

KEY FINDINGS AND IMPLICATIONS FOR POLICY AND PRACTICE

This concluding section begins by summarizing findings related to the evaluation questions posed by the study and then moves to recommendations for NSF action regarding the policies and practices of the GRF Program. We emphasize findings and recommendations that are related to NSF goals of quality and diversity of the SMET workforce.

Key Findings

We began this study by looking at four central evaluation questions. Analysis of multiple data sources has given us some clear and interesting answers.

1. How do NSF applicants and fellows compare to non-applicants in the same academic programs, and do fellows attend institutions with the highest reputations?

Graduate students in the same academic programs are quite similar to each other. Most NSF fellows attend programs whose reputations are among the highest in the country and where admission is highly competitive. For example, both NSF fellows and peers have high GRE scores, especially quantitative scores. NSF fellows have stronger verbal and analytic scores than peers. In some programs, especially Biochemistry, no distinctions between NSF fellows and peers were either reported or observed.

We discovered that international students in the peer groups are often considered among the best students, although this too varies by discipline. For example, in the Disciplinary sample, 49% of the Economics peers responding were foreign nationals. In some programs we visited, high percentages of students were international (70% in Mathematics at Institution D), and they were considered among the strongest in the program by the faculty. Previous studies of the GRF Program did not include international students, which would be perhaps a more serious weakness today given the heavy enrollments of international students in many SMET disciplines.

Since NSF fellows usually attend programs with distinguished or strong national reputations, their program peers also have graduate funding support, often in the form of other major competitive fellowships. The mix of support varies by discipline, with the emphasis ranging from research assistantships and traineeships in Biochemistry to teaching assistantships in Mathematics.

2. Do recent NSF fellows show evidence of more timely completion of degree and early career success?

Despite faculty opinions that GRF support may shorten the time to degree, this is more perception than reality. While some NSF fellows also believe they will finish in less time because of the GRF, others indicate they choose more coursework or research experience over

speedy completion. Time to degree did not change significantly between the first two cohorts, with the average remaining at about 5.5 years. We found that about one-third of NSF fellows who complete the Ph.D. take more than six years. However, TTD for NSF fellows is shorter than for QG2 non-awardees.

Completion rates remained high and relatively constant between the first two cohorts. Doctoral program completion rates for NSF fellows increased between our first two cohorts with 73% of 1984-1988 fellows earning doctorates in 11 years, up from 68.3% for 1979-1983 fellows. While these completion rates are somewhat lower than those reported in previous studies of NSF fellows, the decline is likely due in part to the increased number of NSF fellows in Engineering. Survey respondents (1989-1993 cohort) in Engineering reported seeking master's degrees rather than Ph.D.s: 18% of WENG fellows; 22% of Disciplinary fellows; and 32% of MGF fellows. The most recent cohort shows a lower completion rate at the 6-year mark, which may indicate that NSF fellows are taking longer to complete the Ph.D. or that more are leaving graduate programs without completing the doctorate.

Overall, Quality Group 1 NSF fellows continue to complete doctorates more often than Quality Group 2 fellows, who in turn complete more often than Quality Group 2 non-awardees. This pattern continues the findings of prior studies (Baker, 1994, 1995; Snyder, 1988) and is particularly true for women. Completion rates for 1984-1988 women fellows in most discipline areas are within ± 6 percentage points of men's within 11 years. Six-year completion rates are 40% for 1990-1993 WENG fellows, which compares favorably to 45% for other Engineering fellows.

From site visits we learned that fellow and peer career aspirations frequently shift during graduate school. Many become less inclined to pursue academic careers as time passes—a shift precipitated by a number of factors, including the tight competition within the academic job market, better pay in the private sector, and disillusionment with academia. Some discover that they do not enjoy either teaching or theoretical research. Others, both men and women, are disillusioned by academic politics, work demands, or the challenge of balancing an academic career and family life.

