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Graduate Research Fellowship Program

Final Evaluation Report

September 2002

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NATIONAL SCIENCE FOUNDATION
GRADUATE RESEARCH FELLOWSHIP PROGRAM

Final Evaluation Report

Prepared Under Contracts REC 9452969 and 9912174

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EXECUTIVE SUMMARY

WestEd conducted an evaluation of the National Science Foundation's Graduate Research Fellowship (GRF) Program. This evaluation was designed to inform ongoing NSF efforts to strengthen its programs and support the agency's commitment to make optimal use of its resources across program options that address its goals. This report provides findings related to GRF Program effectiveness and examines important contextual issues that influence GRF impact.

The NSF Graduate Research Fellowship Program, started in 1952, continues to play a distinguished and vital role in graduate education. Since then, other fellowship programs have started that confer equivalent stature on their recipients or provide higher levels of funding. None approach the scope or size of the GRF Program. With more than 5000 applications and about 900 new fellowships awarded each year, the GRF Program reaches all fields supported by NSF. It funds students with potential to become leaders of the next generation of scientists and engineers.

NSF fellows pursue graduate study in science, mathematics, engineering, and technology (SMET) fields. The purpose of the GRF Program is to ensure for the Nation a future stream of highly qualified scientists and engineers to undertake careers in research and development. Inherent in this purpose is the commitment to a diverse workforce that includes participation of women and underrepresented minorities in successful careers in science and engineering. From 1978 to 1998, GRF fellowships were awarded through a Minority Graduate Fellowship (MGF) competition in addition to the Graduate Fellowship (GF) competition. Beginning in 1990, additional funds were made available for Women in Engineering (WENG) fellows in both competitions.

GRF support includes a portable stipend and a cost-of-education allowance that the NSF fellow can use at the institution of his/her choosing. Three years of support must be used within a five-year period. The value of the GRF Program stems not only from the direct financial support for fellows, but also from the stature that success in this national competition confers on them and the impact on graduate programs where fellows enroll. Senior university administrators have high praise for the GRF Program and its contributions to graduate education.

Graduate education in the United States is part of a complex system of higher education that includes competition as well as institutional and disciplinary variation. The GRF Program plays different roles at key transition point in graduate students' careers. We focused on three key transition points: entry, graduate experience, and career/life choices.

The Evaluation Study

WestEd conducted this evaluation of the GRF Program to update information on program outcomes and assess its contributions to NSF goals. The study included the two GRF Program competitions, which awarded fellowships to Graduate Fellows (GF) and Minority Graduate Fellows (MGF) through 1998 when the MGF competition was discontinued. We also included Women in Engineering (WENG) recipients.

WestEd employed multiple methods, including secondary data analysis for 1979-1993 GRF fellows using data from the Survey of Earned Doctorates (SED) and NSF's Cumulative Index (CI). The SED is administered annually to all new doctoral recipients from U.S. institutions, and the CI is an NSF file that contains records for every individual who applies for a Graduate Research Fellowship. In addition, we conducted surveys of the 1989-1993 cohort of GRF fellows and their peers and site visit interviews with 149 graduate students and 75 faculty, administrators, and staff at six major research universities.

Methods

- **Secondary Data Analysis for 1979-1993 GRF fellows**
- **Graduate Student Follow-up Survey of 1989-1993 cohort sent to three samples of fellows and peers**
- **Six Institutional Site Visits**

In 1999, WestEd administered the Graduate Student Follow-up Survey to three samples: a Disciplinary sample, an MGF sample, and a WENG sample.

Survey Samples

- **<u>Disciplinary sample</u>: GRF fellows and a comparison group of program peers in Biochemistry, Economics, Mathematics, and Mechanical Engineering at 16 institutions. Responses from 200 fellows and 188 peers.**
- **<u>Minority Graduate Fellows sample</u>: 35% random sample of MGF recipients in 33 disciplines at 62 institutions. Responses from 87 MGF fellows.**
- **<u>Women in Engineering sample</u>: 50% random sample of WENG recipients (1990-1993) in all engineering fields at 46 institutions. Responses from 85 WENG fellows.**

For the Disciplinary sample and the site visits, we focused on four disciplines that represent the range of SMET fields supported by NSF. We were able to identify the comparison group of peers through the national Doctoral Education Database developed by the American Association of Universities (AAU) and the Association of Graduate Schools (AGS) in collaboration with the Educational Testing Service (ETS). The Doctoral Education Database was established in 1989 to collect student-level data from AAU institutions and included the four fields of Biochemistry, Economics, Mathematics, and Mechanical Engineering. Access to this database allowed us to identify a comparison group for GRF fellows comprising individuals who entered the same graduate programs in the same years. The Graduate Education Follow-up Survey and institutional site visits gave us the opportunity to probe the reasons for choices made by graduate students as well as to discover institutional and program factors that influenced decisions.

What Did We Find?

Graduate education plays a critical role in the preparation of the academic, business, industry, government, and non-profit workforce in the United States. The contemporary world of graduate education is complicated, dominated by disciplines, and very different from what existed when the GRF Program was created nearly 50 years ago. NSF remains a major source of support for graduate education and includes research grants to faculty, which they use to support graduate students and graduate training programs that advance a research agenda. In contrast, the GRF provides direct support to highly qualified graduate students who enroll in top graduate programs in SMET fields. Because NSF fellows study in a variety of disciplines at public and private research universities, the impact of the fellowship on recipients differs. The GRF Program also affects graduate programs, particularly programs that enroll large numbers of NSF fellows.

NSF fellows value the GRF for the financial support and prestige as well as for the choices it gives them. However, fellows and faculty consider the 1998-1999 GRF stipend ($15,000/year for 3 years) and cost of education allowance ($9,500 /year) levels too low for prevailing costs. Further, GRF support was lower than several other prestigious fellowship programs that offer higher stipends, expense allowances, full tuition reimbursement, more years of support, and/or networking opportunities. Although the GRF Program is larger, involves a national competition, and supports more students for graduate study in a greater variety of fields than other graduate fellowship programs, it is important to keep the GRF stipend competitive with other graduate fellowships to attract the best applicants and maintain its reputation. (Since we concluded the evaluation, the GRF Program has increased the value of the annual stipend to $18,000 for Fiscal Year 2001 fellows and $20,500 for Fiscal Year 2002 fellows and increased the cost of education allowance to $10,500 per year.)

Transition Point One: Entry into Graduate Education

Entry into graduate education involves decisions about whether to apply to graduate school, where to apply, and which fellowships to apply for. These decisions are influenced by many factors, including perceptions about chances of success, which may also be related to the type of undergraduate institution attended. Both NSF applicants and fellows increasingly graduate from Research 1 universities.

Changes in the Percentage of GRF Applicants and Fellows Graduating from RU1 Institutions

	GF	MGF
1979 Applicants	49%	27%
1993 Applicants	53%	40%
Difference	**+4**	**+13**
1979 Fellows	66%	33%
1993 Fellows	69%	66%
Difference	**+3**	**+33**

Traditionally, many underrepresented minorities have attended historically minority institutions as undergraduates rather than the Research 1 universities that produced most GRF fellows. However, between 1979 and 1993 the percentage of MGF fellows who graduated from Research 1 universities increased from 33% to 66%. We also found that 1993 GF fellows were more diverse. Furthermore, comparing 1979 to 1993 GRF fellows, we found that the latter were also more likely to be women, in large part due to the WENG awards.

Changing Characteristics of GRF Fellows

	1979 Fellows	1993 Fellows	Difference
GRF Women	29%	43%	**+14**
GF Fellows - White	90%	71%	**-19**

The GRF Program is implemented within the context of graduate programs in which competition for top students can be intense. Faculty and staff describe admissions and recruitment in market terms, indicating that they offer as much as they can to be competitive because enrolling the best graduate students is considered critical to attracting and retaining top faculty. Consequently, most doctoral students receive offers of financial assistance when accepted into a Ph.D. program, which means that GRF support alone is not likely to be the critical factor in an NSF fellow's decision to enroll in a particular institution.

Both NSF fellows and their peers said they enrolled in a particular program for reasons ranging from academic quality to personal preferences. Of all fellows from 1979-1993 who had completed doctorates by 1999, 62% of GF fellows did so from programs rated as Distinguished by the National Research Council. Fewer MGF fellows (48%) enrolled in programs rated as Distinguished. MGF fellows are also less likely than GF fellows to enroll in and complete doctorates from programs ranked among the top five or ten graduate programs in their field.

Due to the timing of admissions decisions, which are made before GRF awards are announced, the fellowship award has virtually no impact on admission to graduate programs. However, the GRF may be an asset for late admission or for changing programs, although few take advantage of this option. Once an admitted student receives GRF funding, some graduate programs work actively to attract them to enroll and may enhance GRF fellowship support. Since NSF fellows continue to be admitted to, enroll in, and complete degrees in highly ranked graduate programs, the selection criteria for the GRF Program appear to be consistent with the criteria used by top graduate programs. We also found that GRF fellows tend to enroll in and complete degrees in a small number of institutions; more than 90% chose graduate study in RU1 institutions.

Transition Point Two: The Graduate Experience

The path to the Ph.D. is frequently a long and arduous journey, and many of those who begin that journey do not complete their degrees. NSF fellows value GRF support for different reasons, and the fellowship's value to graduate students also varies in different disciplines. Disciplines both shape the graduate experience and affect completion rates and time to degree.

Value of the Graduate Research Fellowship

NSF fellows reported that GRF advantages were related primarily to financial assistance and prestige. We also found that GRF funding increased the freedom of fellows to make important choices regarding teaching and research. Individual fellowship funding is thought to carry with it dangers of intellectual and social isolation and reduced opportunities to teach, but we did not find these to be major concerns for NSF fellows.

Major Advantages and Disadvantages Reported by NSF Fellows

Advantages	Disciplinary Fellows	WENG Fellows	MGF Fellows
Financial support (stipend)	84%	89%	89%
Reputation among faculty as a good student	70%	74%	60%
Having it on my CV helped/will help in job	67%	59%	66%
Tuition assistance (COE allowance)	65%	74%	69%
Full-time study allowed quicker start in program	57%	51%	58%
Disadvantages			
Support only lasted 3 years	46%	42%	46%
Less opportunity to teach (TA)	23%	18%	18%
Could not live on stipend alone	9%	17%	15%
Isolated from other students in program	6%	3%	4%
Less opportunity to work with faculty on their research projects (RA)	5%	5%	5%

The Disciplinary Difference

Graduate school is experienced differently by every student because of differences in background, educational preparation, and personal factors. The norms and expectations of the particular disciplines and institutions to which the student belongs also influence how students experience their education. Graduate programs in the SMET fields supported by the NSF GRF Program have distinctive disciplinary cultures situated within complex institutional settings. In many cases these disciplinary factors color the effect of the GRF Program. For example, norms, expectations, and requirements vary substantially by discipline in terms of financial support, teaching requirements, organization of research, activities, productivity measures, degree value, and career options.

Variation in Activities Reported by GRF Fellows (Disciplinary Sample)

	Mechanical Engineering	Mathematics	Biochemistry	Economics
Work on Team	**62%**	**33%**	**53%**	**29%**
Collaboration	**66%**	**55%**	**73%**	**59%**
Interdisciplinary Research	**54%**	**25%**	**48%**	**20%**
Learn Organizational or Managerial Skills	**48%**	**14%**	**32%**	**14%**
Interact with Professionals in Field	**50%**	**8%**	**19%**	**20%**

Disciplinary differences include the nature of research and the relative importance of teaching. Faculty and graduate students told us about the impact of GRF support in different disciplinary contexts. For example, where research and graduate study are focused in laboratories (Mechanical Engineering and Biochemistry) GRF support greatly benefits faculty by saving research funding that supports large research projects and benefits NSF fellows by giving them greater flexibility in selecting research projects that interest them. In contrast, in Economics and Mathematics, where research is more individual and less likely to be externally funded, the primary benefit of GRF support to NSF fellows is the flexibility to pursue research rather than devote considerable time to teaching responsibilities.

Ph.D. Completion

Goldman and Massey[1] recently concluded that three-quarters of science and engineering graduate students never receive a Ph.D. However, of GRF fellows in the 1984-1988 cohort, 73% completed their doctorates within 11 years. For some disciplines, such as Engineering, the Ph.D. is not the goal of most graduate students. More recent GRF cohorts have higher proportions of Engineering fellows than earlier cohorts, which would have the effect of lowering overall Ph.D. completion rates. Even in Engineering, 69% of GF and 55% of MGF fellows in this cohort completed within 11 years. In this context, completion rates for GRF fellows are exceptionally high.

We looked at trends in completion rates and time to degree from 1979-1993 by analyzing three five-year cohorts (1979-1983, 1984-1988, and l989-1993). Secondary data analysis (SED/CI) reveals that 68.3% of 1979-1983 NSF fellows and 73% of 1984-1988 NSF fellows completed the Ph.D. within 11 years of entering their graduate programs.

Ph.D. Completion Rates for NSF Fellows Completing in 11 Years or Less

1979-1983 Cohort	**68.3%**
1984-1988 Cohort	**73.0%**

To update findings from previous studies, WestEd compared Ph.D. completion rates for GRF applicants who are assigned to different Quality Groups during the selection process. Past studies have compared QG2 fellows and non-awardees, although fellowship awards are not made on a random basis within this Quality Group (QG2). All applicants in Quality Group 1 (QG1) receive fellowships based strictly on competitive ratings. However, those applicants assigned to Quality Groups 2 and 3 (QG2, QG3) receive either a fellowship or an Honorable Mention based on competitive ranking plus other factors such as field of study, level of earned graduate credits, and geographic location of applicant's high school.

[1] Goldman, C. A. & Massey, W. F., 2001. *The Ph.D. Factory: Training and Employment of science and engineering doctorates in the United States* (Boston: Anker Publishing Company).

Looking at NSF fellows (QG1 and QG2) and QG2 non-awardees, we found consistent results in 11-year Ph.D. completion rates between the 1979-1983 and 1984-1988 cohorts. QG1 fellows (72% to 75%) continued to complete doctorates more often than QG2 fellows (65% to 69%), who in turn completed somewhat more often than QG2 non-awardees (63% to 65%). This pattern is consistent with findings of prior studies. We also found that while QG1 MGF fellows increased completion rates from 56% to 68% for the1984-1988 cohort, the QG2 MGF fellows saw a more modest increase from 46% to 51%.

We also compared completion rates by gender and found that women have substantially closed the completion gap with men.

- 11-year completion rates for women in the 1984-1988 cohort were 72%, compared to men at 74%.

- 11-year completion rates for 1984-1988 women fellows in most discipline areas are within ±6 percentage points of men's completion rates; however, there were much greater differences in computer science/math and social sciences.

- At the 6-year completion mark, WENG fellows (1990-1993) are completing doctorates at rates (40%) approaching those of all other fellows in Engineering (men and women) (45%).

We also found that the 11-year doctoral completion rate for MGF fellows increased more than it did for GF fellows.

Comparison of 11-Year Ph.D. Completion Rates

	1979-1983 Cohort	1984-1988 Cohort	Difference
GF Fellows	**71%**	**74%**	**+3**
MGF Fellows	**50%**	**61%**	**+11**
Men Fellows	**70%**	**74%**	**+4**
Women Fellows	**64%**	**72%**	**+8**

Despite faculty and student beliefs that GRF support may shorten the time to degree for NSF fellows compared to their peers, this is more perception than reality. While some NSF fellows think they will finish in less time because of the GRF, others indicate they choose more coursework or research experience over speedy completion. Such choices are made in relation to important contextual differences associated with graduate study in different disciplines and/or at different institutions, as well as those that stem from rapidly changing fields and job markets. Faculty and student estimates of time to degree ranged between five and six years across the programs that we visited, with only one Economics program indicating an average of six years for completion. However, in our analysis of SED/CI data, we found that fewer QG2 non-awardees than NSF fellows complete doctorates within six years, and that about one-third of NSF fellows who complete degrees within 11 years still take more than six years to earn doctorates. Faster does not necessarily mean better to all graduate students, and the benefits of the GRF freeing up discretionary time should not be underestimated.

Transition Point Three: Career and Life Choices of Graduate Students

The goal of NSF support for graduate study is to ensure the quality and diversity of the next generation of the SMET workforce. NSF fellows told us that having GRF is an asset in getting postdoctoral fellowships, securing research funding, and searching for a job. Although the likelihood of pursing faculty careers varied greatly by discipline, Disciplinary fellows (56%) indicated that faculty advised them to pursue academic careers with somewhat greater frequency than did the Disciplinary peers (45%).

With the exception of Mechanical Engineering, the majority of Disciplinary fellows and more than one-third of the Disciplinary peers responding to the survey had positions in higher education. For a substantial number of respondents, however, these were postdoctoral positions or non-tenure track teaching appointments. Only in Economics were these early career appointments likely to be tenure track faculty positions, where 64% of the Disciplinary fellows and 35% of their peers had tenure track appointments. In the other fields represented in our study, very small percentages of NSF fellows or peers were in tenure track faculty positions at the time of the survey.

We found that career choices shift during graduate school. Many graduate students 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 choose academic careers at teaching institutions over research universities. Many men and women view life at research universities in negative terms due to academic politics, heavy work demands, or the challenges of balancing an academic career and family life.

Both NSF fellows and peers are increasingly likely to pursue careers in government, business, and industry, and most respondents indicated their primary responsibilities were research and development (R & D). However, there are disciplinary differences, with 76% in Mathematics, 75% in Economics, 62% in Mechanical Engineering, and 60% in Biochemistry reporting R & D emphasis in their positions. Fewer than 10% of NSF fellows in each discipline indicated teaching was their primary responsibility.

Recommendations

Given the high level of national regard that the GRF Program continues to garner, we offer recommendations 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 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 day-to-day operation of the GRF Program, which is widely regarded as a well-run program.

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.

Tactical Recommendations

- **Increase GRF Stipend and Cost of Education Allowance**
- **Create an Allowance for Related Education Expenses**
- **Announce GRF Winners Sooner**
- **Maintain or Expand Use of the On-line Application Process**
- **Foster Development of an NSF Fellows Network**
- **Remove the First-year Deferral Prohibition**

- ➢ Increase the GRF stipend and cost of education allowance to ensure that the award continues to convey to its recipients the national honor that currently accompanies it by providing an adequate level of financial support.

- ➢ Create an allowance for related education expenses such as travel, books, and computers.

- ➢ Announce GRF winners sooner to increase the likelihood of the GRF influencing admission decisions and financial support packages.

- ➢ Maintain or expand use of the on-line application process since students find it efficient.

- ➢ Foster the development of an NSF fellows network using a combination of on-line and in-person arrangements, regarding issues of fellowship use, graduate school experience, careers, research, teaching, and job search.

- ➢ Remove the first-year deferral prohibition to allow fellows the flexibility to use the three years of support to their best advantage during the five-year period.

Strategic Recommendations

- **Change the Number of Years of Support**
- **Eliminate the Eligibility Cap on Prior Graduate Units**
- **Restructure the Selection Process to Expand Access**
- **Collaborate with Other NSF Programs**

➢ Change the number of years of support to emphasize support of graduate-level, not primarily doctoral-level, studies. Changing job markets in fields like engineering and biochemistry have led to an increased demand for master's level members of the SMET workforce.

➢ Eliminate the eligibility cap on prior graduate units to support career transitions and/or later entry to graduate programs.

➢ Restructure the selection process to expand access for applicants from a broader range of undergraduate institutions by allowing multiple ways for applicants to demonstrate their capacity to engage in research.

➢ Collaborate with other NSF Programs to develop joint strategies to boost the numbers from underrepresented minorities who apply for and win the GRF.

GRF Program Changes

Since the initial draft of this report was submitted to NSF, there have been substantial changes in the Graduate Research Fellowship Program, including increasing the annual stipend and the cost of education allowance. In addition, revised eligibility criteria allow more advanced graduate students to apply for the GRF and increase the flexibility of fellowship use. The changes are in line with several of the tactical and strategic recommendations found in this report.

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PREFACE

This report is presented to the Division of Research, Evaluation and Communication (REC) of the National Science Foundation (NSF) in compliance with contracts REC-9452969 and REC-9912174.

From 1998 through 2000, WestEd conducted an evaluation of the NSF Graduate Research Fellowship (GRF) Program that included secondary data analysis, surveys of samples of fellowship recipients and their peers, and institutional site visits to six major research universities. We appreciate the generous assistance of the university staff who helped us locate survey recipients and arrange the site visits. We would also like to thank survey respondents for participating in the survey and faculty, administrators, staff, and students we interviewed during site visits for their hospitality and cooperation.

