was conducted of the existing GRFP eligibility guidelines, including representatives of the graduate education community. Following these discussions, the eligibility guidelines were changed to include students who follow less direct or continuous path to advanced degrees. The effects of this change on the 2001 competition will be reported. The final change that the paper will discuss involves new strategies to attract a more diverse applicant pool, including additional outreach and developing faculty recruiters throughout higher education to identify and promote minority participation.

II. Introduction of the two NSF Merit Criteria

All proposals and applications submitted to the NSF are judged based on two merit criteria: intellectual merit and broader impacts. These two criteria were approved in March, 1997 by the National Science Board (NSB), the governing body of the NSF. The new criteria were implemented later in 1997 and are now an integral part of the review process at the NSF. These two criteria ensure that all NSF funding decisions are made based on a consistent definition of excellence. The two criteria are characterized by the two following questions in the context of the GRF. The lists of items beneath each question are examples of the types of evidence that reviewers look for in each application.

What is the intellectual merit of the applicant?

- Ability to work as member of team as well as independently, to communicate, to plan & conduct research,
- Strength of academic record,
- Proposed plan of research & previous research experience,
- References, and
- Graduate Record Examinations Scores

What are the broader impacts of supporting the individual's graduate study?

- Contributions to community, both social and scholarly,
- Consideration is given to unique characteristics of applicant's background (personal, professional, & educational experiences),
- Applicants should address the integration of diversity into projects and activities, and
- Applicants should address the integration of research and education in their research, projects, and other activities

Attention to the two merit criteria is clearly reflected in the Guidelines for Submission of Applications¹, the application and reference forms and the reviewers rating sheet. While intellectual merit questions have always been part of the program, each form now has explicit broader impact questions. Reviewers are briefed on the merit criteria. Both NSF and ORAU also include a discussion of the merit criteria when giving presentations or workshops to potential applicants.

III. Changes in Eligibility Guidelines

After the 2000 GRFP competition, representatives of the graduate education community reviewed the GRFP eligibility guidelines (both principles and implementation). A meeting via teleconference convened in May of 2000, and the following points were discussed:

- Since 1972, the program has provided support for students at or near the beginning of their graduate study,
- Prior to 1999 consolidation of competitions, eligibility guidelines for MGF and WECS allowed applicants who had earned a Master's degree and allowed more graduate hours earned,
- The fixed limit of credits earned didn't accommodate the variety of university practices,
- The then current guidelines disqualified students who follow an indirect path through higher education, and
- It is common for women in ENG/ CISE to work after MS and return for Ph.D studies.

Following these discussions, the eligibility guidelines were changed to include students who follow less direct or continuous paths to advanced degrees. The program abandoned the earlier fixed limit of credits earned, which did not accommodate the variety of university practices. Now, individuals who are essentially starting over would be considered eligible if they were no further advanced in their current studies than a talented student with one year or less of full-time graduate study. For example, the applications of candidates who are returning to their studies after an interruption or who are changing fields could be evaluated for eligibility. Applicants with more than one year of earned graduate study are asked to explain why they are eligible under the guidelines. The entire application is considered in the eligibility evaluation.

IV. Diversity in the Program

In response to particularly low numbers of women in engineering and computer science, in 1990 awards for Women in Engineering were added, and in 1993 awards for Women in Computer and Information Science were added. These awards (Women in Engineering and Computer Science, or WECS) are funded by the Engineering and the Computer and Information Science and Engineering Directorates of NSF. The WECS awards provide several benefits. The awards attract more applications from females in engineering and computer science. This results in increased opportunities for females to earn graduate degrees in fields in which they are underrepresented. Another benefit is increasing the pool of females who are able to consider entering the professoriate.

Figure 1 shows the number of applications (in all fields) from 1989 to 2000 broken down by gender. Clearly the overall numbers show that parity is being approached. However, it still may be a few years before this parity is reached.