We find some differences in early career paths for 1989-1993 Disciplinary fellows and peers in the four disciplines. Most Disciplinary fellows and peers in Mechanical Engineering are pursuing careers outside of academia. The majority of Disciplinary fellows in Mathematics and Biochemistry remain in higher education, most holding postdoctoral positions or its non-tenure track equivalent in Mathematics. Only in Economics are Disciplinary fellows more likely than their peers to hold a tenure-track position. This difference, however, may be related to the fact that almost half of program peers in Economics were international students.

We found no significant differences in early career productivity using traditional measures of academic career success. The changing career choices of NSF fellows and peers suggest the need to develop broader measures of career success.

3. Do GF and MGF fellows experience similar educational and career success?

MGF fellows are somewhat less likely than GF fellows to attend and graduate from programs with reputations that are ranked among the top five or ten programs. Of those fellows who had completed doctorates by 1999, 62% of GF fellows did so from programs rated as Distinguished compared to 48% of MGF fellows. This difference, of course, begins with decisions about where to apply to graduate school and is related to undergraduate institution attended. MGF doctoral completers were also more than twice as likely as GF completers to graduate from programs in the categories of Good, Adequate/Marginal, or Not Ranked. Generally, however, NSF fellows continued to enroll in highly regarded graduate programs, and three of five NSF fellows who completed degrees did so in Distinguished programs.

Doctoral completion rates for MGF fellows increased more than those for GF fellows between the first two cohorts. While 61% of 1984-1988 MGF fellows earned doctoral degrees within 11 years, only 50% of the 1979-1983 MGF cohort completed in that time. The gap in 11-year completion rates narrowed from 20% for 1979-1983 fellows to 13% for 1984-1988 fellows, driven largely by Quality Group 1 MGF fellows whose doctoral completion rate within 11 years rose to 68%.

NSF fellows value the prestige associated with winning a GRF. Over two-thirds believe the award made them an asset to faculty. However, some MGF and WENG recipients reported that the award carried a certain amount of stigma associated with assumptions that the award was not merit-based. Again, we found no statistically significant differences in early career productivity.

4. Does the individual award aspect of the NSF Graduate Research Fellowship enhance the educational experience and career options of fellows?

Since admission to graduate programs is determined before GRF awards are announced, the fellowship has virtually no impact on admission decisions. However, having a GRF may be an asset for changing programs, although very few take advantage of this option, or for late admission. Furthermore, once an admitted student receives GRF funding, some programs actively recruit them to enroll and may enhance the fellowship with additional financial support.

The GRF award makes a discernible difference to NSF fellows enrolled in programs that rely heavily on teaching assistantships as a source of graduate student support. Reduced teaching responsibility frees NSF fellows to pursue additional coursework or explore additional research avenues, thereby broadening as well as deepening their educational experience.

Individual fellowship funding is thought to carry with it dangers of intellectual and social isolation and reduced opportunities to teach (National Science Board, 1998), but we do not find these to be serious concerns for most NSF fellows. While about one-fifth of survey respondents identified reduced teaching opportunities as a disadvantage, only 2% to 6% of Disciplinary fellows and MGF fellows cited other disadvantages such as lack of office space, isolation, and less opportunity to work with faculty on their research projects. WENG fellows were somewhat more likely to identify lack of office space (10%) and less opportunity to work collaboratively with other students (13%).

We find no evidence that the individual award aspect of the fellowship enhanced NSF fellows' career options, although some fellows we interviewed believed the prestige factor of the GRF was an asset in getting postdoctoral fellowships, securing research funding, and in a job search.

The broadest finding from our study, but one that it is important to confirm, is that the GRF Program continues to play a distinguished and vital role in graduate education. Since its inception in 1952, other fellowship programs have emerged, some conferring equivalent stature on their recipients or providing higher levels of funding, but none approach the scope or size of the GRF Program. With approximately 5000 applicants and about 900 new fellowships awarded each year, the GRF Program reaches all fields supported by the National Science Foundation by identifying and funding those students with the potential to become leaders among the next generation of scientists and engineers.