Data from the Survey of Earned Doctorates (SED) and the Association of American Universities (AAU) and Association of Graduate School (AGS) Doctoral Education Database were critical in conducting the completions analysis and identifying comparison groups of doctoral students. We wish to thank Lance Selfa of the National Opinion Research Center (NORC) for providing SED data runs for the doctoral completions analysis. Our thanks also to Rocco P. Russo, Director of the AAU/AGS Project for Research on Doctoral Education at the Educational Testing Service and the participating graduate schools for access to Project data used to identify program peers. We appreciate the advice on study design received from members of the GRF Panel of Experts: Maresi Nerad, Willie Pearson, Albert Teich, Peter Syverson, and Mary Golladay. We would like to thank staff of NSF's Division of Graduate Education for their time and thoughtfulness in framing the evaluation questions, providing GRF program data, and reviewing drafts of this report, including: Susan Duby, Richard Metcalf, Janet Rutledge, and Eric Sheppard. We also appreciate the support and guidance provided by Conrad Katzenmeyer and Deh-I Hsiung, REC program officers on this evaluation.

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INTRODUCTION

WestEd conducted an evaluation of the National Science Foundation's Graduate Research Fellowship (GRF) Program. The evaluation was designed to provide information useful to ongoing NSF efforts to strengthen its programs and support the agency's commitment to make optimal use of its resources across program options that address its goals. This report provides findings related to the GRF Program's overall effectiveness in meeting program objectives. To enhance the evaluation's usefulness to NSF, we also examine important contextual issues surrounding the educational experiences and career directions of graduate students to understand how they shape the overall impact of the GRF Program. We consider the implications of GRF Program effectiveness and the contextual issues surrounding the program vis-à-vis the overarching purposes of the GRF Program and those of the Education and Human Resources Directorate within which it is housed.

Taking this more macro perspective is intended to afford NSF the opportunity to confirm and/or strengthen the goodness-of-fit between its programs and goals. We begin by placing the Graduate Research Fellowship Program in its historical and organizational context and then discuss its intended role and contribution within the current science, mathematics, engineering, and technology (SMET) research and education reform landscape.

The National Science Foundation Act of 1950 (PL 810-507) established NSF as a Federal agency, with the mission "to promote the progress of science, to advance the national health, prosperity, and welfare; and [to promote] other purposes" (NSF, 1997b, p. 2). Activities and programs authorized to receive NSF support include:

1. basic scientific research and research fundamental to the engineering process,

2. programs to strengthen scientific and engineering research potential,

3. science and engineering education programs at all levels and in all of the various fields of science and engineering,

4. programs that provide a source of information for policy formulation, and

5. other activities to promote these ends. (NSF, 1995, p. 11)

Since the agency's inception and through its program portfolio, the NSF has served as an effective catalyst for the nation's continued progress in the areas of science, mathematics, engineering, and technology research and education. It has done so by functioning primarily as an investment agent, awarding merit-based grants and contracts to public and private institutions and individuals throughout the U.S. to support investments in three broad functional categories:

research projects (55% of NSF budget), research facilities (19%), and education and training (20%). The remaining 6% of the agency's budget of approximately $3.773 billion support its administration and management.

According to NSF's *GPRA* [Government Performance and Results Act] *Strategic Plan FY 1997-FY 2003*, the agency expects its investments to produce, collectively and over time, five outcomes (NSF, 1997b, p. 3):

1. Discoveries at and across the frontier of science and engineering;

2. Connections between discoveries and their use in service to society;

3. A diverse, globally oriented workforce of scientists and engineers;

4. Improved achievement in mathematics and science skills needed by all Americans; and

5. Timely and relevant information on the national and international science and engineering enterprise.

All NSF proposals and awards are managed through eight program directorates, each with a distinct purpose that supports the agency's overall mission. The GRF Program is housed within the Education and Human Resources (EHR) Directorate, the purpose of which is to provide national leadership in improving SMET education by supporting reform at all levels of the education system and strengthening education pipelines. Specifically, the GRF Program is situated within the EHR Directorate's Division of Graduate Education (DGE), which promotes the early career development of scientists and engineers in order to ensure a steady flow of diverse, high-ability graduates to the nation. DGE seeks to accomplish this aim by providing fellowships and traineeships for graduate and postdoctoral study.

The Graduate Research Fellowship Program was established in 1952, making it one of the agency's oldest programs. Its intent is to promote the strength and diversity of the nation's scientific and engineering base by offering recognition and awarding three years of financial support to approximately 900 outstanding graduate students annually. Support takes the form of a portable stipend and a cost-of-education allowance that the NSF fellow can use at the institution of his/her choosing. The three years of support must be used within a five-year period, and fellows may elect to go on reserve status with NSF for up to two years during this period.

The Minority Graduate Fellowship (MGF) competition awarded fellowships to highly qualified underrepresented minority applicants from 1978 to 1998 to promote increased diversity within SMET fields. The GRF Program also offers fellowship awards to enhance the participation of women: Women in Engineering (established in 1990) and Women in Computer and Information Sciences (established in 1994) in both the Graduate Fellowship (GF) and Minority Graduate Fellowship (MGF) competitions. The MGF competition was discontinued in 1998.

Of the five outcome goals specified in the NSF Strategic Plan, the GRF Program most directly supports Outcome Goal 3: A diverse, globally oriented workforce of scientists and engineers. The performance goals associated with this outcome goal as identified in the FY 1999 GPRA Performance Plan are as follows:

> NSF is minimally effective when: opportunities and experiences of students in NSF-sponsored activities are comparable to those of most other students in their field; and when the participation of underrepresented groups in NSF-sponsored science and engineering projects and programs increases. NSF is successful when: participants in NSF activities experience world-class professional practices in research and education, using modern technologies and incorporating international points of reference; when academia, government, business, and industry recognize their quality; and when the science and engineering workforce shows increased participation of underrepresented groups. (NSF, 1998, p. 7)

In light of these performance goals, key to evaluating the GRF Program's effectiveness is assessing the extent to which there exists evidence of the program's contribution to both the quality and diversity of the SMET workforce. However, as noted in the Strategic Plan:

> External factors have a significant impact on NSF's [and GRF Program] performance. In particular, the circumstances of our institutional partners in academia, the private sector and the government affect how the individuals [supported by NSF programs] are able to respond in both proposing and conducting research and education activities. (NSF, 1997b, p. A1-2)

With regard to the specific goal of ensuring a diverse, globally oriented SMET workforce, the Strategic Plan goes on to caution:

> The characteristics of the workforce of scientists and engineers are highly dependent on the systems through which they are educated and trained. While NSF can influence these systems through the types of proposal solicitations generated and types of awards made, the agency does not control them…. NSF programs influence educational systems and the public that supports them, but are only one influence among many. (NSF, 1997b, p. A1-3)

Therefore, to be maximally meaningful and useful, an evaluation of the NSF Graduate Research Fellowship Program must attend to more than just standard program processes (fellowship application and selection procedures) and outputs (numbers, demographics, completion rates, and career accomplishments). In addition, contextual factors that lie beyond the direct influence of the program, but that nonetheless affect its operation, should be identified and addressed. During the course of this study, we noted several such external factors, and this report speaks to the ways, for better or worse, they have an impact on the GRF Program's ability to fulfill its goals.

THE EVALUATION STUDY

WestEd conducted a multiple method study of the NSF Graduate Research Fellowship Program designed to update information on program outcomes and assess the contributions of the GRF Program to NSF goals. The last cohort of NSF fellows to be included in an analysis of outcomes was 1981 fellows, and both the science and engineering environment and the university context of graduate education have changed dramatically in the past two decades. The study included both GRF Program competitions, which award fellowships to Graduate Fellows (GF) and Minority Graduate Fellows (MGF). Additionally, Women in Engineering (WENG) award recipients were included. The purpose of the GRF Program evaluation is to provide data on program effectiveness that will be useful to ongoing NSF efforts to strengthen its programs and support the agency's commitment to make optimal use of its resources across program options that address its goals. WestEd was assisted in study design by NSF program staff and a panel of experts (Appendix A).

Previous Studies

The National Research Council (NRC) has conducted four major studies of outcomes of the GRF Program (Harmon, 1977; Snyder, 1988; Baker, 1994, 1995). Outcome indicators have included traditional measures of academic career success such as completion rates, time to degree, subsequent academic appointment, success in obtaining research grants, and, in the first study, publications and citations. These studies looked at completion rates and career plans of cohorts of new NSF fellows (1952-1972; 1967-1976; 1972-1981; and 1979-1981 cohorts respectively). They used NSF's annual Survey of Earned Doctorates (SED) to track completion rates and time to degree of fellows by gender, ethnicity, and discipline. As a comparison group, the Snyder and Baker studies used GRF applicants who were assigned to Quality Group 2[2] but who were not awarded fellowships.

All of the National Research Council studies used a measure of program quality to assess the stature of fellows' graduate programs as well as the quality of subsequent academic appointments. The measures of success and explanations for differences in outcomes for different groups relied on existing databases, especially the SED, NSF/NIH (National Institutes of Health) postdoctoral and research grant files, and the sample of NSF fellows included in the Survey of Doctorate Recipients (SDR).[3]

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[1]GRF applicants in each competition are assigned to quality groupings during the review process. There are four quality groupings: Quality Group 1s receive fellowship awards; Quality Group 2s and Quality Group 3s receive either awards or Honorable Mentions; and Quality Group 4s do not receive either awards or Honorable Mentions. All applicants in Quality Group 1 receive fellowships based strictly on competitive ratings. However, those applicants assigned to Quality Groups 2 and 3 receive either a fellowship or an Honorable Mention based on competitive ranking plus other factors, such as field of study, level of earned graduate credits, and geographic location of applicant's high school.

[2]The Survey of Doctorate Recipients is a longitudinal survey. The primary source of the sampling frame is the SED. The target population and sample frame consist of all individuals under the age of 76 who received a research doctorate in science or engineering from a U.S. institution and were residing in the United States on April 15 in the year of administration (biennial). Recipients of research doctorates are added each time the survey is conducted, and those individuals over age 75 are dropped. A total of 50,000 individuals with research doctoral degrees in science and engineering were included in the 1995 survey. Approximately 15% of NSF fellows who complete their degrees are included in the SDR sample.

The four NRC studies confirmed that the students supported by the GRF Program are well qualified, attend outstanding graduate programs, complete their degrees in a shorter time than the comparison group of non-awardees, and are likely to become successful scientists and engineers. An "award" effect was identified because Quality Group 2 awardees achieved greater success than did Quality Group 2 non-awardees. However, such a conclusion implies comparability between these two groups that may not supported by the selection process. More recent NRC studies also reported that the large gender differences in career outcomes found in earlier studies appeared to be disappearing.

The authors of these studies acknowledged limitations in the data used in the reports and suggested additional approaches and follow-up questions. Harmon (1977) devoted an appendix to suggestions for a more comprehensive study, including collecting information to address the reasons for individuals' decisions and information on the impact of the GRF Program on the academic community. Another problem was the use of appropriate measures of success for NSF fellows and the GRF Program. The NRC reports used several traditional measures of success in academic careers such as appointments to faculty positions and publications and citations. Snyder (1988) noted the "limited nature of measures used for career outcomes"[4] and suggested that "more adequate responses could be obtained through direct follow-up with a sample of fellows and a matched sample of non-awardees" (p. 166). Baker (1995) commented that "further efforts to deepen our understanding of these disturbing statistics [low completion rates for African-American fellows] will be necessary in order to formulate appropriate policies to deal with them" (p. 28).

NSF also funded a comprehensive assessment of the effectiveness of the GRF Program that used secondary data analysis. The focus of the report (Sween, 1982) was on traditional outcome measures of academic career achievement, including degree completion, time to degree, securing academic positions, receipt of research grants, supervision of dissertations, and publications/citations. Findings confirmed the value of the GRF Program in contributing to scientific career achievements.

There were two reports prepared by NSF about the GRF Program that focused on the MGF competition and addressed an important NSF policy concern, the diversity of the SMET workforce. An internal preliminary report on the first four years of the MGF competition (Johnson, 1987) offered an overview of participants, the institutions they attended, and the results to date of their academic achievements. Of interest in this report is the finding that the first cohort (1978-1981) of MGF recipients differed significantly from their GF counterparts:

> In addition to the predictable differences in the ethnic composition of Fellows in each program, the Graduate Fellows were younger, there were proportionately more males, and a larger percentage were majoring in the natural sciences versus the social sciences.
> On the other hand, a larger percentage of Minority Graduate Fellows had previous graduate work at the time of application. (p. 3)

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[4] Appointments to faculty positions are obtained from the National Faculty Directory, which uses data from college catalogs and questionnaires. There is a problem with coverage, as well as with identical or ambiguous names (Snyder, 1989, p. 176). The data on research support cover only NSF/National Institutes of Health/Alcohol, Drug Abuse, and Mental Health Administration awards. Because of the difficulty in using publications and citation data that are available from the Institute for Scientific Information databases, only the Harmon (1977) study used that information. And finally, no information is available on those pursuing non-academic research careers (with the exception of a small number of fellows who are included in the longitudinal Survey of Doctorate Recipients).

Legacy for Tomorrow (NSF, 1988) documented the stories of 51 MGF recipients who received their awards in 1986 or earlier and included a discussion by a panel of leaders in higher education. Two things are particularly striking about this account compared to the formal NRC studies of the GRF Program. First, the individual stories of the MGF recipients included their struggles and the importance of the NSF fellowship to their educational experiences and career choices. Second, attention was given to the context of graduate education and how the MGF awards made an impact on issues such as breaking down the barriers to graduate study in science and engineering for underrepresented groups.

In his introduction to *Legacy for Tomorrow*, NSF Director Erich Bloch wrote:

> The Minority Graduate Fellowship Program, which is highlighted in this publication, addresses the first and most crucial component of our science and engineering base–people. It is no secret that there are alarming shortages of graduate level engineers, mathematicians, and scientists. It is also no secret that certain groups remain, unfortunately and to our nation's cost, underrepresented in these ranks. (p. vi)

Although the MGF competition was discontinued in 1998, the GRF Program continues to play an important role in achieving the NSF goal of diversity in the SMET workforce.

Evaluation Questions

The purpose of the NSF Graduate Research Fellowship Program is to ensure for the nation the future stream of highly qualified scientists and engineers to undertake research and development. Inherent in this purpose is the commitment to a diverse workforce that includes participation of women and underrepresented minorities in successful careers in science and engineering. This study was designed to update findings regarding program outcomes through traditional measures such as those used in earlier studies, and provide new information on recent NSF fellows. The evaluation questions that guided this study are:

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

- How do the academic qualifications of NSF applicants and fellows compare to non-applicants in the same academic programs?
- Are other funding opportunities more attractive to graduate students and why?
- What are the quality characteristics of institutions chosen by NSF fellows?

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

- Do NSF fellows demonstrate higher degree completion rates and shorter time to degree than non-fellows do?
- What GRF Program or institutional factors contribute to success?
- Do NSF fellows show more evidence of early publication success?
- Do NSF fellows show more evidence of early research success?
- Do NSF fellows accomplish non-traditional activities that demonstrate excellence in scientific and engineering research in new ways?

Do GF and MGF recipients experience similar educational and career success?

- Do MGF recipients complete degrees at the same rates and in comparable time to other fellows, or their peers?
- Do MGF recipients experience similar early career success to other fellows, or their peers?
- Do recipients of the Women in Engineering and Women in Computer and Information Science awards have similar patterns of success compared to other fellows?

What factors contribute to differences? Does the individual award aspect of the NSF Graduate Research Fellowship enhance the educational experience and career options of fellows?

- Does receipt of an NSF fellowship change a fellow's enrollment choices?
- Does individual funding enhance the graduate experience and access to career opportunities?

Methodology

The study used multiple methods to answer the evaluation questions: secondary data analysis, administration of a survey questionnaire, and interviews from institutional site visits. The design builds on strengths of prior studies that used existing data sources but also addresses their weaknesses by employing both quantitative and qualitative data collection methods. For details of the methods employed for data collection and analysis, see Appendix B, Methodology.

Secondary Data Analysis of Attendance Patterns and Completions

We matched the Cumulative Index (CI)[5] to the Survey of Earned Doctorates from 1999 to measure attendance patterns, completion rates, and time to degree of NSF fellows who received first-year awards between 1979 and 1993. We included the 1979-1981 cohorts, even though they were also included in the two most recent studies (Baker, 1994; 1995) in order to update the completion data. Since the Minority Graduate Fellowship competition also began full implementation in 1979, starting then allows a nearly complete analysis of MGF recipients through 1993. Program quality rankings were obtained from the National Research Council's most recent study of doctoral programs (National Research Council, 1995). As in prior studies, we compared the performance of NSF fellows to non-awardees in the Quality Group 2 category. We examined differences by discipline grouping, gender, program quality, and GF and MGF competitions.

The Graduate Student Follow-up Survey

The Graduate Student Follow-up Survey (Appendix C) included items on educational background and experience, careers, and financial support during graduate school. In order to allow for comparison, the survey questionnaire contained some questions included in a recent University of California, Berkeley study that was administered to a sample of 1982-1985 Ph.D. completers in several disciplines. We also reviewed findings of the Berkeley study for the 107 NSF fellows included among the 6000 doctoral recipients surveyed (Cerny & Nerad, 1999).

By selecting cohorts of NSF fellows and program peers who *entered* their graduate programs between 1989 and 1993 we were able to gather data from respondents who did not complete graduate programs to discover reasons for not completing degrees and to gather information on their career paths. Although some respondents were still enrolled in graduate programs, most had transitioned from graduate school to postdoctoral study or employment. This enabled us to capture experiences of recent graduate students, including those who chose to leave their graduate programs without completing.

We sent the Graduate Student Follow-up Survey questionnaire to the following three samples:

1. **Disciplinary Sample**: NSF fellows (termed Disciplinary fellows in this report) and a comparison group of program peers (Disciplinary peers) in four disciplines at 16 institutions who entered the same programs from 1989 to 1993 (sample=1131)

2. **Minority Graduate Fellows Sample**: 35% of all MGF fellows from 1989-1993 (sample=200)

3. **Women in Engineering Sample**: 50% of all WENG recipients from 1990-1993 (sample=143) (WENG began in 1990. Since 1994, additional awards have also been made to women in Computer and Information Sciences. We did not include computer science recipients because these awards began after our survey cohort period, 1989-1993.)

[5]The Cumulative Index of NSF Fellowship Applicants and Awardees contains information on all applications to the NSF GRF Program, including applicant demographics, educational data, test scores, and fellowship status.

The analysis was conducted by sample. Although we found differences between NSF fellows and program peers and differences across disciplines, these differences did not attain statistical significance. However, findings suggest areas for further exploration of the differences reported here. Care should be taken when looking at findings across samples because of the significant disciplinary and institutional differences in the samples and because there were some respondents included in more than one sample.

The Disciplinary Sample

The Snyder (1988) and Baker (1994, 1995) studies as well as our secondary data analysis used Quality Group 2 non-awardees as the comparison group. The strength of this approach is that those in the comparison group went through the same fellowship review process. Having done so, the Quality Group 2 non-awardees were considered comparable to fellows not only using such measures as Graduate Record Examination (GRE) scores but also with regard to their ability to write a strong research essay and the strength of personal recommendations.

There are also weaknesses to this approach. This comparison group is limited to individuals who applied for an NSF graduate fellowship, and it does not reflect a random assignment based on selection criteria. Furthermore, Quality Group 2 non-awardees are not necessarily enrolled in the same graduate programs as NSF fellows, allowing institutional effects to intrude into the design. Finally, GRF applicant eligibility requirements also influence this non-awardee comparison group since many SMET students are ineligible, including international students and those who already hold advanced degrees.

We identified a database that allowed the selection of a comparison group that is not limited to NSF applicants. Since 1989, the American Association of Universities (AAU) and the Association of Graduate Schools (AGS) have been working with the Educational Testing Service (ETS) on a database on doctoral students. The resulting AAU/AGS Doctoral Education Database contains data on doctoral students entering graduate programs since 1989, including graduate students from 40 institutions in four NSF disciplines: Biochemistry, Economics, Mathematics, and Mechanical Engineering. The AAU/AGS database includes GRE scores and undergraduate institution, but it does not contain personal recommendations or other materials that are taken into account in the awarding of GRF fellowships.

We used the AAU/AGS database to identify program peers entering the same graduate programs as NSF fellows in the same years. Anticipating a lower response rate from non-NSF fellows, we administered the Graduate Student Follow-up Survey to all NSF fellows (GF and MGF recipients) and a sample of two program peers for each fellow (2X sample) (sample=1131) in the disciplines of Biochemistry, Economics, Mathematics, and Mechanical Engineering at 16 institutions (Appendix D). The pool for the "program peers" comparison group included all students who began the same graduate programs at the same time as the NSF fellows but who did not receive (and may not have applied for) an NSF Graduate Research Fellowship.[6]

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[6]The 16 institutions included 15 participants in the AAU/AGS database that was used to sample the program peers and one non-participating institution with a large number of NSF fellows that agreed to provide comparable data and a program peer sample. With this exception, we only included those institutions that participated in the database and had at least two NSF fellows entering programs in the four disciplines from 1989-1993.