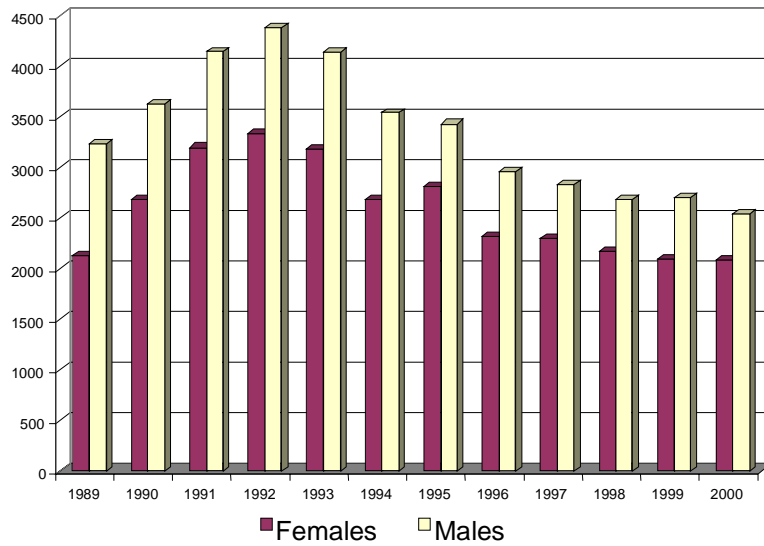


Figure 1: GRF applications from females and males, 1989-2000

Figures 2 and 3 show the total and female enrollment of graduate students in engineering and computer science, respectively.⁴ Only U.S. citizens and permanent residents are included in the counts. Both demonstrate that it will take some time to reach anything approaching parity.