The value of the GRF Program stems not only from the direct financial support available to fellows, but also from the stature that success in this national competition confers on NSF fellows and its impact on graduate programs. With few exceptions, senior university administrators had very high praise for the GRF Program and its contributions to graduate education.

I can't say enough about the importance of the program. If I had to create a list of the ways which Federal government is spending its money on research, or indeed how the Foundation is spending its money on research, the NSF fellowship program in my way of thinking would be at the top. (D)

It is one of the most prestigious [fellowship programs]. The money is not so great, but it says a lot about our institution that they come here.... It is certainly one of the premier programs. The honor to the student would be hard to state-how prestigious it is to the student.... It has importance to the graduate enterprise nationally.... More top students enhance the quality of graduate education.... It is of immeasurable value and enriches the enterprise. (E)

[Eliminating GRF] would send a signal to the community that would be very confusing and perhaps discouraging for graduate study.... I think that this is a uniquely successful program. A national competition and students can take the funds anywhere they want. It gives them a degree of choice, makes them very eligible to be recruited by top graduate programs. (A-M)

Given the high level of national regard that the GRF Program continues to garner, we offer some suggestions for the future to strengthen its impact and enhance its capacity to contribute to NSF and national goals of science and engineering discovery and building a diverse, globally oriented workforce.

Recommendations

The recommendations arising from the evaluation of the GRF Program fall into two broad categories. The first focuses on *tactical* recommendations, or actions that can be taken to streamline or strengthen existing program operations without altering its fundamental nature. Most of the feedback concerning the day-to-day operation of the GRF Program was very positive and emphasized the well-run nature of the program, and so this list of recommendations is brief.

The second set of recommendations is *strategic* in nature, in that each recommendation focuses on actions NSF might consider to move the program in desired directions and/or to bring program policies and practices into closer alignment with its overarching mission.

The GRF Program operates within a larger political and societal context. It is housed within an overall NSF structure that includes other programs, some of which are inter-related, and all of which support the agency's broader goals. Therefore, some of the strategic recommendations we propose speak to issues over which GRF Program managers may have no direct influence, but which are nonetheless germane to GRF Program's effectiveness, and thus important to address.

Tactical Recommendations

Increase the GRF Stipend and Cost of Education Allowance.

Because other fellowship programs may have higher stipends and more generous support for ancillary educational costs, NSF should regularly revisit and, as necessary, increase the stipend and Cost of Education allowance. If the award is to continue to convey to its recipients the national honor that currently accompanies it, the program must continue to attract top applicants. One component of maintaining this stature is to provide an adequate level of financial support.

Create an Allowance for Related Education Expenses.

Earmark a portion of the fellowship to be used by recipients as a supplemental allowance for related education expenses such as travel, books, and computer equipment. Fellows are acutely aware of the fact that other fellowship programs offer a small supplement (roughly \$1000-\$3000) that students access directly and automatically (without having to apply for it) for a variety of related education expenses. The fact that the GRF Program has no such provision is a source of dissatisfaction to some fellows.

Announce GRF Winners Sooner.

The current announcement schedule precludes, for most university departments, the possibility of award notifications preceding admission decisions. Posting the winners sooner, e.g., by March 1st, would increase the likelihood of the GRF influencing admission decisions and financial support packages.

Maintain or Expand Use of the On-line Application Process.

Students who had used it praised the FastLane application process as being efficient and helpful. “Bugs” from previous versions had apparently been worked out to a substantial degree, according to students who had applied on-line more than once.

Foster the Development of an NSF Fellows Network.

It would be useful to offer NSF fellows the opportunity to network with one another across institutions, using a combination of on-line and in-person arrangements, regarding issues of fellowship use, graduate school experience, careers, and job search strategies/support. Fellows would also benefit from opportunities, either cross-disciplinary or intra-disciplinary, to share information on research and teaching through networks or meetings.

Remove the First-Year Deferral Prohibition.