Locating survey recipients proved to be a very difficult task. NSF does not track former fellows, and although most of the 16 institutions provided mailing addresses to us, many of these were no longer valid. We sent two post card follow ups to individuals whose questionnaires were not returned completed or marked undeliverable. We hired a private investigation firm to further search for current addresses, but some individuals still could not be found. More than three-quarters of those we could not locate in this sample were program peers. Discounting the individuals we could not contact (194 or 17.15%), our response rate for the Disciplinary Sample was 41.41%. Completed surveys received from 200 NSF fellows (55.71%) and 188 program peers (32.53%) have been included in the analysis for this report.

MGF Sample

We were concerned that the Disciplinary sample would not include sufficient numbers of fellows from the Minority Graduate Fellowship competition to provide us with good data on the experience of MGF recipients. To increase responses from NSF fellows from underrepresented groups, we administered the same Graduate Student Follow-up Survey to 200 MGF recipients (35% sample), regardless of discipline or institution enrolled in. The MGF sample was randomly drawn from the Cumulative Index for 1989-1993. There is no comparison group for the MGF sample.

The MGF sample included fellows in 33 disciplines at 62 institutions. Each institution was asked to provide a current mailing address, but as with the Disciplinary sample, many addresses were no longer valid. We employed the same follow-up and search procedures, and discounting individuals we could not contact (25 or 12.50%), the response rate was 49.71%. Questionnaires were received from 87 MGF recipients. The MGF sample was analyzed independently of the Disciplinary sample.

WENG Sample

In 1990, the Directorate of Engineering began providing funding to the GRF Program for additional fellowships for women pursuing graduate education in engineering. These additional fellowships were awarded in both the GF and MGF competitions. In order to see how the WENG recipients have fared, we also administered the Graduate Student Follow-up Survey to 143 WENG recipients from 1990-1993 (50% sample). The WENG sample was randomly drawn from the Cumulative Index for 1990-1993 and included NSF fellows in various sub-fields of engineering at 46 institutions–not just Mechanical Engineering, the field used for the Disciplinary sample. There is no comparison group for the WENG sample.

Each institution provided addresses for WENG fellows. After using the same follow-up and search procedures and discounting individuals we could not contact (18 or 12.58%), the response rate was 68.00%. Questionnaires were received from 85 WENG recipients. The WENG sample was analyzed independently of the Disciplinary sample.

Institutional Site Visits

We conducted site visits at six major research universities that will be identified as Institutions A-F.[7] Four of these universities enroll very large numbers of NSF fellows, and the other two were selected for institutional and geographical balance. The six institutions included two private and four public universities located in the Northeast (1), Southeast (1), Midwest (1), and on the West Coast (3). The two private institutions enroll more graduate students than undergraduate students, and the six universities range in total enrollment from 10,000 to 40,000. In the academic year of the site visits (1998-1999), these universities individually enrolled between 38 and 293 NSF fellows in all programs and, taken together, enrolled 962 NSF fellows. Five of the six universities we visited were also included in the survey for the Disciplinary sample. At the six institutions, we interviewed 75 administrators, faculty, and staff and 149 students (73 NSF fellows and 76 peers) in 19 departments that correspond to the four disciplines in the Disciplinary sample. Interview protocols may be found in Appendix E.

What Did We Find?

The NSF Graduate Research Fellowship Program continues to fund highly qualified graduate students and is considered to be a very prestigious award. However, the 1998-1999 stipend ($15,000/year for 3 years) and the cost of education allowance ($9,500/year for 3 years) levels are considered too low for prevailing costs. Other fellowship programs are more attractive because they offer higher stipends, expense allowances, full tuition reimbursement, more years of support, and/or networking opportunities. Unlike many of these other graduate fellowship programs, the GRF is much larger, involves a national competition, and supports more students for graduate study in a greater variety of fields. The GRF is most highly valued for its prestige and the choices it affords fellows. The GRF Program is also a major source of graduate student funding for some programs at top research universities.

A high percentage of NSF fellows complete the Ph.D. However, we found that despite qualifications and financial support, 32% of 1979 to 1983 NSF fellows and 27% of 1984 to 1988 NSF fellows did not complete the Ph.D. within 11 years of entering their graduate programs. Furthermore, a gap in completion rates remained between GF and MGF recipients, although this gap appears to have narrowed. We also found that 11-year completion rates for women are approaching those of men. WENG fellows' 6-year completion rates are lower than Ph.D. completion rates for all other fellows (both men and women) in Engineering.

The Graduate Education Follow-up Survey and institutional site visits gave us the opportunity to probe the reasons for choices made by students as well as to discover institutional and program factors that influenced decisions. We found a highly complicated world of graduate education populated by real people coping with the challenges and changes of the late 20th century. Costs of graduate education have grown dramatically, and graduate students are more diverse, reflecting major changes in American society. When NSF and the Graduate Research Fellowship Program were created nearly 50 years ago, it was literally a different world.

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[7] In this report, site visit institutions are referred to as Institution A through F. References to other institutions will read Institution X. To reference quotations from site visit reports, disciplines are abbreviated as follows: BIO for Biochemistry, EC for Economics, M for Mathematics, and ME for Mechanical Engineering.

Higher education in the United States is a world of hierarchy, dominated by those institutions that receive the most funding for research and have faculty with reputations for high levels of research productivity. Among those institutions previously classified Research University 1 or 2 by The Carnegie Foundation for the Advancement of Teaching (Carnegie, 1994), there is also a reputational hierarchy. The National Research Council (NRC) ranks individual graduate programs in research universities using reputational measures (NRC, 1995).

Competition among top ranked programs for the best graduate students is fierce. Equally important, however, is the competition for admission to top programs because the prestige of graduate program and advisor are key determinants of initial appointment and academic career success (Clark, 1987; Smith, Wolf & Busenberg, 1996). Within institutions, there is a very high degree of decentralization that is particularly profound at the graduate level. Disciplines are the major determinants of the graduate experience, and there is significant variation within many disciplines (Bowen & Rudenstine, 1992). Disciplines change over time, subdividing but sometimes reorganizing around core themes. This has been true, for example, of Biochemistry.

Graduate education plays a critical role in the preparation of the academic, business, industry, government, and non-profit workforce in the United States. In 1996, for all science and engineering disciplines (excluding professional degrees), 28,458 doctorates and 131,436 master's degrees were awarded (NSF, 1999b). The nation's research and development funds support the work of both faculty and students. Over $13 billion of Federal funds went to universities and colleges for research and development in 1997 (NSF, 1998). NSF has been a major source of support for graduate education at universities that produce the research scientists of the future. NSF funding includes research grants to faculty that support graduate students who participate in funded research projects and graduate training programs.

Through the GRF, NSF supports graduate students in specified fields at institutions of their choice. NSF fellows study in a variety of disciplines, so their experiences and the impacts of the fellowship differ. We found this to be true for participants in the Graduate Student Follow-up Survey and NSF fellows interviewed during the institutional site visits. Graduate education in the United States is part of an interlocking system of higher education that includes complex dynamics, variation, and also key leveraging points. This report focuses on three transition points: entry, graduate experience, and career/life choices.

TRANSITION POINT ONE:
ENTRY INTO GRADUATE EDUCATION

We found that due to the timing of the GRF fellowship award announcement the GRF generally does not affect admission to graduate programs; however, being an NSF fellow may influence recruitment efforts by programs, including financial incentives to enroll. Recruitment and admissions are two edges of the same sword that guards the gateway to graduate education. Although some institutions we visited have campus-wide recruitment programs, especially those focused on underrepresented groups, the major locus of recruitment efforts and admissions decisions for graduate study is at the department or program level. Faculty are keenly interested and involved in selecting each cohort of graduate students. We heard repeatedly how important it is to attract and enroll top students, in part because good students help graduate programs recruit and retain top faculty.

In the programs we visited, selection is highly competitive. Faculty and staff know very well the other programs they compete with for top students, frequently describing the admissions and recruitment arena in market terms indicating that they offer as much as they can to be competitive. This dimension of the academic marketplace sets the stage for future employment competition as well, a fact not lost on students seeking admission to the highest ranked programs.

Decisions on whether or not to apply to graduate school, where to apply, and which fellowships to apply for, are influenced by many factors, including perceptions about chances of success. The reputations of graduate programs and faculty are also important factors. For NSF fellows and their peers, reasons for enrolling in a particular program ranged from academic quality to personal preferences. The timing of the admission decisions, GRF award announcements, and enrollment choices makes recruitment strategies of some programs important factors in enrollment decisions. Since NSF fellows continue to be admitted to, enroll in, and complete degrees in highly ranked graduate programs, the selection criteria for the GRF Program appear to be consistent with the criteria used by top graduate programs.

Undergraduate Institutions

NSF fellows and their peers are most likely to have been undergraduate students at research universities. By 1993, more than 69% of Graduate Fellows (GF) received baccalaureate degrees from RU1 institutions[8], up from 62% in 1979. For Minority Graduate Fellows (MGF) this

[8] RU1 institutions are those that are classified as institutions offering a full range of baccalaureate programs, committed to graduate education through the doctorate, and give high priority to research. They award 50 or more doctoral degrees each year. In addition, they receive annually $40 million or more in Federal support. Other terms used in this report include RU2 (receiving between $15.5 million and $40 million per year in Federal support); Doctoral (awarding at least ten doctoral degrees in three or more disciplines, or 20 in one or more disciplines); and LA1 (primarily undergraduate institutions awarding 40% or more of their baccalaureate degrees in liberal arts fields and that are selective in admissions). (Carnegie Foundation, 1994)

change was even greater, from 33% in 1979 to 66% in 1993. Not only are recent GRF applicants increasingly more likely to have obtained their bachelor degrees from RU1 universities, these applicants continue to have higher fellowship award rates than applicants from other types of institutions. Furthermore, applicants and fellows are likely to come from a select group of those RU1 institutions. Seventeen percent (17%) of all GRF applicants come from ten institutions of baccalaureate graduation, representing almost one-third of applicants from the 88 RU1 institutions.

The institutions of baccalaureate graduation for GF fellows are even more concentrated, with 30% coming from ten institutions. The top three institutions of baccalaureate graduation for applicants to the MGF program and MGF fellows are Hispanic- or African American-serving institutions. Ten institutions of baccalaureate graduation produced 27% of MGF fellows. We found that institutions of baccalaureate graduation were even more concentrated when we broke the data down by disciplinary area. For example, almost one-quarter of 1979-1993 GRF fellows in the Social/Behavioral Sciences (SBS) graduated from five undergraduate institutions, as did one in five fellows in Engineering/Math/Physical Sciences (EMP) (Table G1).

In the 19 graduate programs we visited, those NSF fellows and peers interviewed who had attended U.S. institutions as undergraduates were most likely to have graduated from RU1 institutions (76.4% of fellows; 69.8% of peers).[9] Peers who attended U.S. undergraduate institutions were more than twice as likely to have graduated from colleges and universities that do not offer the doctorate (8% of fellows compared to 19% of peers). Admission to these highly ranked graduate programs is very competitive, and there appears to be a clear advantage to having attended a research university as an undergraduate. As we will see, this is an even greater advantage for receiving GRF support.

The Graduate Admissions Process

For undergraduates, admission to top graduate programs is a process that begins in the junior or early senior year of college. Application deadlines vary by institution and even by graduate programs within institutions, but they typically occur in the fall of the year. As part of the process, students usually take the Graduate Record Exam (GRE), secure letters of recommendation, and complete separate applications, which often include personal essays, for each program. The decision of where to apply is a critical point in this process. Decisions are influenced by undergraduate faculty and advisors, peers, and family as well as by the student's perception of the graduate programs and chances of acceptance.

For the graduate programs, this is also a critical point, and faculty committees spend endless hours reviewing applications. Most of the programs that we visited encourage top applicants to visit the campus to meet with faculty and students. The university and/or department may even pay for part or all of the travel expenses. Sometimes these visits are coordinated in official

[9] However, 13 peers and one NSF fellow had attended foreign universities that are not classified by the NRC.

weekend open houses where many hopeful applicants come to campus, and there are formal and informal activities and opportunities to learn more about the graduate program. Recruitment is an increasingly important function, particularly for programs that hope to increase the number of top students who enroll.

> Roughly 10% of applicants to the program were admitted this year. The program conducts two recruitment weekends per year where 18-20 students are brought in each time to visit the program. (E-BIO)

> The department has an active program for recruiting graduate students. It keeps records of students who inquire about its graduate programs and invites promising applicants to visit [Institution B] before admissions decisions are made. These visits are important to the department because it is competing for students against other quality graduate programs. Prospective students who visit the university have the opportunity to learn first-hand about its programs and what they offer. The department has found that it will not recruit the NSF fellow who has not visited the campus prior to the fellowships being awarded.... Faculty also observed that they have a tough time recruiting U.S. applicants. They have to increase stipends to be competitive with alternative choices, both other universities and corporations. Minorities are particularly hard to recruit since corporate American is also recruiting them. (B-ME)

> We woo every student. Each faculty member is given a set of students to be called. But the NSF students are wooed more. We supplement their stipend with an additional $1000 per quarter [for a total supplement of $3000]. (D-EC)

A major factor for both students and programs at this point is the availability of financial support. Particularly for Ph.D. programs that actually or in effect guarantee financial support for five years (on average), the availability of funds is critical. Here we found great differences among the disciplines, even on the same campus. We also found that admission for Biochemistry, Mathematics, and Economics graduate programs are for doctoral study, although some admit a limited number of master's students. However, in Mechanical Engineering, admission may be (and in the case of Institution D is only) for the master's degree, with a second screening before admission to the doctoral program.

Beyond applicant qualifications, availability of financial support affects admissions decisions. In fact, offers of admission are normally coupled with offers of financial support. These offers are frequently some combination of teaching assistantships, research assistantships, and fellowships. All six institutions have some form of university fellowship, some for all disciplines and others that are targeted (e.g., for science and engineering at Institution D), and some for all students and others for underrepresented groups. These fellowships are frequently used to lure top applicants to enroll and may be for one year only or for several years.

The timing of admission decisions limits any potential leveraging effect of a GRF award as well as the enrollment choices for NSF fellows. Admission and financial aid offers may be made at or immediately following campus visits in January-February. Most admission decisions and offers are made by early March. According to the guidelines of the Council of Graduate Schools, students have until April 15 to respond to offers of financial aid. Since the posting of GRF awards occurs in the third week of March, graduate admission decisions have been made and financial aid offers have been extended prior to the GRF award notification in the programs we visited. A subsequent GRF award usually requires a revision to the original financial aid offer. Institutional practices vary when an admitted student receives a GRF award. For example, at Institution B, every NSF fellow and all GRF applicants who receive an Honorable Mention (everyone in Quality Groups 1, 2, and 3) who are admitted to the university receive an offer of an additional $5000 per fellowship year**.** At Institution D, the top 100 science and engineering students admitted are awarded a generous university fellowship that is articulated with the GRF for a total of five years of support.

Graduate programs vary in the extent to which they actively pursue admitted students who have received a GRF.

> The department determines which of its admitted students have been awarded an NSF fellowship and then actively tries to recruit them to the university. The department from time to time supplements the NSF fellowship and Presidential Fellowship combination with funds from its own endowment. (B-ME)

> The department does not assertively pursue students it has admitted who are then awarded a GRF. It does contact them and congratulate them on their achievement. (F-BIO)

> The department does nothing special to encourage fellows to choose to enroll here-and acknowledges that it may lose some because of this. One administrator noted that "University X Medical School can buy students for another $1000, but we won't." (C-BIO)

> Staff matches students admitted to the NSF list and notifies recipients that [Institution D] will make up the difference in the cost of education. NSF fellows are invited to come to campus, and the Department pays for part of their travel. "We do actively recruit all NSF recipients.... Some of them don't know until they get my letter or e-mail that they got an NSF." (D-ME)

In cases of late admits or transfer students, having GRF support can influence admissions decisions, but this is not common. However, some students interviewed indicated that having the GRF did influence their admission to certain programs.

> He believes the fellowship was influential in getting him admitted to [University C] from [University X]…. Winning an NSF showed he “could compete with the entire world.” He was contacted by someone and was admitted after he received his fellowship. (C-M)

> Three of the four departments…did mention that receipt of a GRF might positively influence transfer and/or late admissions decisions. However, it was emphasized by most faculty that it would be unlikely for a student who has met the criteria for being awarded a GRF to be turned down via their standard admissions process. (A)

> Although admissions decisions are made prior to the posting of NSF awards, the Graduate Program Coordinator commented about NSF fellows: "We love them, would admit almost anyone with one. The evaluation process they use selects the kind of student we want.... There is more competition, and fellows can choose." (E-M)

NSF GRF Application and Selection Process

The GRF Guidelines for Submission of Applications provides information on eligibility, the application process, and conditions of awards to potential NSF fellows (NSF, 1997a). Generally the GRF is intended for students at or near the beginning of graduate study in science, mathematics, or engineering fields. However, Women in Engineering and Computer and Information Science awards and the Minority Graduate Fellowship competition allow applicants to have completed more units of graduate study than Graduate Fellowship awards. The application includes academic records, GRE scores, references, and application forms, including information on previous research experience and a research proposal.

During site visit interviews, we heard both positive comments and criticisms regarding the GRF selection process. Although some faculty and administrators questioned the criteria used for selection, NSF fellows are generally recognized as outstanding students, which validates the selection process.

> NSF fellows are seen as better students-they have been through two screenings, and the expectation is that they will “work out." (C-ME)

Concerning the eligibility criteria, we heard suggestions that GRF funds should be available to more advanced students who have had more exposure to research.

> The chair believes that the criteria used to select NSF fellows are not the best in terms of selecting students who will be skillful researchers because of the emphasis on academic coursework and test scores. He also believes that the timing of applications and awards should be changed to allow students to apply during their 2nd year and receive the fellowship in years 3-5 of their program in order to allow students a chance to gain meaningful research experience before applying for the fellowship. (A-BIO)

> The Senior Associate Dean also recommended that NSF consider providing opportunities to recognize “late blossoming stars”. He believed that by allowing students to apply in their second year of graduate school when they could be showing more promise would result in even better quality fellows than at present. (C)

Applying for the GRF

Applications for the GRF are due early in early November, almost a year before a student begins graduate study or at the very start of the first year of graduate study. Most survey respondents and students interviewed had heard about the GRF as undergraduates from faculty and peers. Others heard about the GRF from more informal sources, including family. More than one in four WENG and MGF fellows first learned of the program when already in graduate school.

As shown on Table 1, 91% of Disciplinary fellows knew of the GRF Program as undergraduates.

Table 1
Hearing about the GRF Program

	Disciplinary Peers	Disciplinary Fellows	WENG	MGF
Before becoming an undergraduate	2%	2%		1%
While an undergraduate	53%	89%	73%	72%
In first year of graduate school	31%	6%	21%	25%
Later in graduate school*	11%	2%	6%	2%
After graduate school*	2%	1%		

*An explanation for the fellows who indicate hearing about the GRF Program after the first year of graduate is that WENG and MGF fellows may apply after completing 30 semester hours or 45 quarter hours of graduate study. We have no explanation for how a Disciplinary fellow could hear about the GRF after graduate school.

We looked to see if there were differences among the discipline areas. Large numbers of the Disciplinary fellows heard about the GRF while undergraduates: 84% in Mechanical Engineering, 91% in Mathematics, 83% in Biochemistry, and 91% in Economics. For MGF fellows, 91% in Mechanical Engineering heard about the program while they undergraduates, compared to 75% of Mathematics fellows, 65% of Biochemistry fellows, and only 47% of Economics fellows. Information about the GRF Program is less likely to reach potential underrepresented applicants while they are still undergraduates, except in Engineering.

Graduate departments were influential for WENG fellows (cited by 30% of survey respondents.) For those Disciplinary fellows who applied as graduate students, graduate advisors were influential in the application decision. Several Biochemistry programs that we visited either required or formally encouraged first-year graduate students without external funding to apply for the GRF.

We asked those program peers who never applied for an NSF fellowship why they had not. Many were not eligible for the fellowship due to their citizenship status (37% non-U.S. citizens). Almost 30% did not think they would be able to win an award, and a similar number had other funding. Thus, most peers were not eliminated from the competition through lack of knowledge about the program, or by the effort involved in the application process.

The GRF Selection Process

After an initial eligibility screening, GRF applications undergo extensive panel review. About 260 faculty experts are convened each year for NSF by Oak Ridge Associated Universities into about 20 panels by subject area. For the Minority Graduate Fellowship competition, an additional group of 84 experts were convened into nine panels to review those applications. Reviewers are drawn from a wide range of institutions. Among the 1995 reviewers for the Graduate Fellowship, for example, the 261 panelists came from 157 different institutions, and no more than six were from the same institution. There were only seven members from three of the four institutions that enroll the largest numbers of NSF fellows. There also was a wide geographic distribution of panelists. One-fourth of the 255 panelists who provided race/ethnicity information were from underrepresented minority groups. Among MGF panelists for 1998, 58% of panelists were from underrepresented minority groups.