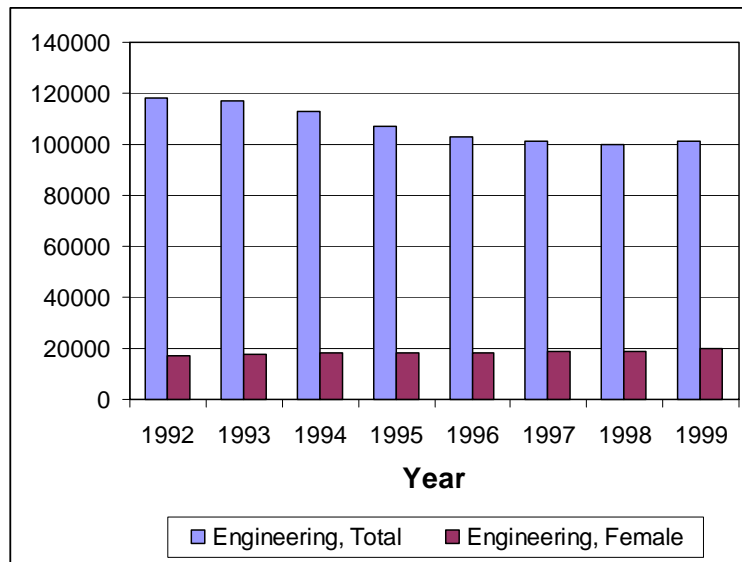


Figure 2: Engineering Graduate Students, all U.S. Institutions⁴

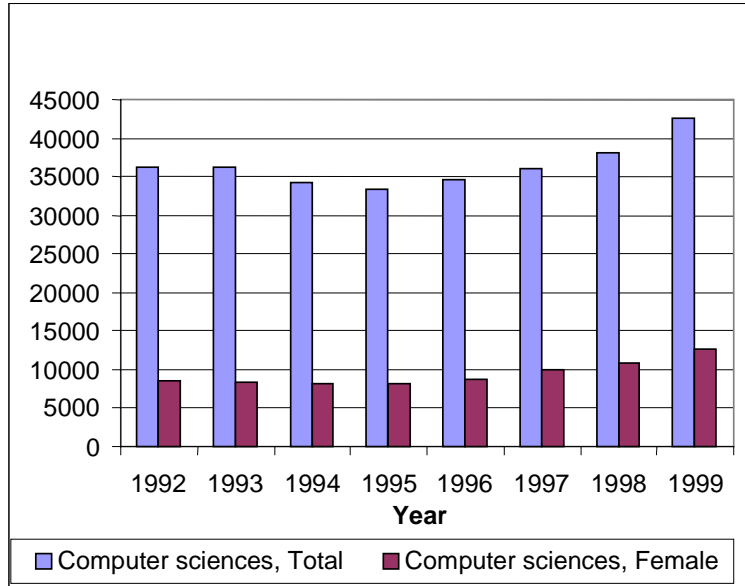


Figure 3: Computer Science Graduate Students, all U.S. Institutions⁴

Many under-represented minority (URM) applicants to GRF (and, previously, MGF) started their educational careers at Minority Serving Institutions (MSIs, such as Historically Black Colleges and Universities (HBCUs) or Hispanic Serving Institutions (HSIs)), as can be seen in the first column of Table 1. However, the second column of the table indicates that there is a lower success rate for URMs from MSIs than in general. We need to analyze why this is so and address the causes. It will be important to also consider the success rate for similarly sized non-MSIs so that we can address any general small-school issues.

Table 1: Applicants and Awardees from Minority Serving Institutions, in the latest complete program years of GRF and MGF

Program Year	Percentage of URM Applicants from MSIs	Percentage of URM Awardees from MSIs
2000 GRF	28	12
1998 MGF	21	10

Figure 4 compares the total number of U.S. citizens and permanent residents enrolled in science and engineering fields at U.S. institutions with the number of underrepresented minorities (URMs) enrolled in graduate study in the same fields. As was found in figures 2 and 3 for women in engineering and computer science, the disparity is large.

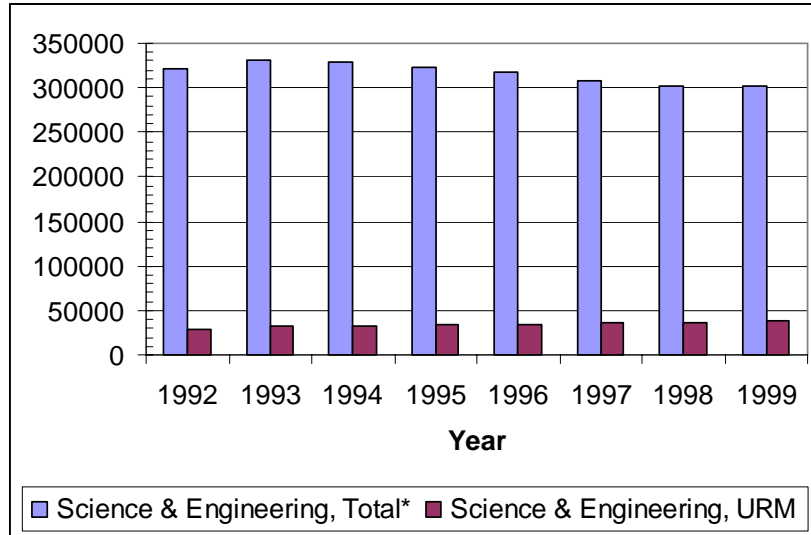


Figure 4: Science and Engineering Graduate Students

*U.S. citizens and permanent residents only

URM here refers to Black, non-Hispanic, American Indian/Alaska Native and Hispanic (the data set combined Asian and Pacific Islander groups)

V. Impact on the Program

Through the changes described above, the current GRFP competition now includes:

- Uniform eligibility criteria
- Short personal statements on applicant experiences involving advancing diversity in science and the integration of education and research
- Race-neutral selection based on panelists' recommendations
- Race/ethnicity and gender information included in files for panelists
- Explicit use of revised NSF merit review criteria
 - Evaluate broader impacts and academic merit
 - Shift in emphasis reflected on the application form, reference report form, and panelist score sheet
- Proportionately more minority panelists
- More time allowed for review of applications
- At least two reads for every application

Figure 5 shows the success rate for all applicants and that of under-represented minorities for the program years 1989 to 2000 (the most recent completed cycle at this writing).

The dramatic change in success rate for underrepresented minorities between 1998 and 1999 marks the shift between two separate GRFP competitions and one consolidated competition. The associated administrative changes include expanded outreach and recruitment, emphasis on the two revised merit review criteria, changes in the application materials, increased proportion of minority reviewers, and changes in review procedures. Although we cannot demonstrate causation, NSF believes that if we had not markedly changed our procedures beginning in 1999, success rates for underrepresented minorities might well have continued to be only a fraction of that for the competition overall.