As the program currently operates, recipients are only allowed to defer receipt of the first year of the fellowship in cases where they are also deferring entry into their graduate program, and permission must be specially requested and approved by NSF. In keeping with the program’s overall emphasis on flexibility, NSF fellows would benefit, and few if any costs would be incurred, by removing the first-year deferral restriction and allowing the three years of the fellowship to be used at any time during five years. For example, if first-year students are funded under training grants, deferring this year of support could fund the dissertation year for a GRF fellow.

Strategic Recommendations

Change the Number of Years of Support to Emphasize Support of Graduate-level, not Primarily Doctoral-level, Studies.

The GRF Program is biased, whether intentionally or inadvertently, toward supporting doctoral studies as opposed to graduate studies, which would encompass both the master’s and doctoral levels.

The rapidly changing nature of job markets in fields like engineering and biochemistry have led to an increased demand for master's level members of the SMET workforce. Moreover, across all disciplines, one-third or more of GRF recipients do not complete the doctoral degree. Another reason for more directly supporting master's-level study is as a means of making GRF policies and practices more congruent with larger programmatic aims to diversify the SMET workforce. Women (in some fields) and underrepresented minorities, particularly, are more likely to enter graduate programs with the initial intent of pursuing only master's degrees. They may decide to pursue doctoral studies only after having their confidence boosted by demonstrating success during their early graduate school experience. Thus, more explicitly supporting master's-level study across disciplines would move the GRF Program into closer alignment with broader NSF goals.

Responding to the need to legitimize and support master's as well as doctoral-level studies could be accomplished by establishing, for example, a two-pronged system of support. Initial support could be for two-year instead of three-year fellowships, and the second could offer one- or two-year extensions upon re-application and demonstration of satisfactory progress within the graduate program. Applications for extension would not be competitive like initial fellowship awards. This would not be a return to the annual GRF competitions that existed prior to 1972.

Eliminate the Eligibility Cap on Prior Graduate Units to Support Career Transitions and/or Later Entry to Graduate Programs.

As currently structured, the GRF Program prohibits application by students with more than 20 semester or 30 quarter units of graduate study taken within the past ten years, eliminating applications from most students who already possess master's degrees. Removing the cap on the number of units an applicant can accumulate prior to applying for the GRF would accomplish two important objectives. First, it would encourage the return of highly qualified master's-degree holders in various disciplines to pursue either a second master's or a doctoral degree in SMET fields. Second, it would facilitate applications from students (and particularly underrepresented minorities) who, for whatever reason, lacked the preparation to successfully compete for the GRF prior to gaining research experience during graduate study.

Restructure the Selection Process to Expand Access for Applicants from a Broader Range of Undergraduate Institutions.

The CI analysis indicates that awardees tend not only to enroll in the top schools with their fellowships, but they also tend to come from those top schools. Further, students perceived that the undergraduate institution they applied from plays a large role in the GRF selection process. The GRF selection process has a heavy emphasis on an applicant's demonstrated ability to conduct research, which no doubt contributes to this phenomenon, since undergraduate applicants from research universities are more likely to have research experience and fare better. NSF may want to consider restructuring the GRF selection process to open up opportunities to applicants emerging from a broader variety of institutions by expanding the basis for evaluating research ability and potential.

Collaborate with Other NSF Programs to Develop Joint Strategies to Boost the Numbers from Underrepresented Minorities Who Apply for and Win GRF Awards.

A number of other NSF programs (e.g., the Alliance for Minority Participation and the Research Experience for Undergraduates Program) are designed to enhance the diversity and quality of undergraduate SMET programs as well as prepare students for graduate study. The newer Minority Graduate Education program is also designed to increase diversity of graduate students in SMET fields. Elimination of the MGF competition and the continuing importance of the NSF goal to increase the diversity of the SMET workforce make it increasingly important for the GRF Program to partner effectively with these programs to strengthen the undergraduate-graduate pipeline generally and the GRF applicant pool in particular.