GRF Recipients–Who Applies and Who Becomes an NSF Fellow?

Table 2 shows application and award data for selected years for the Graduate Fellowship competition of the GRF program, and Table 3 provides similar data for the Minority Graduate Fellowship competition, which began in 1978 and terminated in 1998. The number of applicants to the GRF program has fluctuated quite widely over the almost five decades of its history. The success rate, or percentage of GF applicants receiving awards, has averaged 15.3%. The average success rate for applicants to the MGF competition has been 12.9%.

Table 2
Applications and Awards in Selected Years: GF Competition

Year	Number of applications	Number of new awards	Success Rate	Comments
1952	2685	569	21.2%	First year of program
1962	4977	987	19.8%	
1972	5005	550	11.0%	First year of new administrative procedure whereby fellows did not need to reapply each year
1982	2672	500	18.7%	Lowest number of applicants
1992	7723	740	9.6%	Highest number of applicants
1998	4851	766	15.8%	
1999	4796	900	18.8%	Most recent year

Table 3
Applications and Awards in Selected Years: MGF Competition

Year	Number of applications	Number of new awards	Success Rate	Comments
1978	72	43	58.0%	Program initiated
1979	520	65	12.5%	First full year of program
1992	1480	120	8.1%	Highest number of applicants
1998	720	134	18.6%	Last year of program

The number and characteristics of applications has changed over the history of the program (Tables G2 and G3). The percentage of all GRF applications from women has increased, as has the percentage of applications from underrepresented minorities. Women are less likely to be white and more likely to be African American than men who apply. The percentage of applications from individuals in all groups receiving bachelor's degrees from research (RU1) universities has increased substantially over the 15-year period. This percentage remained somewhat lower for applications to the MGF competition compared to the GF competition (Table G2), and for women compared to men (Table G3). Quantitative GRE scores for applications from women and for MGF competition applications increased significantly, as did Verbal GRE scores for MGF applications, from 1979 to 1993.

Application patterns by discipline have also changed over time. By 1993, almost as many applicants to the GF competition were applying in Engineering as the Life Sciences. In the MGF competition, applicants to Engineering exceeded those to other discipline groupings except the Social and Behavioral Sciences. The percentage applying to Math/Computer Science/Physical Science in the MGF competition doubled to 12%. The discipline grouping attracting the largest percentage of applications from women continued to be Life Sciences, although this is down from 1979. The percentage of applications from women in Engineering increased almost four-fold, from 5% to 19%. Among men, the most popular discipline by 1993 was Engineering. The largest decreases in applications are seen in the Physical Sciences and Life Sciences.

Overall trends in GRF recipients from 1979 to 1993 are similar to those of applications, with regard to gender and race/ethnicity:

- The percentage of women among GRF fellows has increased, from 29% to 43%. One quarter of the1993 women fellows were WENG recipients, accounting for 40% of this increase.

- The percentage of Caucasian, non-Hispanics receiving GF fellowships has declined, from 90% to 71%, showing increased diversity.

Over time, there have been changes in the disciplines chosen by fellows, with an increase in the percentage of engineers among GF fellows and a decreased in the percentage of biological/life scientists by 1993. Further, the dominance of Engineering is more pronounced among MGF fellows and women fellows of all races, with 34% of MGF fellows and 33% of women fellows in Engineering, as compared to 30% of white male fellows. The introduction of Women in Engineering awards to the GRF program influenced this outcome.

GRF fellows have higher average GRE scores than do applicants. In addition, there have been increases in scores for MGF fellows since 1979. GRF fellows' GRE scores overall have decreased moderately in most discipline areas but remain high. Both Disciplinary fellows (200 respondents) and their program peers (188 respondents) answering the survey have high GRE scores. Average quantitative scores are close, ranging from 737 for peers in Biochemistry to 787 for fellows in Mathematics. GRF fellows have consistently higher average verbal scores (means for four disciplines of 653-694 compared to 566-633) and analytical scores (735-766 compared to 682-720) than peers have (Table G2).

We found that differential success rates by type of undergraduate institution are quite consistent over time, and similar for GF and MGF applicants for 1984-1988 and 1989-1993 cohorts. About 17% of RU1 applicants become fellows (both GF and MGF), compared to about 5% of GF and MGF applicants from non-research institutions (Tables G4.1 and G4.2). However, a much larger percentage of applicants to the MGF competition graduated from non-research institutions (38%) than did applicants to the GF competition (16%), which corresponds to lower overall award rates for 1984-1993 MGF applicants. This reflects their undergraduate academic experience, which is more likely to be at non-RU1 institutions where access to undergraduate research experience is limited. Since the research proposal component of the NSF application carries considerable weight in the review process, it is not surprising that applicants from non-research institutions are less successful in winning NSF fellowships. Thus, the GRF selection process continues the sorting out process that begins at the undergraduate level (Owings, Madigan, & Daniel, 1998).

Declining the GRF

Fifteen respondents among the Disciplinary peers had been awarded an NSF fellowship but declined it. Nine cited receiving an alternative award that carried a better stipend, and seven also cited an alternative that carried additional funding beyond the stipend. Three peers interviewed during the site visits declined the GRF:

> Accepted a Ford Foundation Fellowship instead for the stipend but now thinks this was a mistake and is reapplying for the GRF with the intention of deferring Ford if successful. (D-EC)
>
> Accepted the Department of Defense National Defense Engineering and Science Fellowship for its higher stipend. (D–M)
>
> Accepted the Howard Hughes Medical Institute Fellowship because it is longer, has higher stipend, and includes meetings for fellows. (C–BIO)

Enrollment Choices of Students

We found that both NSF fellows and their peers decided to enroll in a graduate program based on many factors, and financial support was not necessarily the most important. This is especially true in programs where all Ph.D. students are fully supported. Student preference was for an RU1 institution and a graduate program and faculty with outstanding reputations in their research area. Given acceptance at roughly equivalent graduate programs, other factors became important to many, including perceptions of a supportive environment, financial support, location, and weather.

> Two fellows mentioned choosing [Institution B] because they were recruited heavily…and both of these were encouraged to become doctoral students. Location and reputation also influenced enrollment choices. One student also mentioned that she wanted to be at a state university with a strong research program. (B)
>
> According to the vice-chair, factors that influence student choice include west coast/east coast preferences and the "style" of the department. He noted that [Institution D] is more business-like and has better facilities, but [Institution A] is more personal. (A-ME)
>
> Fellows and peers made their choices for similar reasons: program, faculty, location, weather. [Institution D] benefits from the "sunshine and palm trees" factor. (D)
>
> Students chose the [Institution E] Biochemistry program for various reasons related both to the program itself and also to personal lifestyle choice. While students consistently made remarks such as "the program here is excellent," several also stated that they chose the program for its geographic location or for personal reasons (e.g., "I like the more laid back lifestyle" or "My husband was already working here so it made sense to come here"). (E-BIO)
>
> All students in this department receive equal funding. They were not influenced by financial support in their enrollment choices. (C-BIO)

For many applicants, campus visits are important in determining their enrollment preferences. We heard accounts during the site visits of how this direct interaction with faculty and students in a program influenced enrollment choice.

> Two fellows mentioned choosing [Institution B] because they were recruited heavily-"the graduate advisor is amazing" and both of these were encouraged to become doctoral students. (B)
>
> And another peer also chose [Institution A] because future support seemed less likely at [Institution D] although the friendly, personal style of the [Institution A] faculty during his campus visit was also a factor. (A-ME)
>
> Among the advantages [Institution D] has in attracting top graduate students, "location and weather" rank high in addition to the good program and feeling welcome on visitor's day compared to the reception at other universities, according to a faculty member. (D-ME)

From our survey of 1989-1993 NSF fellows and Disciplinary peers we learned more about the attendance patterns of fellows, including the type of degree program that they chose to enroll in. Not all NSF fellows enter graduate school with the intention of pursuing doctoral degrees. The important role of the master's degree in the discipline of Mechanical Engineering is clearly seen from Table 4. Whereas 83%-97% of Disciplinary fellows in the other three fields were seeking doctorates, only 74% of Disciplinary fellows in Mechanical Engineering and 73% of WENG fellows were pursuing a doctorate. Almost one-third of MGF fellows reported seeking the master's degree. Fellowship support for graduate study in disciplines where a master's degree has value for starting research career s and is the degree of choice for one-fourth to one-third of students requires a different measure of success. Assessment of NSF fellows' success needs to take these differential degree goals into account by looking beyond Ph.D. completion rates for evidence of success. For example, securing a research position in industry or teaching at a community college or high school in a SMET field with a master's degree should be considered positive outcomes. Similarly, a decision to pursue an MBA, JD, or MD degree program should not be seen as failure but as a matter of choice.

Table 4
Degree Sought by Survey Respondents

Respondent Group	Percent seeking master's	Percent seeking doctorate
Disciplinary Peers	8%	86%
Mechanical Engineering	27%	68%
Mathematics	6%	90%
Biochemistry		92%
Economics	2%	91%
Disciplinary Fellows	8%	88%
Mechanical Engineering	22%	74%
Mathematics	2%	96%
Biochemistry	3%	83%
Economics	2%	97%
WENG Fellows	18%*	73%*
MGF Fellows	15%	75%
Mechanical Engineering	32%	59%
Mathematics	8%	77%
Biochemistry		88%
Economics		94%

* Percentages do not add to 100% because 1 Disciplinary Peer and 1 WENG respondent gave MBA as their reference degree sought, and 9 Disciplinary Peers, 8 Disciplinary Fellows, 6 WENG, and 8 MGF respondents gave a professional degree.

Secondary data analysis (CI)[10] reveals that most NSF fellows chose to enroll in a small number of institutions. For the most recent cohort studied (1989-1993), GF fellows (94%) and MGF fellows (91%) enrolled primarily in RU1 universities. For MGF fellows, this represents a 14 percentage point increase over the first cohort (1979-1983). From 1979-1993, more than half of GF fellows in the Engineering/Math/Physical Sciences (EMP) disciplines enrolled in just five institutions. In EMP and Social and Behavioral Science, more than two-thirds of GF fellows enrolled in one of 10 institutions. GF fellows in Biological and Life Sciences were the least highly concentrated, but still more than half of them enrolled in just 10 institutions. MGF fellows were somewhat less concentrated in their first 10 institutions than were GF fellows (Tables G5 and G6).

[10] The CI contains data on anticipated institution of enrollment. We compared CI data for 1989-1993 with NSF's internal database that contains actual institution of enrollment. While only 75% attended their anticipated institution, there was no effect on which institutions were among the top 10 destinations of fellows.

There are 88 institutions with an RU1 classification in the United States (Carnegie Foundation, 1994). Quality characteristics of graduate programs vary considerably within this group of institutions and may also vary within an individual institution. Although there is no nationally available metric to measure overall institutional reputation in graduate education, the reputation of a graduate program as being of high quality is understood among scholars and practitioners in individual disciplines and is reflected in the National Research Council (NRC) ratings. The reputational quality ratings from the NRC study (National Research Council, 1995) provide a tool to assess the types of programs in which NSF fellows are enrolling. The NRC rates graduate programs as Distinguished, Strong, Good, Adequate/Marginal, and Not Ranked. Since programs rated by the NRC are not defined in the same way as those in the GRF Program, we used less direct methods for assessing the reputational quality of programs in which GRF fellows enroll, using disciplinary area indices derived from NRC program ratings (Webster & Skinner, 1996).

Of NSF fellows who completed the Ph.D., about 90% received degrees from doctoral programs rated either Distinguished or Strong. This percentage has remained consistent over the 15-year period 1979-1993, increasing just one percentage point from earliest to most recent cohort. For the 1989-1993 cohort, women remained less likely to complete degrees from a Distinguished program than men (56% versus 62%). While 90% of GF and 78% of MGF doctoral graduates in the most recent cohort completed degrees from Distinguished or Strong programs, less than half of MGF graduates completed degrees from Distinguished programs (48%) compared to 62% of GF fellows. 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.

TRANSITION POINT TWO:
EXPERIENCING CONTEMPORARY GRADUATE EDUCATION

The path to the Ph.D. is frequently a long and arduous journey, and many of those who begin that journey do not complete their degrees. In some disciplines, graduate study is primarily for the master's degree. Naturally, graduate school is experienced differently by every student because of individual differences in backgrounds, educational preparations, and temperaments. Additionally, as will be elaborated upon, that experience is shaped to a large extent by the norms and expectations of the particular disciplines and institutions to which the student belongs.

Nonetheless, key challenges and elements cut across these individual, disciplinary, and institutional differences. One of these is the need to secure adequate financial support and the nature and source of that support. Graduate students also must meet the demands and expectations associated with advanced study in a field, including coursework, research, teaching, and publishing or presenting work. They are expected to complete degrees within time limits imposed not only by the university but often also by the availability of financial support or external factors, including family obligations. They must gather information and decide about potential careers, procure a suitable position, and be able to demonstrate satisfactory progress and productivity within it. While experienced differently by every student, these elements and challenges are present for all graduate students, and thus comprise critical factors that influence the effect of the GRF Program.

In this section, we discuss critical factors as they are experienced by NSF fellows and their peers and highlight the similarities and differences between the groups. We discuss the direct and indirect impacts of the GRF on the graduate student experience, and where possible we compare the experiences of Disciplinary fellows, WENG fellows, and MGF fellows. To place these evaluation findings in proper context, however, we first look at institutional variation in GRF impact and then discuss the differences that often make the most difference, namely, those arising from the particular disciplinary contexts within which NSF fellows and peers pursue graduate study.

Institutional Variation

In 1998-1999, the GRF provided stipends to students ($15,000 per year) and Cost of Education (COE) allowance to institutions ($9,500 per year). NSF funds are given to the institution, which distributes the stipend to GRF fellows enrolled. The cost of graduate education varies considerably, and there is also variation in the impact of the COE allowance.

For some institutions, there is a surplus of COE funds that may be used to support students or for other institutional programs. Where the COE allowance does not cover the costs of tuition and fees, however, institutions and/or departments must make up the difference from other sources of funds. For high-cost institutions with large numbers of NSF fellows enrolled, this can be a considerable expense. For example, although Institution D received over $2 million in COE funds in 1997-1998, this only covers about half of the actual costs. Although the GRF COE allowance was increased to $10,500 per year in 1999-2000, for high tuition institutions, a substantial gap between the allowance and actual costs remains. Other graduate fellowship programs pay the actual costs of tuition and fees (Department of Defense Science and Engineering Graduate Fellowship), making them more desirable from the institution's point of view.

In order to compete for the top students, institutions and/or graduate programs may supplement the GRF stipend to encourage enrollment of NSF fellows or to offset the high cost of living.[11] While some NSF fellows received no supplement to the $15,000 stipend, programs that seek parity in stipends for graduate support will supplement the GRF. We found that norms for graduate student support varied by both institution and discipline. For example, for 1998-1999 at Institution A, all Biochemistry students received $17,000 per year and at Institution D in Mechanical Engineering, support ranged from $17,400 to $19,200 per year, depending on status in the program. Other graduate fellowships offer higher stipends and support for more than three years (Fannie and John Hertz Graduate Fellowship). Some also provide an additional payment directly to students for educational expenses (Howard Hughes Medical Institute Predoctoral Fellowship). While three years of NSF funding is highly desirable, it appears that the stipend level has not kept pace with prevailing costs.

Where Discipline Makes the Difference

Graduate education in the science, mathematics, engineering and technology (SMET) fields supported by the NSF GRF Program occurs within distinctive disciplinary cultures situated within complex institutional settings. In many cases these disciplinary factors color the effect of the GRF Program. Norms, expectations, and requirements vary substantially by discipline in terms of financial support, teaching requirements, organization of research, productivity measures, and career options. For each of these dimensions, we look at how disciplinary differences manifest themselves.

Amount and Type of Financial Support Available

In top graduate programs, most students receive financial support throughout their graduate programs, especially Ph.D. students. However, certain disciplines, such as Biochemistry and Engineering, tend to be more resource rich than others with respect to the financial support available for graduate students. Programs with substantial external funding for research, such as Biochemistry, may be able to offer all students support from a variety of sources, including training grants, research grants, teaching funds, and institutional funds. For other programs, such as Mathematics, for which external funding is less available, teaching assistantships become the primary source of support.

[11] As of March 2001, the annual GRF stipend increased to $18,000, and in 2002 it increased to $20,500.

> It is almost exclusively TA-ships with limited departmental fellowships and RA positions…. We must offer support to get quality students…. For [external] fellowships, NSF is the only game in town. (E-M)

The impact of the GRF on graduate programs with more student funding options is understandably less significant than it is for those where even a small amount of external support has a substantial impact on program support for graduate students. The impact of the GRF on fellows in disciplines with fewer sources of graduate student support (Mathematics and Economics) is greater, too, because having the fellowship may reduce teaching demands on NSF fellows. Where departmental or institutional resources enable a program to offer complete packages of financial support, the GRF and other external fellowships enable articulation of support so that more graduate students can be funded. In addition, resource rich institutions and programs can and do supplement the GRF stipend.

Program Teaching Requirements

There is variation among programs in the emphasis placed on developing graduate students' teaching abilities, and this results in differences in teaching expectations. For example, Biochemistry at Institution E requires all students to be teaching assistants for at least three quarters whether they have an external fellowship or not, and they are not paid extra to do so because it is considered part of their training. In such cases, the GRF may make little or no difference in teaching requirements.

> There are no differences in requirements for NSF fellows. They don't get out of the teaching requirement. We want them to have enough exposure to teaching to know whether they want to do it or not. (E-Bio)

Other disciplines require less teaching, such as Economics at Institution D that requires only one quarter of teaching and pays a stipend to all students whether they receive external funding or not. In Mathematics, the heavy demand for staffing undergraduate math courses contributes to the expectation that graduate students will teach, although GRF or other external fellowship support can greatly reduce this requirement.

Nature of Research

Disciplinary differences in the nature of research have a direct bearing on such things as the availability of external research support, the degree to which collaboration with faculty members and/or other students is feasible and desirable, and the scope and duration of research projects. Pure Mathematics research, which is largely an individual activity, is very different from the nature of research done in Mechanical Engineering, which is by its nature more applied, amenable to team effort, and requires laboratory facilities and equipment.

Disciplines like Economics and Mathematics rely more on identification and pursuit of a unique problem or topic whereas Mechanical Engineering and Biochemistry research is based on collaborative work that is usually tied to a larger research project that is based in a laboratory. GRF support plays a different role in such settings where the primary benefit of the fellowship may be to the laboratory and faculty member rather than to the individual student.

Opportunities to Publish and Present Work

Traditionally, a key measure of professional productivity is number of publications and presentations. Disciplines differ substantially with respect to what is expected of graduate students, when the process of publishing or presenting work begins, and whether individual or multiple authorship is the norm. When comparing graduate student productivity, it is critical to view findings through the different disciplinary lenses. In Mathematics, for example, the norm is not to have produced any publications until well into the dissertation stage of a graduate career, whereas, in Economics, Mechanical Engineering, and Biochemistry, it is customary to begin presenting work and publishing far earlier. Disciplinary differences such as these again point to the need to interpret findings of professional productivity appropriately.

Career Paths and Job Markets

We speak to this more fully under Transition Point Three, but disciplines differ with respect to the nature of job markets and the careers pursued by students. More than in other fields, students in Mechanical Engineering enter graduate programs intending to leave with master's degrees rather than doctoral degrees. Even in fields where initial aspirations are for doctoral completion, a variety of factors lead NSF fellows and peers to exit with master's degrees. Thus, assessments of GRF Program effectiveness that are based primarily on fellows' Ph.D. degree completion must be tempered with an acknowledgment of the fact that for some students, exiting programs prior to doctoral completion is a desirable outcome.

Having highlighted in general terms the extent to which disciplinary contexts affect the use and impact of the GRF, we turn next to a discussion of the perceived advantages and disadvantages of the GRF identified by survey respondents, faculty, administrators, staff, and current graduate students.

Perceived Advantages and Disadvantages of the GRF

In the survey, we asked Disciplinary fellows, WENG fellows, and MGF fellows to tell us some of the advantages and disadvantages of receiving NSF fellowship support while in graduate school. Approximately 86% of fellows in each group cited the obvious advantage of financial support (stipend). Other advantages reported by more than half of the NSF fellows responding in each sample were "Reputation among faculty as a good student," "Having it on my CV helped/will help in job search," and "Tuition assistance (cost of education allowance)." Also, 72% of WENG fellows and 61% of MGF fellows thought the fellowship made them an "asset to faculty to work on their projects," while 36% of Disciplinary fellows marked this as an advantage of the fellowship (Table G7). Based on our site visit interviews, this continues to be an important advantage for many fellows, especially in Mechanical Engineering and Biochemistry, and particularly for junior faculty whose research is not well funded by research grants.

More than one-third (38%) of NSF fellows in each survey sample thought that the GRF shortened time to degree. In our site-visits, we found that although there is a perception that fellowship support may reduce time to degree, there is little or no data to support this belief. Many NSF fellows indicated that the fellowship relieved them of specific duties (e.g., teaching or working as a research assistant on projects not directly related to their own research). Some thought that being relieved of such responsibilities would make it possible for them to complete degrees faster or has allowed them to take more courses.