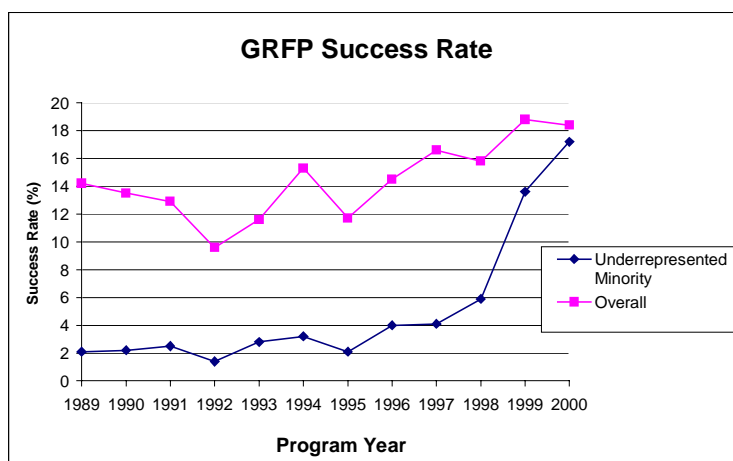


Figure 5: GRFP Success Rate, 1989-2000, Underrepresented minority and overall.

The early effects of the program changes on the 2001 competition are being examined now. A total of 5560 applications were reviewed this year, which is a considerable increase (20 percent) over the 2000 competition. These applicants represented 699 baccalaureate institutions in the U.S. and 69 schools from abroad. Following the federal standard, race and ethnicity data are now collected differently, and applicants may select more than one ethnicity, or not select any. Of the applications reviewed, 544 (9.8 percent of the total) had one or more under-represented race or ethnicity selected, 267 had no race/ethnicity selected (nearly 5 percent), 2564 selected female (46.1 percent), and 167 with no gender selected (3 percent). Figure 6 shows data from the applications for the 2001 competition 9awards for 2001 were not officially announced before this paper’s submission deadline), broken down by broad fields, gender, and underrepresentation.

Table 6: 2001 Applicants by Field: Total Applications, Applications from Females, and Applications from Underrepresented Minorities

Fields	Total 2001 Applications	Female 2001 Applications	Underrepresented 2001 Applicants
Computer Science	288	89	33
Engineering	1189	396	143
Mathematical Sciences	213	63	20
Physical Sciences	975	367	58
Life Sciences	1798	992	137
Psychology	389	255	45
Social Sciences	708	402	108
Total	5560	2564	544

For reference, the 2000 awardees who accepted the GRF attended 93 institutions in 36 states, Puerto Rico, and 2 foreign countries. Table 3 shows the distribution of awards by field for the last two years of the program, which is typical.

Table 3: Fields of Study of Graduate Fellowship Awardees, 1999 and 2000

	Engineering	Mathematical Sciences	Physical Sciences	Life Sciences	Psychology	Social Sciences	Total
1999 Awards	256	101	147	249	66	81	900
2000 Awards	243	87	139	235	52	94	850

VI. New Strategies to Attract a More Diverse Applicant Pool

GRFP and ORAU staff have discussed new strategies to attract a more diverse applicant pool, including additional outreach and developing faculty recruiters throughout higher education to identify and promote minority participation. Students need to be presented with the fellowship program and relevant materials, and they need to be prepared. For undergraduate students, exposure to quality research experiences (REU and RUI are two NSF programs that may support this) and practice in writing essays for fellowship and graduate school applications are both critical.

Correspondingly, the faculty in their roles as advisors, mentors, and references, need to be kept abreast of new developments. The role of faculty is to

- Provide stimulating educational experiences that excite students toward further SEM study
- Advise students of graduate school opportunities and encouraging students to submit applications
- Mentor students on preparing applications, and
- Write effective recommendation letters

VII. Conclusion

The result of the changes described above is a program with an enhanced focus on both excellence and diversity (in all senses of this word) in choosing a set of Fellows. GRF is an investment in the future research enterprise of the United States and these changes should increase the impact of this investment. However, the enrollment numbers clearly show that additional outreach work is needed.

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