> No teaching means more time for research…. The freedom means time to take an extra class per semester to explore and work on research—to be a mathematical tourist. (A-M)

More than half of WENG and MGF fellows mentioned that the increased flexibility provided by the GRF afforded them to pursue additional coursework or research opportunities.

Although generally NSF fellows do not complete in less time, some faculty interviewed speculated that they might.

> Given that fellows would be freed up from having to TA or RA every quarter, one faculty member commented, "if students take advantage of it, they should finish faster." The chair was even more emphatic: "They spend on average one year less in the teaching rotation, and that translates to getting done 6 months faster." (A-EC)

> Since NSF fellows are among the top students, the vice chair noted that it makes sense that they might finish the program in less time, although they have no data to confirm this. (A-M)

> They tend to take more courses overall, rather than getting through more quickly. (C-ME)

Some NSF fellows indicated that having the fellowship expanded their options in terms of laboratory or research advisor assignments. This varied not only by discipline, but also by the specific graduate program.

> The biggest single advantage is being able to be more choosy in who I get to work with and what kind of work I do with them, because professors don't have to pay the tuition. For me, it worked well because there was a professor who'd just arrived who didn't have funding yet that I wanted to work with. (D-EC)

> NSF fellows in the Biochemistry Department clearly had more options available to them in terms of lab assignments and research topics. (E-BIO)

> It's wonderful, totally changed my life. My first semester here I was living off of loans and also working as a teaching assistant. Because of that-it is a huge time sink to be a TA-and juggling classes, I didn't have any time at all for research.... Once you have an NSF fellowship, it allows you to be very, very picky about what lab you join.... (A-ME)

> It let me pick what I wanted to do.... I took the extra time that the fellowship bought me and I did more research. As a result, I have 7 or 8 papers, 5 of which have been accepted for publication. Most students come out with maybe 1 or 2 papers. (D-EC)

There are also significant advantages for graduate programs to having NSF fellows enrolled. In fact, in some disciplines, GRF impact may be more pronounced for the department than for the fellow.

> The main effect of an NSF fellowship, then, is not on the student who receives it, but rather on the department, which is able to stretch its resources (and maintain the high level of support). (Disciplinary fellow)

> Even when the number of NSF fellows admitted to these programs is relatively few (1-3 per year), the impact was described by faculty as being very significant in terms of both freeing up resources to support other students and contributing to the positive reputation/ranking of the department. (A)

> Furthermore, the faculty member gets a "free" student, a student who does not need to be supported by that faculty member's research funds. (B-ME)

> From the point of view of the department, it does help a lot that we've got these people here who are funded because the funding situation is extremely tight.... At any given time we would have maybe three or more NSF fellows. Simply they would be three people who we couldn't otherwise afford to have in the program without that funding. (D-M)

Turning to the perceived disadvantages of holding an NSF fellowship, it is striking how few NSF fellows responding to the survey (11) noted lack of office space, isolation, less opportunity to work with faculty, or less opportunity for collaborative work as disadvantages (Table G7). These items might be expected to be related to individual fellowship funding (National Science Board, 1998). The most commonly listed disadvantage was “Support only lasted 3 years,” mentioned by less that half of the NSF fellows in each sample. About 23% of fellows listed “Less opportunity to teach (TA)” as a disadvantage. This would be perhaps the strongest “academic” disadvantage for NSF fellows in disciplines where teaching experience is viewed as especially critical.

Other respondents commented on the constraining impact of eliminating from eligibility those who hold master’s degrees. One WENG fellow described her experience of trying to get a GRF for a doctoral program when she had worked after her master’s degree. Eventually, she was accepted by NSF, but she commented:

> I hope the exclusion on people with MSs is gone now, since a break/work between MSs and *Ph.D.s is very, very good for many people.* (WENG)

Finally, while most institutions provided continued funding to NSF fellows once the GRF ended, 9% NSF fellows did not receive such financial aid (Table G7). This was particularly difficult for a fellow contributed to a laboratory while on GRF funding who was not supported by that laboratory when the fellowship ended.

Graduate Student Activities and Preparation for the Real World

We asked a set of questions concerning the kinds of academic preparation received in graduate school (Table 5). Our intent was to investigate whether NSF fellows received more or different preparation by virtue of their external funding. We found no significant differences between Disciplinary fellows and program peers. Nor were the responses from WENG fellows and MGF fellows different, except with regard to funding to attend professional meetings, where Disciplinary fellows appear to receive less support than WENG fellows and MGF fellows. Graduate students in all four sample groups were most likely to report having opportunities to present research and least likely to have opportunities to learn about proposal writing (Table 5).

Table 5
Support Received while in Graduate Program

	Disc. Peers	Disc. Fellows	WENG Fellows	MGF Fellows
Opportunities to learn proposal writing	27%	33%	35%	46%
Help in publishing work	51%	55%	61%	61%
Opportunities to present research	76%	76%	67%	75%
Funds to attend professional meetings	53%	45%	56%	58%

We also included in the survey two questions about the acquisition of professional skills as a follow up to the report, *Reshaping Graduate Education in Science and Engineering* (COSEPUP, 1995) and to questions included in the Ph.D.'s Ten Years Later study (Cerny & Nerad, In Press). Table 6 shows the percentage of respondents whose graduate studies involved them in particular activities and their opinions about which skills should be developed in graduate school for subsequent professional success.

Table 6
Activities in Graduate School and Relevance for Professional Success

	Work on Team		Collaboration		Interdisciplinary research		Learning organizational or managerial skills		Interact with professionals in the field
	Had in Graduate School	Needed for Professional Success	Had in Graduate School	Needed for Professional Success	Had in Graduate School	Needed for Professional Success	Had in Graduate School	Needed for Professional Success	Had in Graduate School
Disciplinary Peers	56%	54%	65%	67%	28%	47%	28%	56%	28%
Mech. Engineering	71%	69%	71%	69%	60%	64%	50%	76%	55%
Mathematics	34%	44%	56%	64%	12%	36%	16%	34%	12%
Biochemistry	67%	58%	79%	71%	33%	56%	44%	77%	31%
Economics	55%	47%	55%	66%	9%	32%	9%	40%	19%
Disciplinary Fellows	44%	56%	62%	69%	35%	41%	27%	60%	26%
Mech. Engineering	62%	72%	66%	68%	54%	52%	48%	88%	50%
Mathematics	33%	57%	55%	74%	25%	39%	14%	37%	8%
Biochemistry	53%	68%	73%	65%	48%	55%	32%	84%	19%
Economics	29%	31%	59%	68%	20%	22%	14%	42%	20%
WENG Fellows	55%	76%	66%	61%	52%	51%	40%	73%	43%
MGF Fellows	64%	53%	76%	63%	48%	59%	40%	72%	40%
MGF Engineering	71%	71%	85%	71%	59%	74%	50%	85%	65%

We found no significant differences between Disciplinary fellows and program peers in their graduate school experiences or in their assessments of skills needed for professional success. However, responses do highlight some interesting discrepancies between the skills developed in graduate school and those respondents consider important for subsequent professional success in different disciplines.

We see a large discrepancy in the "learning organizational or managerial skills" responses. Almost one in three (27%) respondents overall reported that their graduate activities involved such an activity, while more than half (58%), and up to 73% for WENG fellows, reported that these were important skills for subsequent professional success. Breaking down these responses again by discipline, we see a sharp distinction among fields. More than three-quarters of respondents in the fields of Engineering (76%) and Biochemistry (77%) said that these skills were important, compared to 35% of those in Mathematics and 41% in Economics. Engineering and Biochemistry students were also more likely to have had some opportunity to learn these skills in graduate school, 44% and 37% respectively.

There is a better match between having collaborative experiences in graduate school and their relevance for professional success. One-half to three-quarters of NSF fellows in the three samples report having this experience. Disciplinary fellows and peers highly related collaborative experiences to subsequent professional success. Only about one-third of graduate students in Mathematics experienced teamwork in graduate school, but 44% of peers and 56% of fellows thought it was important for professional success. Interdisciplinary research obtained the lowest overall experience and interest. Again we see the disciplinary differences, with few Economics and Mathematics respondents having interdisciplinary experience in graduate school, and only a somewhat higher percentage rating that it was of professional importance.

Results reported in *NSF Fellows and their Doctoral Peers in the Ph.D.'s Ten Years Later Study* (Cerny & Nerad, 1999) are generally similar to the findings reported here. Given the small number of NSF fellows (107) and the different set of academic fields included in the Berkeley study, comparisons should be interpreted cautiously. However, what stands out is the larger percentage of respondents to our survey, a 1989-1993 cohort, who report having learned organizational or managerial skills as part of their graduate study than those NSF fellows of a decade earlier, especially as reported by biochemists and engineers. Despite the continuing gap between expressed professional need and graduate experience, the current situation appeared to be better in this category.

NSF fellows and Disciplinary peers responding to the open-ended survey item frequently expressed dissatisfaction with their graduate training, indicating a mismatch between their preparation and the "real world":

> Career development is a vital function in pursuing doctoral studies…to prepare them for the politics and realities of the real world. Doctoral education in the sciences is still too narrowly focused, even at the most prestigious institutions like [Institution C]. (Disciplinary fellow)

> My graduate training was technical and detached from the real world. When it was time to decide whether to go into academia or the private sector, the choice seemed obvious, private sector. I felt it was about time that I started to understand the economy and financial markets in an applied way. Although I had always wanted to become an academic, to research and to teach, I felt that this was not a viable option due to my lack of real world experience. Many of my colleagues felt the same way and ended up in the private sector as well. (Disciplinary peer)

> The main source of malaise or anxiety among graduate students in the biological sciences is that they have little contact with the world in which they will ultimately find employment. (Disciplinary peer)

Consistent with COSEPUP report findings, survey respondents expressed dissatisfaction at what they perceived to be inadequate mentoring and career guidance from faculty members.

> Very poor mentoring. There was no one to whom students could speak frankly about their career choices. (Disciplinary fellow)

> We mistakenly view graduate school and the Ph.D. as an end in itself and not as career training. Too little emphasis is placed on preparation for future careers. (WENG)

> I had absolutely no assistance from faculty in my department in job hunting or job counseling. (MGF)

Women also commented on gender-based barriers still present in the graduate school environment and SMET careers.

> My professional experience and career choices (at a National Lab) are very limited because I am a woman. NSF and the fellowship program are one of the few bright spots in a field that is still very hostile for women and minorities. (WENG)

Clearly, then, even though the majority of respondents indicated general overall satisfaction with their graduate school experiences, there were a number of common concerns that speak to the need for improvement in the degree of support, real-world preparation, and career guidance graduate students receive while in their programs.

Measures of Success for Graduate Education

In evaluating the effectiveness of programs designed to support graduate education, measures have historically been used that we also employed in this study. These traditional measures included time to degree completion and percentage of fellows who complete the doctoral degree. We added a new set of measures gathered through the survey related to productivity while in graduate school as evidenced by publications, presentations, patents, honors, and institutional service.

Productivity during Graduate School

We asked respondents to tell us about accomplishments while in graduate school. Very few respondents report more than one item in any particular category, and many report none. Therefore, we show below only the percentage of respondents who reported one or more accomplishment per category (Table 7).

Table 7
Accomplishments while in Graduate School: Disciplinary Fellows and Peers

Percentage with at least one of the following:	Disciplinary Fellows	Disciplinary Peers
Presentation at professional meeting	65%	57%
Publications	67%	65%
Refereed article	61%	59%
Book/chapter/edited	22%	16%
Patents	6%	9%
Academic honor	18%	17%
Institutional service	6%	4%

A slightly larger percentage of Disciplinary fellows than peers reported having achieved these accomplishments during graduate school. Most notably, 65% of fellows reported having presented at professional conferences, compared to 57% of peers. Overall more than half of respondents reported having presented and/or published work while in graduate school.
We also asked WENG fellows and MGF fellows to report on their accomplishments while in graduate school. More than three-quarters of each group reported having published or presented work while in graduate school (Table 8).

Table 8
Accomplishments while in Graduate School: WENG and MGF Fellows

Percentage with at least one of the following:	WENG Fellows	MGF Fellows
Presentation at professional meeting	76%	73%
Publications	77%	75%
Refereed articles	71%	71%
Book/chapter/edited	15%	21%
Patents	13%	9%
Academic honor	17%	18%
Institutional service	6%	8%

These findings are certainly positive, but they must be compared with care to responses from Disciplinary fellows and their peers because the disciplinary composition of the sample groups are different.

Differences in graduate school productivity emerged between Disciplinary fellows and peers within disciplines (Table 9).

Table 9
Accomplishments while in Graduate School: Disciplinary Analysis

Percentage with at least one of the following:	Mechanical Engineering		Mathematics		Biochemistry		Economics	
	Peers	Fellows	Peers	Fellows	Peers	Fellows	Peers	Fellows
Presentation at professional meeting	59%	71%	50%	59%	71%	74%	46%	60%
Publication	63%	70%	59%	72%	88%	81%	49%	49%
Refereed articles	55%	61%	54%	70%	88%	81%	35%	40%
Book/chapter/edited	6%	16%	10%	27%	29%	24%	19%	24%
Patents	17%	19%	4%	2%	13%	0%	0%	0%
Academic honors	14%	6%	20%	22%	10%	19%	23%	27%
Institutional service	5%	8%	8%	4%	2%	7%	0%	3%

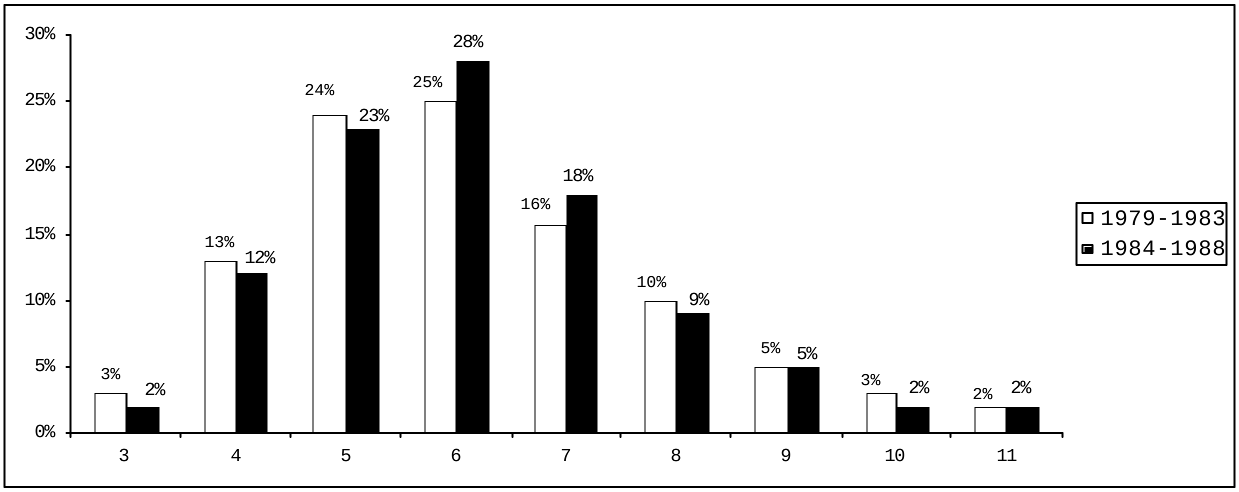
Respondents in Biochemistry reported the most presentation and publication productivity. Economics fellows are more likely to have made presentations at professional meetings than their program peers. Disciplinary fellows in the fields of Mechanical Engineering and Mathematics also reported more presentation and publication productivity, respectively, than their program peers.

Time to Degree

The length of time it takes for doctoral students to complete their programs, time-to-degree (TTD), is a commonly accepted and long-standing measure of graduate student success. It is of limited value when looking at trends, however, because it measures elapsed time from first enrollment in graduate school to receipt of the doctoral degree, rather than number of years enrolled. Many graduate students do not proceed directly to completion but may stop out temporarily or otherwise curtail their studies for a period of time before returning to finish. This persistence over time will affect the patterns of years to completion, and greater completion rates will likely also result in increases in TTD.

Using SED and CI data, we looked at the number of NSF fellows who had completed their doctorates within an eleven-year period from the time they enrolled in graduate school. We compared two cohorts of NSF fellows (those who initially enrolled between 1979-1983 and those who first enrolled between 1984-1988) in order to determine differences in TTD between earlier and more recent NSF fellows (Figure 1).

Figure 1
Years to Doctorate (TTD) for NSF Fellows Completing in Eleven Years



From this figure, we see that the distribution of TTD is similar for both cohorts of NSF fellows with the 1984-1988 cohort taking slightly longer to complete (37% versus 40% completing in five years or less). In both cohorts, about two-thirds of the NSF fellows who completed doctorates within 11 years did so within six years, and the average TTD remains fairly constant at about 5.5 years. The modal number of years to completion is six for both cohorts. Fellows in the 1984-1988 cohort taking more than six years were also more likely to finish by year seven than were 1979-1983 fellows. While the modal number of years to completion for the third cohort is also six, that is also the maximum possible time for the 1993 entrants using 1999 SED data.

For comparison purposes, we looked at TTD for QG2 non-awardees, and we found that fewer complete within six years than NSF fellows (60 % for the 1979-1983 cohort and 62% for the 1984-1988 cohort). In addition to looking at TTD for NSF fellows as a whole, we also examined differences between GF fellows and MGF fellows. TTD within six years is quite steady for GF and MGF fellows alike for the 1984-1988 fellows (GF fellows: 63% increasing to 65%; MGF fellows: 57% decreasing to 56%). The modal TTD, however, shifted from fairly equal percentages completing in five and six years, to a peak at six years for both groups.

TTD also varies by discipline. For the 1984-1988 cohort of NSF fellows completing doctorates in 11 years, those in Engineering/Mathematics/Physical Science finished fastest (71% in six years or fewer), followed by Behavioral/Social Sciences (58%), and the Biological/Life Sciences (58%). Shifts in TTD are related to the increase in the overall percentage of NSF fellows completing doctorates. We found that about one-third of NSF fellows who complete are still taking more than six elapsed years to earn doctorates. For the programs we visited during the site visits, faculty and student estimates of TTD ranged from five to six years, with only one program indicating an average of six years for completion (Institution C-EC).

Ph.D. Degree Completion

Although relying on Ph.D. completion as the primary measure of success for graduate students is problematic, especially for disciplines like Engineering, it remains an accepted measure of academic success. Therefore, we looked at Ph.D. completion rates for NSF fellows in the aggregate and for comparison purposes, using 5-year cohorts to avoid year-to-year fluctuations in completions. We calculated 11-year completion rates for the first two cohorts of fellows (1979-1983; 1984-1988) because these maximize our ability to compare groups over time using the most recent SED data available (1999). In order to include the most recent cohort (1989-1993), we also compared 6-year completion rates for all three cohorts (Table 10).

With the exception of Engineering fields, Ph.D. completion rates are high for all comparison groups – at or approaching three-quarters within 11 years and close to half within six years. The 11-year completion rates for NSF fellows in the first two cohorts (68.3% and 73%) are somewhat less that the eight to 12-year completion rates reported for earlier cohorts (1962 through 1981) in previous studies of NSF fellows conducted by the NRC (1977 at 78.7%; 1988 at 74.5%; 1994 at 75.8%). More recent cohorts have higher proportions of fellows in Engineering, which may account for these lower completion rates. A recent model projects overall Ph.D. attainment in science and engineering at only 24% for U.S. students and 27% for U.S. students at the most elite, research intensive, private graduate programs (Goldman & Massy, 2001) and concludes: "Three-quarters of science and engineering graduate students never receive a Ph.D." (p. 74). Placed in this context, the completion rates for NSF fellows are exceptional.

Table 10
Doctoral Completion Rates for NSF Fellows

Five-Year Cohort	Percentage completing Ph.D. in 6 years or less	Percentage completing Ph.D. in 11 years or less
1979-1983	44.5%	68.3%
1984-1988	47.3%	73.0%
1989-1993	41.0%	NA

While the 6-year and 11-year completion rates show increases from the first to the second cohort, the most recent cohort shows a decline in completions within six years. It remains to be seen whether the third cohort is taking longer to complete or completion rates are declining; however, the increase numbers of fellows in Engineering in this cohort may be related to Ph.D. completion rates in this cohort.

As in past NRC studies (Snyder, 1988; Baker, 1994, 1995) we used Quality Group 2 (QG2) non-awardees for comparison because in the application process they were assigned to the same group as QG2 awardees, although awards are not made randomly within the QG2 group. We used the Survey of Earned Doctorates (SED) through the most recent year available (1999) to compare completion rates. We made several comparisons using CI and SED data between NSF fellows and QG2 non-awardees. We compared the following Ph.D. completion rates and discuss each below:

- NSF fellows and QG2 non-awardees over time
- Gender differences over time
- WENG fellows and other engineering fellows
- Disciplinary differences by quality grouping
- MGF fellows and GF fellows
- MGF fellows and QG2 MGF non-awardees

Completion Rates of NSF Fellows and QG2 Non-Awardees over Time

Several important findings can be observed in Figures 2 and 3. First, more QG1 fellows than QG2 fellows complete doctorates, and this has not changed over time. Second, more QG2 fellows complete doctorates than QG2 non-awardees after 11 years, but at the 6-year mark, completion rates are somewhat higher for QG2 non-awardees in the most recent cohort (1989-1993). Finally, for the most recent cohort, early completion rates are very similar for fellows and non-awardees, but with additional time, more fellows complete the doctorate.

Figure 2
Six-Year Doctoral Completion Rates: NSF Fellows and Non-Awardees

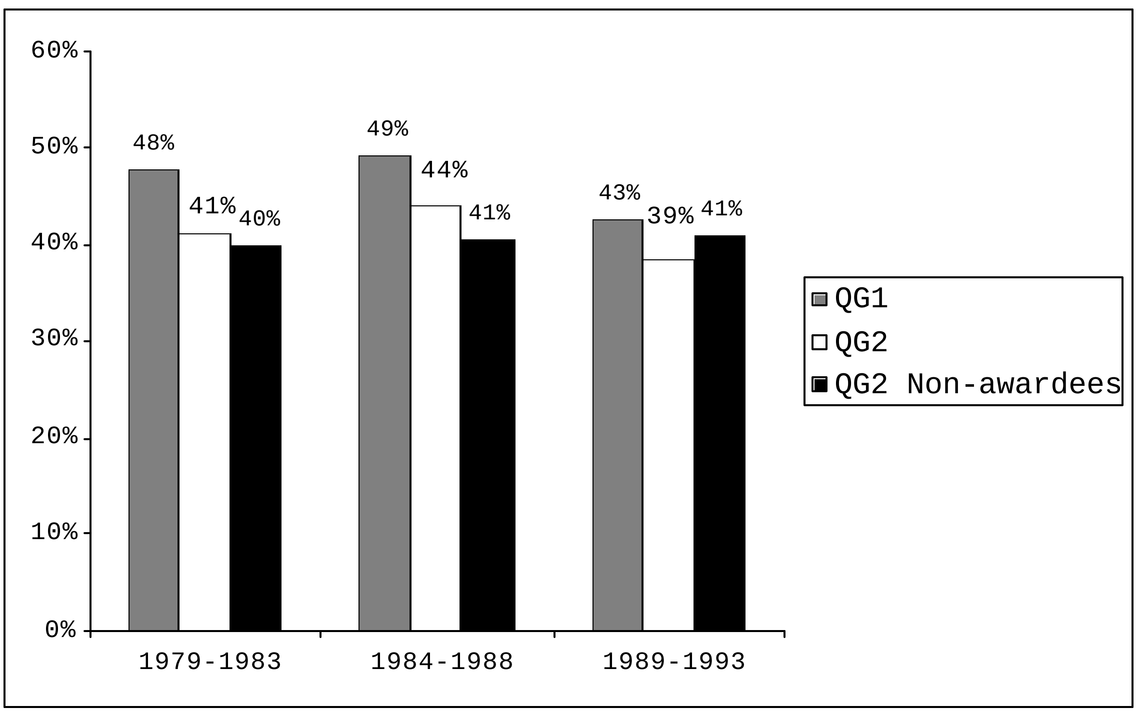
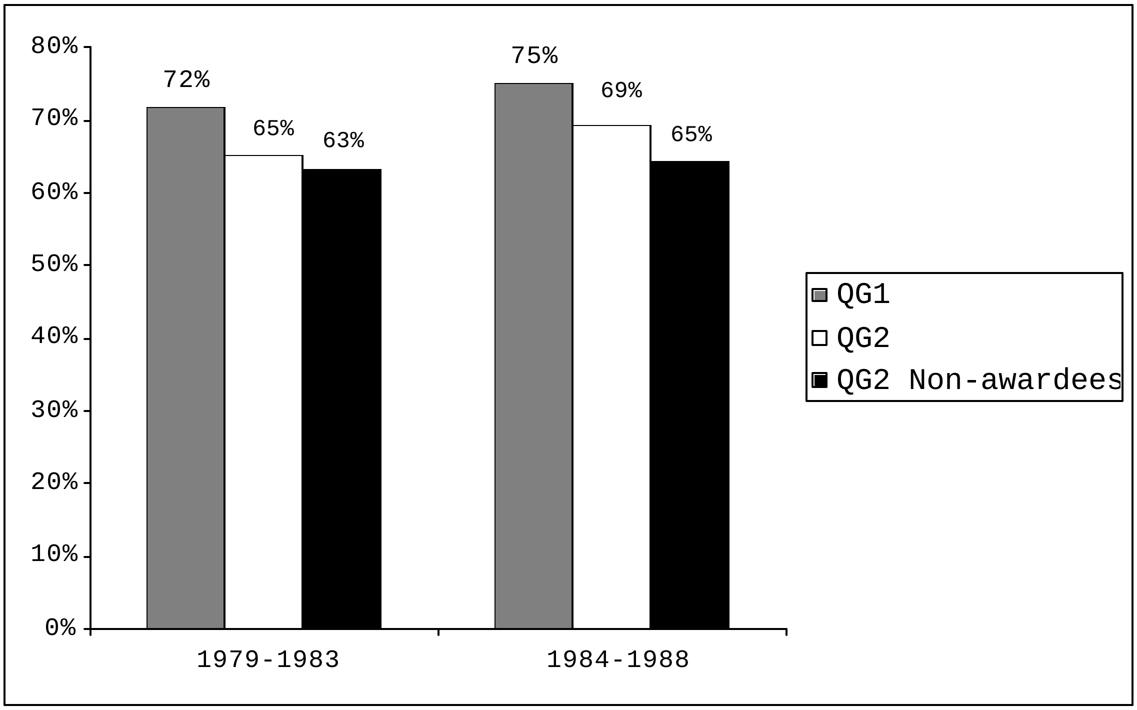


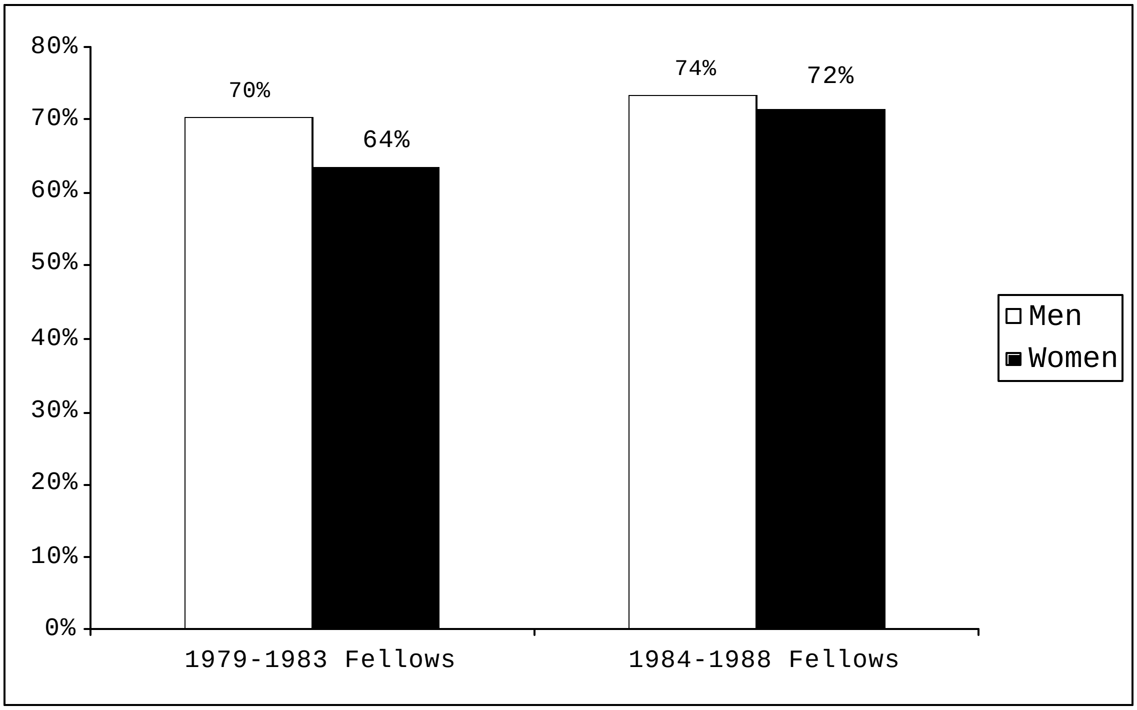
Figure 3
Eleven-Year Doctoral Completion Rate: NSF Fellows and Non-Awardees



Completion Rates by Gender over Time

Doctoral completion rates for women fellows were only slightly lower than for men within 11 years for the first two cohorts, and the difference is getting smaller (Figure 4).

Figure 4
Eleven-Year Doctoral Completion Rates by Gender



Completion rates for 1984-1988 women fellows in most discipline areas are within ±6 percentage points of those for men (Table G8). For the both cohorts, the largest discrepancies are in Social Science fields, where 57% of women, compared to 65% of men completed, and Computer Science/Math, where 37% of women and 66% of men completed within 11 years. Women fellows' doctoral completion rates are also lower in these disciplines than they are in other discipline areas. Importantly, the differences between NSF fellows and QG2 non-awardees is about four times greater for women than it is for men, with 73% of QG1 and 68% of QG2 women fellows completing, compared to 59% of QG2 non-awardees (Table G9). Thus, the GRF award seems to provide an advantage to women fellows in moving to doctoral completion.

Completion Rates of WENG Fellows Compared to Other Engineering Fellows

In 1990, NSF initiated additional GRF awards for Women in Engineering (WENG) to encourage more women to undertake graduate education in that area. Since the program had not been in place long enough to look at 11-year completion rates using 1999 SED data, we looked at 6-year completion rates for WENG fellows and other Engineering fellows (including non-WENG women fellows). We found that 40% of 1990-1993 WENG fellows had completed doctorates in six years, compared to 45% of other Engineering fellows, both men and women, in the 1989-1993 cohort. This difference is relatively small when you consider that most WENG fellows were selected from the Quality Group 3 (QG3) of applicants. QG3 is those who receive Honorable Mentions but are not considered to be as highly qualified as QG1 and QG2 applicants. It would be useful to follow the progress of the WENG fellows for a longer period to assess whether the gap narrows or grows as TTD increases.

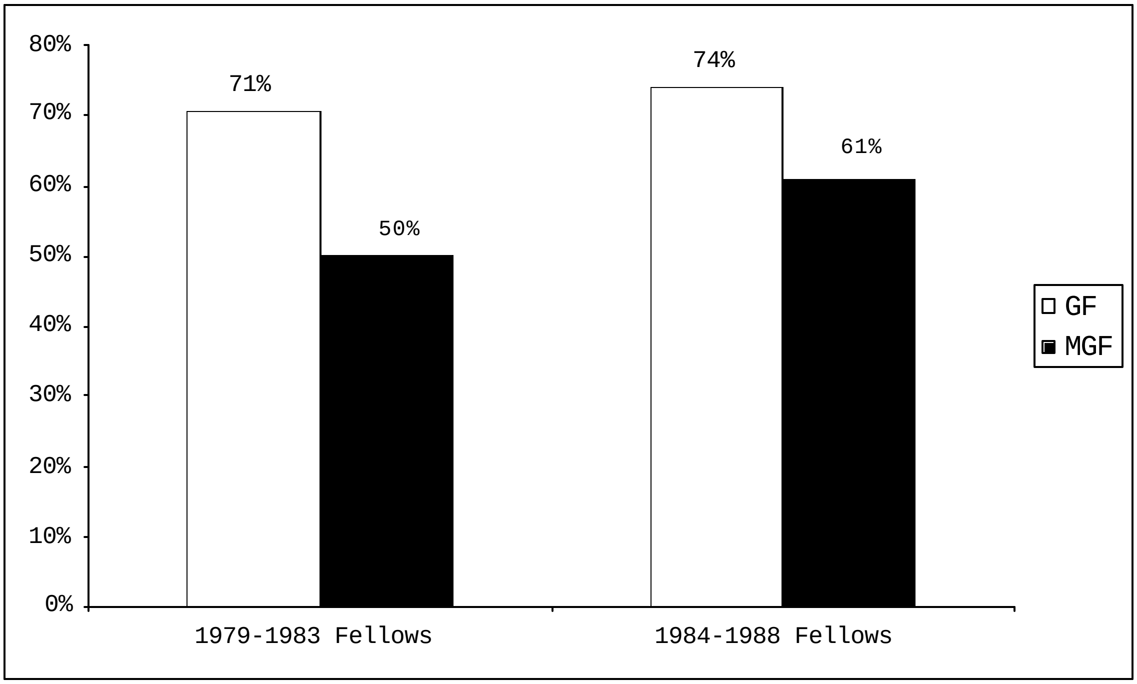
Disciplinary Differences in Completion Rates by Quality Grouping

For GRF QG1 fellows, 11-year doctoral completion rates have increased in all discipline areas except for Engineering/Math/Physical Sciences, where the completion rate declined slightly (less than one point) between the 1979-1983 and 1984-1988 cohorts (Table G10). Eleven-year completion rates for QG1 fellows in the Biological and Life Sciences rose from 72% to 79% between the 1979-1983 and 1984-1988 cohorts. For Behavioral and Social Sciences, the percentage of QG1 fellows completing within 11 years increased from 63% to 70%. For QG2 fellows, completion rates have risen in all three discipline areas. For QG2 non-awardees, on the other hand, completion rates in 11 years declined for those in Engineering/Math/Physical Sciences but increased in the other areas. Across all disciplines, 11-year completion rates have risen for both QG1 fellows and QG2 fellows while the 11-year completion rates for QG2 non-awardees have increased but to a less extent. QG2 fellows completed at somewhat higher rates (five percentage points) than QG2 non-awardees, and this difference was greater for the 1984-1988 cohort.

Completion Rates of MGF Fellows Compared to GF Fellows

In this comparison, we looked at doctoral completion rates for both Graduate Fellowship recipients and Minority Graduate Fellowship recipients. Completion rates for MGF fellows (+11) increased more than 11-year completion rates for GF fellows (+3) (Figure 5).

Figure 5
Eleven-Year Doctoral Completion Rates: GF and MGF Fellows



Analysis of SED and CI data shows that the gap between GF and MGF doctoral completion rates declined across all disciplinary areas except Social Sciences, where the gap between GF and MGF completion rates widened by 6% and Computer Science/Math where it widened by 2% (Table G11). For other disciplinary areas, the gap between GF and MGF doctoral completion rates has been narrowed dramatically. The difference decreased from 28% to 14% in Engineering, from 18% to 7% in the Physical Sciences, from 22% to 4% in the Biological Sciences, and from 15% to 14% in the Behavioral Sciences. However, for the 1984-1988 cohort, an overall 7% difference in 11-year completion rates persisted (Table G12).

Completion Rates of MGF Fellows Compared to QG2 MGF Non-awardees

To assess whether MGF fellows graduate more often, and more quickly, than do QG2 non-awardees in the same competition, we compared completion rates of QG1 and QG2 MGF fellows to a comparison group of QG2 non-awardees (Table G13). Completion rates have increased for both MGF fellows and QG2 non-awardees. For 1984-1988 MGF QG1 fellows, 11-year completion rates was 68%, exceeding in just 11 years the rate of completion after 16 years for the 1979-1983 group (61%). For QG2 MGF fellows, the increase to the 11-year mark is smaller-from 46% to 51%. Furthermore, the completion rate of QG2 non-awardees is approaching that of QG2 fellows, from 34% to 50%. In all categories of the MGF competition, completion rates increased, but the biggest differences were for the QG1 (12.6%) and QG2 non-awardee (15.7%) groups.

There were dramatic increases in completion rates in some discipline areas. For example, the percentage of QG1 MGF fellows who had completed doctorates within 11 years increased in the Engineering/Math/Physical Sciences disciplines from 50% for the 1979-1983 cohort to 67% for the 1984-1988 cohort. In the Biological and Life Sciences, the percentage increased from 57% to 79% for QG1 MGF fellows and from 47% to 69% for QG2 MGF fellows. By contrast, 11-year completion rates remained fairly constant for the same two MGF cohorts in the Behavioral and Social Sciences (Table G13). Completion rates declined in Engineering/Math/Physical Sciences for QG2 MGF fellows, and more QG2 MGF non-awardees earned doctorates within 11 years than QG2 MGF fellows did. Other changes in completion rates were similar to those of QG1 MGF fellows.

For all 1979-1988 fellows combined, 76% of QG1 GF fellows and 65% of QG1 MGF fellows had received doctorates by 1999 (Table G14). For QG2 fellows, these percentages were 72% and 52% respectively for GF fellows and MGF fellows. The distinction between the completion rates of fellows and non-awardees is especially striking for the MGF competition, where only 45% of QG2 non-awardees in all disciplines completed within 11 years.

Decisions to Leave Graduate Programs

Because not all graduate students complete their programs, we asked Graduate Student Follow-up Survey respondents to tell us if they left their first graduate program without completing the degree sought when they entered. The percentages of respondents in all samples reporting that they did so are small, ranging from 12% for Disciplinary fellows to 18% for Disciplinary peers. The most important reasons given for leaving programs were changing graduate programs, problems meeting academic requirements, family and other personal reasons, and accepting employment in the field of study. We found that very few NSF fellows changed graduate programs, which indicates that the portability benefit is not often used.

One problem with focusing too much attention on doctoral completion rates is the implication that those who do not complete doctoral programs have failed. Survey respondents offered many reasons for leaving graduate programs, and not all of them suggest that leaving meant either failure or leaving graduate study forever. Survey respondents also mentioned a lack of preparation for graduate school or inadequate guidance by faculty members as reasons for leaving.

> I entered graduate school because I was supposed to, based on what I had been told all my life. Once in graduate school, I found out that I was not ready for it. I really wanted it to be more like "real life." I wanted to get out of academia and apply what I had learned thus far, which is what I am doing now. I am still being encouraged, by my husband and also by my academic advisor, to complete a master's program. I am still not quite ready, but I will keep the option open. (MGF)

> As you can tell from my responses, I left [Institution E] in my first semester and therefore forfeited my NSF award. There were multiple factors in this decision. I had received inadequate career guidance as an undergraduate and graduate student so I was misguided

> in my desire for a Ph.D. in mathematics. The isolation and disconnectedness, combined with a lack of opportunity to participate in research and/or teaching, was also a significant factor. I will begin a Biostats ScD program at [University X's] School of Public Health in the fall. (Disciplinary fellow)

However, other survey responses emphasized that graduate students also leave programs with the intent to shift career focus or fulfill other obligations.

> Overall, I enjoyed my graduate school experience. I had to leave earlier than I wanted because my family was experiencing a financial rough spot, but I'm hoping to go back and do things, like publish and go to conferences, that I did not do. I am also planning to do research in a field like computer science or computational biology, where I see the research opportunities after school as greater. This was also another important thing I didn't spend too much time thinking about: What field or industry was I going to work in after finishing school and what are the research opportunities? (Disciplinary fellow and MGF)

> Having an NSF fellowship allowed me to transfer schools when I realized the 1st grad school I chose did not have a research project that seemed to be right for me. I did not complete my Ph.D., only my master's in engineering, but I also got a master's degree in physical therapy and am trying to combine both fields. I am currently getting ready to go back for my Ph.D. after having six years of clinical experience to guide my future research efforts. (WENG)

> A significant influence in my decision to leave my Ph.D. program in Political Science was that several friends in my program made a similar decision to go to law school. (MGF)

> I enjoyed my time at graduate school, but decided I wanted to do something different after completing my oral and comprehensive exams. I went back home to law school. (Disciplinary peer)

> I am an atypical respondent in that I worked for three years after completing my master's. I am currently in an MBA program. Even though I did not go into research, the NSF fellowship gave me an opportunity to explore a career in research and academia. (WENG)

Implications for Defining and Measuring GRF Program Success

As discussed earlier, assessments of graduate student success (and of the programs designed to support them) have relied on measures of time to degree and doctoral degree completion. We added measures of productivity during graduate school. Our findings suggest that these indicators provide at best an incomplete picture of GRF Program success. The GRF Program is providing support that is highly valued by fellows themselves and the graduate programs in which they are enrolled. Additionally, the productivity and completion rate data suggest that the GRF Program supports highly qualified students who demonstrate impressive accomplishments while still in graduate school.

It is important to keep in mind the contextual differences associated with graduate study in different disciplines and/or at different institutions, as well as those that stem from rapidly changing fields and job markets. Also important is the extent to which NSF fellows value the opportunity to have more time and flexibility to pursue additional coursework or research interests, particularly in relation to TTD. Faster does not necessarily mean better, in other words, and the benefits of the GRF freeing up discretionary time should not be underestimated.

TRANSITION POINT THREE: CAREER AND LIFE CHOICES OF GRADUATE STUDENTS

The goal of NSF support for graduate study is to ensure the quality and diversity of the next generation of the SMET workforce. Previous studies have used traditional measures of academic career success, including faculty status at research institutions, publications, and research grant awards. As with use of Ph.D. completion rates to measure academic success, these measures do not fully reflect the career choices and contributions of graduate students in SMET fields, including NSF fellows. This section combines results from the Graduate Student Follow-Up Survey with findings from the six site visits in order to present an integrated view of career aspirations and choices of NSF fellows and peers.

The number of respondents who completed the "career activities" section of the survey was substantially lower than it was for the survey overall (298 versus 541). Part of this difference stems from the fact that some 57 respondents had no career activities to comment upon yet, as they had been continuously enrolled in graduate school at the time of the survey. It appears possible that other respondents may have thought that this section did not apply to them. Therefore, findings from this section are interpreted with some caution. In particular, MGF fellows who responded were less likely than other groups to complete this section, with the exception of MGF fellows in Engineering. When combined with site visit data, however, the findings from the survey contribute usefully to the overall picture of NSF fellow and peer career aspirations and choices.

Initial Career Aspirations

While the Ph.D. is considered the union card for faculty positions, a doctorate does not necessarily mean that academia is the career of choice. In the Disciplinary sample, NSF fellows do not differ from program peers in terms of their pursuit of the Ph.D., although there are disciplinary differences. The most pronounced disciplinary difference is in Mechanical Engineering. In most disciplines, NSF fellows and peers initially pursued academic careers and entered graduate school seeking a Ph.D., but in Mechanical Engineering, they did not. More than 70% of Mechanical Engineering graduates (doctoral and master's levels combined) responding to the survey pursued careers in industry. Even with a Ph.D., most Mechanical Engineering students do not choose an academic career. This degree choice and career pattern is also evident among WENG fellows and MGF fellows in Engineering.

Site visit interviews revealed that, for the majority of NSF fellows and peers in fields other than Mechanical Engineering, initial career aspirations centered on academia.

> Students generally entered the program with a career in academia in mind. (A-BIO)
>
> The peers had long exchanges about the nature of the academic market, which they thought they wanted when they entered graduate school. (C-M)

> Close to 100% of students enter the program with their sights set on an academic career. (E-BIO)

> Although most students enter the program with the goal of achieving faculty positions, this changes over time. (C-EC)

> One NSF fellow began with academic aspirations, but is "seeing the trends" and is now thinking along the lines of industry or government laboratory. (F-BIO)

Shifts in Career Aspirations

Shifts in initial career aspirations occurred for both NSF fellows and peers. Students became less inclined to pursue careers in academia as time passed, and this shift seemed to be precipitated by a number of factors. One reason given by both NSF fellows and peers concerned the tight competition in the academic job market.

> The thing that had the most influence on my career choice was not grad school—it was the bad academic job market. My current job has almost nothing to do with my thesis, but I decided it would be better to work in industry than spend the next several years looking for low-paying temporary post-doc jobs with no guarantee of landing a professorship at even a small teaching college. (Disciplinary fellow)

> When I started, I thought I'd be in academia. It's shifted due to there not being lots of faculty jobs. (A-BIO)

> I came here to be an academic, but I was behind the veil of ignorance. I now realize how competitive it is. (D-EC)

Another reason students switched from academic to industry career goals had less to do with academia itself and more to do with the strong pull of more lucrative options elsewhere.

> I'd be lying if I said that money isn't an issue. (F-ME)

> Business pays off bigger, and faster, and there is a less certain future in academia. (C-EC)

> Medicine will provide me with more immediate rewards via patient interactions. Also, better financial rewards-not my primary motivation, but money doesn't hurt. (Disciplinary fellow)

A third factor, which we elaborate on below, concerned disconnects between initial expectations concerning careers in academia and the realities subsequently experienced or observed at research universities.

> I entered graduate school with the hopes of becoming a professor of mathematics at a research university. My experiences in graduate school helped me realize that I do not enjoy teaching in a classroom setting, and I do not enjoy theoretical research as much as I thought I did. (Disciplinary fellow)

> Before coming here, I'd have said I'd like to be a faculty member at an academic institution,…but I'm feeling jaded. I wouldn't want to be at an institution like [Institution A]. It's a miserable job. I love the science, but the schedule is terrible. (A-BIO)

Disenchantment with Academia

It appears that many NSF fellows and peers are moving away from a preference for academic careers and toward careers in government, business, or industry. Of particular note, however, is the degree of disenchantment apparent in negative student descriptions of academic careers in research universities that go beyond bad job markets or a preference for teaching over research. We saw this in responses to the survey's final open-ended question that was completed by 194 respondents. One-quarter of these respondents took time to spell out reasons why the academic life was not their choice or, for three of them, was a difficult choice. Some left doctoral programs for professional programs (JD, MD, MBA), and others either never sought academic positions or left them.

> A major issue not addressed is balancing the tenure track years with the childbearing years. This is a huge issue with many women, and I think it is a major reason why there are so few women in tenure track positions. I had a hard time deciding whether to pursue a tenure-track position and decided to see if I could make it work, but I had a lot of doubts and fears. (WENG)

> While I do not have many publications or awards, I have a good pedigree and an excellent current project that I could use to form the basis of a lab at a research institution/university. However, I have chosen to go into industry rather than academia because the culture seems more humane-better pay for working a more normal work week. (Disciplinary peer)

> Academics is unattractive to many recent Ph.D.s I've talked to because of high pressure and low pay of tenure track positions. Most graduates from our lab previously stayed in academics, but graduates from the past few years and current Ph.D. students are heavily weighted toward industry and consulting careers. The difficulties in obtaining grant funding are a problem. (Disciplinary fellow)

> Academic politics led to my work being downgraded and authorship denied on what my peers agreed were papers I had great input to. My advisor and I created a new research model system. I believe he downplayed my work and did not support my academic growth, as it was seen as a threat to his own credit for creating this model. This greatly soured me on academic life and caused me to take a position in industry. (Disciplinary peer)

> I have decided not to pursue a career in academia due to the lack of attention and guidance I received as a graduate student. (MGF)

> After I finished my Ph.D. (actually as I contemplated my next career step) I decided to pursue a different (but related) career in medicine. Basically, the rewards of a research scientist career were not equal to the energy, labor, and time that that career requires. (Disciplinary fellow)

> I have seen many, many postdocs struggle with no support from their advisor, and no financial compensation to make up for it. That has strongly influenced my decision to leave academics as soon as possible and take a career in industry, or get an MBA. (Disciplinary peer)

The words of such highly qualified graduate students who enrolled in top RU1 universities should be cause for concern to institutions of higher education. These students are not simply becoming more attracted to the alternatives available to them; rather, many are *rejecting* what they see as comprising the academic life. Our site visits also revealed that current graduate students have serious reservations about an academic career that go beyond their ability to secure an academic position. In spite of initial goals of academic careers, graduate students in all programs are looking at options other than RU1 faculty careers. Only a few students interviewed will pursue and expect to attain such a professorship. Depending on the field, career choices of students are likely to favor teaching at an institution where teaching in emphasized or working in industry.

Students are reluctant to discuss non-academic careers or teaching careers with faculty advisors, especially in programs where academic careers are clearly favored by faculty.

> To be admitted, you have to focus on academics. The faculty expect to turn out people just like themselves. (C-EC)

> Initially, I wanted to go into academia…but I believe I'll be much more likely to end up in biotech and industry, doing research definitely, but maybe not in academia…. It's too much. It's too many hours, too little money. It's too much of everything, and I want to have a life. (A-BIO)

> Initially, I wanted a professorship at someplace like [Institution C]. And now, I don't have the desire to do research. I'm thinking about teaching public policy or politics or something, but not the bench. Not the ball and chain. (A-BIO)

> My ultimate goal would be to be able to teach for whatever pittances they give to teachers, and I would prefer not to teach at an insane research university with the tenure system, which is possibly the dumbest system ever invented. So, I would like to be able to do that, but I would also like to be able to live the lifestyle I'd like to live. So I'll probably work in some money grabbing field for a while to get enough money to invest, and then I'll switch to teaching. (A-ME)

> I’m not forthcoming about it. I haven’t told them that I’m not going to be doing research. (D-BIO)

> I don't really want to go that route. I guess I do it well enough, but I don't like begging for money. (D-ME)

> I’m now wanting to avoid postdocing by whatever means necessary-perhaps by going into biotech industry. (E-BIO)

> The system is a mess. Graduate students get more money than postdoctorates. This isn't realistic. (C-M)

Although there is considerable uncertainty about careers among graduate students and an expressed need for better guidance, most NSF fellows and peers are, upon reflection, opting out of academic careers at research institutions. That is, among current NSF fellows and peers interviewed, the shift away from academia is pronounced, although many expressed their desire to teach at non-research institutions, including community colleges and high schools. In these careers, they are not likely to demonstrate success according to the same measures of academic productivity that apply to faculty at research universities. International students, especially in Mathematics, were most likely to pursue research and teaching careers at universities, either in their home country or in the U.S.

Challenges in Balancing Academic Careers and Family

Whether or not students shifted from initial academic career aspirations, many NSF fellows and peers expressed serious concern at the extent to which the pursuit of an academic career directly competes with spending time with families. This concern was expressed by both survey respondents and students interviewed during site visits. Although raised more frequently by women, men also expressed this concern.

> This would allow me more time for myself and my family…. You have to work really hard the first few years to get tenure, the very same time many people also start having kids. (Disciplinary peer)

> Graduate school definitely taught me one thing: it is impossible to have a happy family life and be a professor. I chose the former, as did most of my female friends. (Disciplinary peer)

> I see how my professor lives, and I’m not particularly interested in it. I want to have a family. (A-BIO)

> Four of the five students could see themselves teaching in ten years. Some of them felt they would be at smaller schools where they could balance their professional and family lives more evenly than they believe would be possible at a large, research university. (B-ME)

> When asked the 10-year-plan question, one fellow reflected: “My dreams? At that point I could see myself being a professor, married with children, and juggling it all." Another woman echoed her dream, with some emotion: "I hope to be teaching. I'll be 34. I hope to have a kid by that time, before I'm 35." (A-ME)

Faculty Views and Support of Student Career Options

There were no significant differences between NSF fellows and peers in their perceptions of faculty career expectations for them. However, Disciplinary fellows (56%) indicated that faculty members advised them to pursue academic careers with somewhat greater frequency than did their Disciplinary peers (45%). For example, 85% of Economics Disciplinary fellows indicated that faculty members had encouraged academic careers, compared to 75% of Economics Disciplinary peers. In Mathematics, 56% of Disciplinary fellows, compared to 46% of Disciplinary peers indicated faculty encouragement toward academia. For all disciplines except Mechanical Engineering, where the encouragement toward academia was far less, more than 50% of survey respondents reported that faculty had encouraged them to pursue academic careers. Comparing these findings to a report on earlier NSF fellows (Cerny & Nerad, 1999), it appears faculty may now be more likely to encourage careers in other employment sectors (government, non-profit, business, industry, and at other levels of education) than they were a decade ago.

Site-visit data and open-ended survey comments corroborated this preference for academia among faculty members, although there was some evidence to suggest that faculty recognize the increased likelihood that both NSF fellows and peers will pursue careers in government, business, or industry. For some faculty and administrators, this trend was acknowledged with reluctance while others embraced it. Moreover, faculty in the same departments often held different views.

> Increasingly, newly minted Ph.D.s are being drawn off into non-academic markets…. They’re going into semi-research jobs, like working for the International Monetary Fund or the World Bank or the Federal Reserve…. They may even have academic offers and still go into these positions instead. (A-EC)

> Since NSF fellows are considered among the top students, they may be more likely to seek academic positions. However, working conditions are generally getting worse for research-oriented Ph.D.s because of the huge emphasis on remedial teaching. (D-M)

> We’re not discouraging. We’re open and encouraging of these options being acceptable…. The faculty don’t speak with one voice, but overall, the environment is very open to different career options…. We have a number of seminars and programs that

> expose students to different career options. They're not even called career alternatives because that sounds pejorative. Ten or 15 years ago, there definitely used to be the attitude that these routes were inferior. Students used to have to sneak around behind their advisors' backs. (A-BIO)

> For U.S. students, there is no call for doctorates. The tenure-track route is a fast-fading dream. (C-ME)

> I think they are very wise. They've gotten street wise compared to maybe even ten years ago.... My best student…says, "You know I see how tough it is to get money." I think academia can potentially lose him. Getting funding-they know how difficult it is. They say, "I would love to be in academia, but I don't know if I want to pay that price."... Some of the best minds will not go into academia. (D-ME)

Student views of the extent to which faculty supported pursuing career options in industry varied considerably. Generally speaking, students from Mechanical Engineering and Biochemistry described the faculty as somewhat more accepting of careers in industry, but this was not always the case.

> Doing the dissertation should have taught me I wouldn't like research, but I went ahead with three years as an assistant professor anyway, only to discover what I already should have known. I attribute this to the very strong tilt to the academic career, which is present among the faculty at [Institution X]. Faculty who have chosen that path for themselves sometimes don't see it's not for everyone. (Disciplinary fellow)

> Unfortunately, little assistance is provided by the career center or my department to Ph.D. students looking for non-academic jobs. (WENG)

> While we were not dissuaded from pursuing non-academic research positions, I never felt exposed to non-research oriented careers. I feel this was a tremendous disservice and has made it difficult to figure out what path I want to take. (Disciplinary peer)

> The department was not very interested in helping students go into non-traditional careers; in fact, some professors were openly hostile to the idea. (Disciplinary peer)

> I have to give her [faculty advisor] credit for being supportive when I decided to pursue a career as a [science] writer. (E-BIO)

Careers Chosen by Graduates

In spite of speculation on the part of faculty that NSF fellows might be more likely to have academic careers, we found that differences in early career paths for Disciplinary fellows and peers varied by discipline. For example, more than 70% of both Disciplinary fellows and peers in Mechanical Engineering who responded to this question are pursuing careers outside of academia. While the majority of NSF fellows and peers in Mathematics and Biochemistry are in higher education, most are holding non-tenure track positions, including postdoctoral appointments. In Economics, NSF fellows showed a higher likelihood of holding a tenure-track position than did program peers, 61% compared to 35% (Tables G15.1; G15.2; G16.1; G16.2; G17.1; and G17.2). Site-visit interviews revealed that current NSF fellows and peers are increasingly likely to pursue careers in government, business, and industry.

We asked survey respondents to indicate the primary responsibility of their jobs. Research and development (R & D) followed by teaching responsibilities, were the most commonly listed primary responsibilities for both Disciplinary fellows and peers. Disciplinary fellows in Mathematics and Economics were more likely to list R & D as primary responsibility than were peers in both fields. While 76% of Mathematics fellows listed R&D as the primary responsibility (compared to 30% of Mathematics peers), 75% of Economics fellows listed R&D as the primary responsibility (compared to 53% of Economics peers). Among WENG and MGF fellows, R & D was also the most commonly listed primary responsibility (40% for WENG, 49% MGF). NSF fellows pursue careers in research and development in SMET fields, whether in academia or industry.

Perceived Impact of GRF on Job Search and Career Success

NSF fellows surveyed and interviewed were quite consistent in their view that being awarded an NSF fellowship was or would be beneficial to their careers. Current NSF fellows cited expected career-related advantages afforded by the fellowship and emphasized its prestige. The majority of NSF fellows in all survey samples (67% of Disciplinary fellows, 66% of MGF fellows, and 59% of WENG fellows) indicated that “having it on my CV helped/will help in my job search.” Some senior faculty and administrators we interviewed who had been NSF fellows spoke of the importance of the GRF in their own careers. Students expected to reap similar benefits.

> It still grabs people’s attention. It impresses people beyond reason. (E-BIO)
>
> It’s a brand name on your resume. (D-EC)
>
> One fellow thought that the prestige of the fellowship could help later also. (C-ME)
>
> Prestige was cited by students in both the Math and Biochemistry departments as being a key advantage of the GRF, particularly with respect to future job prospects. (E)

Open-ended survey comments revealed, however, that WENG and MGF awards carried with them, in some cases, not just prestige but a certain amount of stigma as well. Several NSF fellows commented on their discomfort with the fellowship’s “women” or “minority” designation.

> The NSF made me attractive, but being designated “minority” really hurt my career. (MGF)

> There was a strong perception, both during my undergraduate and graduate studies that women and minorities received support and other advantages not generally available…. The result, unfortunately, is that if a woman receives an NSF fellowship, it is discounted and presumed by most to be undeserved based on merit. (WENG)

Early Career Productivity

We asked survey respondents to report on traditional productivity measures, including professional presentations, publications, and grants received (Table G18.1). Disciplinary fellows in Economics and Mathematics exhibited higher levels of professional productivity than did their program peers in terms of refereed publications, which may reflect the greater percentage of fellows in those fields in faculty positions. In Economics, 64% of Disciplinary fellows had produced two or more refereed articles, as compared with 23% of peers. Similarly, 32% of Economics fellows had produced at least one book chapter, compared to 17% of peers, and 48% of Economics fellows, compared to 7% of peers, had procured at least one grant/contract as Principal Investigator. In Mathematics, 9% of fellows, compared to none of peers, had produced two or more non-refereed articles.

Reports of early productivity using these traditional measures for WENG fellows and MGF fellows are reported as frequencies since there are no comparison groups and probably reflect the differences in the samples (Table G18.2). For respondents in both samples, these measures show many with no presentation/publications and some who had produced a lot. For the WENG sample, this finding is likely related to the high number of women in engineering with careers in industry rather than academia. Even so, 76% had produced refereed articles and 7% had published a book or a chapter in a book.

Due to lack of response from the MGF sample for this section of the survey, we focus on those in Engineering because they responded in greater numbers. As with the WENG respondents, we see no or low productivity reported by most respondents. However, 68% of MGF Engineering fellows reported high levels of presentations and publications.

Teaching and Professional Service Since Graduate School

We asked for indications of teaching and professional service in careers. As with the traditional measures of professional productivity, differences existed between Disciplinary fellows and peers in the fields of Economics and Mathematics in the academic areas of teaching and professional service since graduate school (Table G19.1). In Economics, where Disciplinary fellows were more likely than peers to be tenure-track faculty, 68% of Disciplinary fellows, compared with 36% of peers had taught a graduate course. Similarly, 56% of Economics Disciplinary fellows, compared with 13% of Economics peers had served as a member of a dissertation committee. In Mathematics, where more Disciplinary fellows have faculty positions, 63% of Disciplinary fellows, compared with 27% of peers, had reviewed a manuscript or book chapter.

Both WENG and MGF (especially the Engineering) respondents reported limited teaching and academic professional service, reflecting the composition of those samples and non-academic employment (Table G19.2). Interestingly, 27% of WENG fellows reported having taught on-site in business or industry.

Other Professional Accomplishments

Depending on discipline, one-third to three-quarters of NSF fellows responding to the survey are employed in careers outside of higher education. Anticipating that many respondents would be employed in other sectors, we asked respondents to use another open-ended survey item to report achievements, honors, and awards received in those careers. Doing so widened the lens through which we viewed productivity because it identified measures of success other than those measures associated primarily with academia. Our intent was to explore how early professionals employed in other sectors are recognized for excellence.

Responses point to possible areas of future inquiry. They included employee awards for commitment to excellence or quality, awards for best papers at internal research meetings, best "designer," "sales representative," "employee of the quarter," etc., and various specialized awards and medals of recognition in a company or industry. For example, one respondent had received the Henry Ford Technology Award, which is the highest award at Ford Motor Company. Also mentioned were citation of work in the press, professional association service, service on boards of directors or as advisors, and founding successful start-up companies. These open-ended responses highlight the importance of developing relevant measures of success for SMET professionals employed outside academia.

Implications for Defining and Measuring GRF Program Success

Traditional measures of success for graduate students, and programs and institutions that support them, focus on doctoral completion rates, career placements within top-rated research universities, acquisition of tenure-track positions, and professional productivity in the form of scholarly publications, professional presentations, and procurement of research grants. Such indicators reflect a long-standing and deeply rooted emphasis on the desirability of the academic career track. Graduate student support programs that can demonstrate a strong link between their activities and students' subsequent procurement of faculty positions and productivity within research university contexts are likely to be considered effective. The underlying assumption is that NSF fellows will surely choose the academic life if it is open to them. While perhaps true at one time, today it is not so clear cut.

The current study evaluating the effectiveness of the GRF Program employed standard measures of program effectiveness, while also allowing for the exploration of various facets of the ever-changing context surrounding GRF recipients. When held up against the yardstick of traditional doctoral student outcome measures, the GRF Program continues to be successful in selecting and supporting the preparation of the next generation of productive academic faculty members, particularly in the disciplines of Economics and Mathematics. However, for other disciplines such as Mechanical Engineering where industry job markets are strong and a doctoral degree is not essential, the picture is less clear.

However, traditional measures of success are challenged by the deep disillusionment with academia and its demands that was evident across disciplines by NSF fellows and peers alike. When the GRF Program supports a Biochemistry fellow whose use of fellowship funds culminates in the voluntary decision to terminate with a master's degree or switch to medical school, should this be seen as an alternative route to success, or a failure against traditional measures? Similarly, what meaningful indicators of success exist for a Ph.D.'s career within a highly profitable biotechnology firm with a corporate culture that is favorable to having a family but discourages employees from publishing results that might impact business?

Findings regarding career and life choices pursued by NSF fellows and their peers suggest that the GRF Program continues to be successful in selecting and supporting many of the "the best and brightest" students in science, mathematics, engineering, and technology, who in turn enhance the nation's SMET workforce. However, the career marketplace is shifting, and student experiences within and satisfaction with academic life may be shifting too. Broader measures of GRF Program success are needed to more fully capture the variety of forms that success can take among NSF fellows.

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 <u>Graduate-level</u>, 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.

REFERENCES

Baker, J. (1994). Career paths of the National Science Foundation graduate fellows of 1972-1981. Washington, D.C.: Office of Scientific and Engineering Personnel (OSEP), National Research Council (NRC).

Baker, J. (1995). Minority science paths: National Science Foundation Minority Graduate Fellows of 1979-1981. Washington, D.C.: OSEP, NRC.

Blanpied, W. A. (May 1999). The National Science Foundation class of 1952. Unpublished manuscript.

Bowen, W. G., and Rudenstine, N. L. (1992). In pursuit of the Ph.D. NJ: Princeton University Press.

Carnegie Foundation. (1994). A classification of institutions of higher education, 1994 edition. A technical report. NJ: The Carnegie Foundation for the Advancement of Teaching.

Cerny, J., and Nerad, M. (1999). NSF fellows and their doctoral peers in the *Ph.D.'s–Ten years later* study. Report to National Science Foundation. Berkeley: authors.

Cerny, J., and Nerad, M. (In Press). The PhD: Passport to multiple destinations. Baltimore, MD: The Johns Hopkins University Press.

Clark, B. R. (1987). The academic life: Small worlds, different worlds. Princeton, NJ: The Carnegie Foundation for the Advancement of Teaching.

Committee on Science, Engineering and Public Policy (COSEPUP). (1995). Reshaping the graduate education of scientists and engineers. Washington, D.C.: National Academy Press.

Goldman, C. A., and Massy, W. F. (2001). The Ph.D. factory: Training and employment of science and engineering doctorates in the United States. Boston, MA: Anker Publishing Company.

Harmon, L. R. (1977). Career achievements of NSF graduate fellows: The awardees of 1952-1972. Washington, D.C.: Commission on Human Resources, NRC.

Johnson, E. C. (January 1987). Descriptive analysis of program participants and academic outcomes: The Minority Graduate Fellowship program, FY 1978-1981. A preliminary report. Unpublished manuscript.

National Research Council. (1995). Research-doctorate programs in the United States: Continuity and change. Washington, D.C.: National Academy Press.

National Research Council. (1996). Evaluation report 1995: Quality profile for the 1994-1995 Survey of Earned Doctorates. Office of Scientific and Engineering Personnel. Washington, DC: author.

National Science Board. (1998). Science and engineering indicators–1998. (NSB 98-1) Arlington, VA: National Science Foundation.

National Science Foundation. (November 1988). Legacy to tomorrow. Arlington, VA: author.

National Science Foundation. (1995). NSF in a changing world: The National Science Foundation's strategic plan. Arlington, VA: author.

National Science Foundation. (1997a). 1998 Guidelines for Submission of Applications: NSF Graduate Research Fellowships. NSF 97-133. Arlington, VA: author.

National Science Foundation. (1997b, September). GPRA Strategic Plan for FY 1997-FY 2003. Arlington, VA: author.

National Science Foundation. (1998). Survey of federal science and engineering support to universities, colleges, and nonprofit institutions, FY 1997. Arlington, VA: author.

National Science Foundation. (1998, March). National Science Foundation FY 1999 GPRA performance plan. Arlington, VA: author.

National Science Foundation. (1999a, February). National Science Foundation FY 2000 GPRA performance plan. Arlington, VA: author.

National Science Foundation. (1999b). NCES degrees awarded by degree level and field, AY 1996. Available: http://caspar.nsf.gov.

Owings, J.; Madigan, T.; and Daniel, B. (1988, November). Who goes to America's highly ranked "national" universities? NCES 98-095. Washington, D.C.: U.S. Department of Education, Office of Educational Research and Improvement.

Padilla, R. V. (1993). HyperQual2 Version 1.3 [Computer Program]. Chandler, AZ: author. (Address: 3327 N. Dakota, Chandler, AZ 85224 USA).

Smith, D. G.; Wolf, L. E.; and Busenberg, B. (1996). Achieving faculty diversity: Debunking the myths. Washington, D.C.: Association of American Colleges and Universities.

Snyder, J. (1988). Early career achievements of National Science Foundation graduate fellows, 1967-1976. Washington, D.C.: OSEP, NRC.

Sween J. (1982). An evaluation of the scientific career achievements attributable to the National Science Foundation Graduate Fellowship, 1952-1972. Report to NSF (Contract SM17715053). Chicago: author, DePaul University.

Webster, D. S., and Skinner, T. (1996, May/June). Rating PhD programs: What the NRC report says…and doesn't say. Change, 28 (3), 22-43.

APPENDIX A: PANEL OF EXPERTS

Mary Golladay, Program Director, Human Resources Statistics Program, Division of Science Resources, National Science Foundation, Arlington, VA.

Maresi Nerad, Director of Graduate Research, Graduate Division, University of California, Berkeley, CA.

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Albert Teich, Director of Science and Policy Programs,
American Association for the Advancement of Science, Washington, D.C.

NSF staff members from the Division of Research, Evaluation and Communication and the Division of Graduate Education also participated in the review of the evaluation design.

APPENDIX B: METHODOLOGY

We used a mixed methods approach that included secondary data analysis, primary data collection and analysis using a survey questionnaire, and interviews conducted during institutional site visits.

Analysis of Attendance Patterns and Completions

We used two existing data sets to examine sending and receiving institutions for NSF fellows and doctoral completion rates–the National Science Foundation's Cumulative Index (CI) and annual Survey of Earned Doctorates (SED).

Cumulative Index (CI). The CI is a file that contains records for every individual who applies for a GRF. Records include information on undergraduate institution and undergraduate performance, GRE scores, the outcome of the review process, and demographics. The CI goes back to the beginning of the fellowship program in 1952 and was updated each year until 1989. From 1989 to 1993, partial information was added each year, but it has not been maintained since then. In order to undertake complete analysis through 1993 awardees, we also obtained from NSF an updated data set extracted from the GRF Program's internal management information system that identified NSF fellows and Quality Group 2 non-awardees. This enabled us to analyze data for the 1979 through 1993 cohorts of fellows.

If individuals applied more than once, they will be in the CI more than once. We therefore selected the latest applicant record for each individual in order to assess their success in receiving a fellowship. Demographic data for individual years, such as the 1979 and 1993 comparisons in Tables G6 and G7 are based on all applicants in those years. We matched each institutional Office of Scientific and Engineering Personnel (OSEP) identification code to Carnegie institutional categories (Carnegie Corporation, 1994) using a crosswalk provided by NSF contractor Quantum Research Corporation Inc.

Survey of Earned Doctorates (SED). The SED is administered annually to all new doctoral recipients from U.S. institutions. Graduate schools are responsible for submitting completed forms to the National Opinion Research Center (NORC), which administers the survey on behalf of NSF. A study undertaken by the National Research Council (NRC, 1996) confirmed high self-report response rates to this survey of 94%. There is excellent coverage of research doctorates because NORC is also able to create skeleton records for all those who do not return a questionnaire, based on information provided by institutions. Each year new data are added to the cumulative file, known as the Doctorate Records File (DRF). The most recently added year covers those who received doctorates between July 1998 and June 1999.

With NSF authorization, WestEd provided NORC with a file containing the following information for each NSF fellow and Quality Group 2 non-awardee from the CI (unduplicated) from 1979 through 1993: social security number; name (first, last, middle); date of birth (day, month, year); gender; and baccalaureate institution OSEP code. The file included 10,104 individuals awarded the GRF (including 1295 who declined the fellowship) and 3379 QG2 non-awardees.

Using this file, NORC staff sequentially performed six matching tests, including visual review to eliminate false matches, with the 1999 DRF and returned to WestEd a file that indicated whether a doctorate had been granted, year of award, institution, and field. WestEd received data from NORC on 8589 matched cases indicating completion of the Ph.D. According to NORC staff, these cases represented the best possible match given the available data. The matched cases were then compared to the updated GRF data set to generate a database from which we undertook the completions analyses contained in the body of this report. This database included 6535 individuals awarded the GRF (including 727 who declined the fellowship) and 2054 QG2 non-awardees. Decliner information is not included in this report.

Graduate Program Quality Ratings. We used as our measure of the quality of programs attended by GRF fellows ratings from the National Research Council's 1993 study (NRC, 1995). This study collected information on 3634 research-doctorate programs at 274 U.S. universities. To generate reputational measures of quality, the study conducted the National Survey of Graduate Faculty in Spring 1993. We used the 93Q measure of program effectiveness, which is defined in the study as:

> the 1993 trimmed mean for scholarly quality of program faculty. Dropping the two highest and two lowest scores on the survey obtain the trimmed mean before computing the average. For purposes of analysis, scores were converted to a scale of 0 to 5 with 0 denoting 'not sufficient for doctoral education' and 5 denoting 'distinguished'. (NRC 1995, p. 25)

The scale was converted to five groupings, with programs scoring 4.01+ categorized as Distinguished, 3.01-4.00 = Strong, 2.51-3.00 = Good, 2.00 – 2.50 = Adequate, 1.00 – 2.50 = Marginal, and less than 1 = Not Sufficient (p. 32).

The field code contained on the SED file can be crosswalked to the NRC ratings file, and so we were able to attach to each record the program Quality Rating for each doctoral completer based on their institution of graduation and field code. Field codes on the CI, however, were not compatible with the NRC categorization, and so we were unable to attach a Quality Rating to programs in which NSF fellows enrolled. We used as a proxy for this measure information from a study undertaken by Webster and Skinner (1996). These researchers used the NRC program ratings to develop discipline group ranking by institution. Institutions were included when they had specific numbers of programs included in the NRC study by discipline grouping as follows: Biological Sciences = 7; Engineering = 8; Physical Sciences and Mathematics = 4; Social and Behavioral Sciences = 3. Only the top twenty institutions in each group were ranked. This more general grouping allowed us to relate field categories from the CI to the discipline group ranking.

The Graduate Student Follow-up Survey

The Graduate Student Follow-up Survey was administered to three samples–the Disciplinary sample, the MGF sample and the WENG sample.

Samples

Disciplinary Sample. We wanted to compare NSF fellows to non-fellows (program peers) enrolled in the same graduate programs. We identified a database that allowed the selection of a comparison group of graduate students who were enrolled in the same programs as many GRF recipients. This was the American Association of Universities (AAU)/Association of Graduate Schools (AGS) database on doctoral students, administered by the Educational Testing Service (ETS). The AAU/AGS Project for Research on Doctoral Education database was established in 1989 to collect student-level data from AAU institutions. Forty institutions have participated although some have not done so on a regular basis. The first fields included were Biochemistry, Economics, English, Mathematics, and Mechanical Engineering. Four of these are SMET fields included in NSF's mission. In 1992, the fields of Chemical Engineering, History, Physics, Electrical Engineering, and Psychology were added.

We obtained authorization from the AAU/AGS Project's Steering Committee to use the database. We also received permission from each of the participating institutions to use their data from the database. We needed first to match the CI to the AAU/AGS file to see how many NSF fellows who received awards between 1989 and 1993 were also in the latter file. ETS undertook this match and returned to us the tabulated results. They found approximately 500 fellows in the four NSF disciplines of Biochemistry, Economics, Mathematics, and Mechanical Engineering. From these tabulations we established criteria for inclusion in the study.

We included all institutions that had at least two beginning NSF fellows in the match. The Massachusetts Institute of Technology, which enrolls high numbers of NSF fellows had not participated in the AAU/AGS database but agreed to work with WestEd directly to enable its NSF fellows and their program peers to participate in this evaluation. Because of the concentration of NSF fellows by field in a few institutions, we estimate that we included in the survey samples approximately 61% of 1989-1993 fellows in Biochemistry, 81% in Economics, 62% in Mathematics, and 71% in Mechanical Engineering.

When we had identified the 15 institutions that met our criteria (plus MIT), we contacted their chief academic affairs officers to seek permission to use the AAU/AGS database to draw a sample of peers who began the same programs as the NSF fellows at the same time. Appendix D contains the list of participating institutions. We also asked them to help us locate addresses for these NSF fellows and program peers.

After we obtained this permission, ETS provided WestEd with an extract of the AAU/AGS database for these institutions. This allowed us to match the file to the CI to identify NSF fellows in the AAU/AGS database. Our final count was 480. We then selected a probability sample of peers, stratified by institution and the four disciplines. Our aim was to select two peers for each fellow surveyed (a 2X sample), anticipating that we might have more difficulty in locating peers and that their response rate may be lower since the questionnaire clearly is related to the GRF. There were a few cases where there were insufficient program peers for a 2X match. However, since we did not analyze the four groups as a single set, these differences did not disrupt the design of the study. Discounting the individuals we could not contact (194 or 17.15%), our response rate for the Disciplinary Sample is 41.41%. Completed surveys received from 200 NSF fellows (55.71%) and 188 program peers (32.53%) have been included in the analysis for this report.

MGF Sample. We also administered the same Graduate Student Follow-up Survey to 200 MGF recipients (35% sample), regardless of discipline or institution enrolled in. The Minority Graduate Fellow sample was randomly drawn from the Cumulative Index from 1989-1993. The MGF sample included fellows in 33 disciplines at 62 institutions. Discounting individuals we could not contact (25 or 12.50%), the response rate is 49.71% and includes questionnaires received from 88 MGF recipients. The MGF sample was analyzed independently of the Disciplinary sample. There was no comparison group of peers for this sample.

WENG Sample. In order to see how the Women in Engineering GRF recipients have fared in comparison to other fellows, we also administered the Graduate Student Follow-up Survey to 143 WENG recipients from 1990-1993 (a 50% sample).

The WENG sample was randomly drawn from the Cumulative Index from 1990-1993 and included fellows in various sub-fields of engineering (not just the Mechanical Engineering area that was the focus of the Disciplinary sample) at 46 institutions. After using the same follow-up and search procedures and discounting individuals we could not contact (18 or 12.58%), the response rate is 68.00% and includes questionnaires received from 85 WENG recipients. The WENG sample was analyzed independently of the Disciplinary sample analysis. There was no comparison group of peers for this sample.

Questionnaire Design and Administration

WestEd developed the questionnaire in 1998. We pilot tested an alpha version of the survey with four former NSF fellows and two non-fellows. These respondents represented several disciplines and institutions, different enrollment years, and programs with different quality ratings. The panel of experts and NSF staff also reviewed the instrument. A beta version was then pilot tested with two respondents to confirm that the changes worked and establish the amount of time to complete. Approval for its administration was obtained from the Office of Management and Budget (OMB) in December 1998. The questionnaire was mailed in January 1999 and continuously thereafter as possible addresses were obtained for additional recipients. Those living abroad received the questionnaire by Federal Express, where possible, or by U.S. mail. Appendix C contains the survey questionnaire.

Location strategies. For Disciplinary fellows and peers, we sent lists to the 16 institutions for help in locating respondents. We also sought institutional help in locating fellows drawn for the MGF and WENG samples from 69 institutions. Many of the addresses given to us by the institutions were no longer valid, and two institutions, citing privacy concerns did not provide addresses for some or all students. We sent postcard follow-ups to individuals whose questionnaires were not returned either completed or as undeliverable. We hired a private investigation firm to further search for current addresses, but some individuals still could not be found, and more questionnaires were returned as undeliverable. We counted as "located" individuals whose questionnaires were not returned as undeliverable. It is highly unlikely that in fact all these surveys reached their intended recipients. So our response rate is calculated on a base that removes only those whom we know that we could not locate and may in fact be higher than we have reported here.

Our experience demonstrates the difficulty of research involving graduate students also experienced by other researchers. Institutions do not keep track of their former graduate students, and NSF does not keep track of its former fellows.

As expected, the response rate is higher for NSF fellows than program peers. Comparing the distribution of respondents by disciplinary area to the total population of NSF fellows, we found them to be quite similar (Table B1). This is especially true for MGF respondents, whose distribution by discipline area is almost identical to the population of fellows in 1993. Because of the small number of cases, we do not separate out most of the analyses of MGF responses by discipline (Engineering being the exception). The similarity of the disciplinary distribution between the total MGF population and the MGF sample enables us to be confident that the results are representative.

Table B1

Disciplinary Distribution of Survey Respondents

	Engineering (Mechanical Engineering)	Math / Comp Science / Phys. Sciences (Math)	Biological/Life Sciences (Biochemistry)	Behavioral & Social Sciences (Economics)
GF 1993 Population	31%	23%	24%	23%
Disciplinary Fellows	27%	25%	16%	32%
Disciplinary Peers	22%	27%	26%	26%
WENG	100%*			
MGF 1993 Population	34%	16%	23%	27%
MGF	41%	16%	21%	22%

*5 WENG fellows received their graduate degrees in Math. They are all treated as Engineering fellows for purposes of this study since they were awarded fellowships in Engineering.

Data Analysis. Responses were entered into a database. A set of derived variables was designed to simplify analysis of responses to many of the questions. The more detailed data collected through the questionnaire enabled us to choose appropriate categorizations and investigate responses that appeared inconsistent. Differences observed did not attain statistical significance.

We found three significant problems with respondent accuracy. First, 34 respondents did not give us information beyond their bachelor's degree in response to question 1.17. The second problem occurred in the transition from Section 1 of the questionnaire to Section 2. We did not clearly phrase the transition question to emphasize that only those who had been continuously enrolled in graduate school as their primary activity should skip Section 2.

We estimate that about one-quarter of respondents incorrectly failed to answer Section 2. Third, at the beginning of Section 3, we asked for information about financial support in graduate school, but our respondents like those in other studies, such as the SED, did not grasp the intricacies of their sources of funding. Responses to these questions have not been included in the report.

We also added descriptive information to some data elements. All institutions were given their appropriate OSEP code and through that their Carnegie Classification was added. Respondents were asked to choose from a table that was provided the field code for their study. These fields, along with the OSEP code, were designed to map to the NRC Ph.D. program ratings, and we added the 93Q value for each designated field of study.

Institutional Site Visits

Two-person teams conducted interviews over a 2- to 4-day period at six research universities. With advice from the panel of experts and NSF staff, these institutions were selected on the basis of enrollment of significant numbers of NSF fellows as well as geographical location and institutional type. In addition to administrators and staff responsible for graduate studies and fellowships at each university, we interviewed faculty, staff, and students in a total of 19 departments corresponding to the four disciplines selected for the Disciplinary sample for the survey: Biochemistry (5), Economics (3), Mathematics (6), and Mechanical Engineering (5). Interview protocols were approved by OMB in December 1998 and may be found in Appendix E. Interviews were tape recorded to ensure accuracy of the accounts.

Teams created site reports for each institution that were combined in Hyperqual2, a qualitative data analysis program (Padilla, 1993). The data was then sorted using a coding plan (Appendix F) to identify patterns and issues. This sorting made it possible to read across the six site reports and compare responses by departments and by type of person interviewed. Each code produced a set of findings supported by data from the interviews. Both site report text and direct quotations have been used in this report to illustrate findings.

At the six institutions, we interviewed 75 administrators, faculty, and staff. We interviewed 149 students (73 NSF fellows and 76 peers). Only one student interviewed (a peer) indicated having a disability. There was more gender balance in the NSF fellows interviewed (Table B2).

Table B2

Comparison of NSF Fellows and Peers Interviewed: Gender

Gender	Fellows N=73	Peers N=76
Men	41 (56.2%)	52 (68.4%)
Women	32 (43.8%)	24 (31.6%)

Only 5.5% of NSF fellows and 6.6% of peers interviewed were Hispanic, but the NSF fellows were more racially and ethnically diverse than peers interviewed (Table B3). Since only U.S. citizens and Permanent Residents are eligible for the GRF, there were no international students

among NSF fellows; however, 14% of the peers interviewed were international students (Table B4). Most of the NSF fellows and peers interviewed were in the second through fourth year of their graduate program (Table B5).

Table B3

Comparison of NSF Fellows and Peers Interviewed: Race and Ethnicity

Race and Ethnicity	Fellows N=73	Peers N=76
Ethnicity		
Hispanic	4 (5.5%)	5 (6.6%)
Not Hispanic	67 (91.8%)	69 (90.8%)
Unknown	2 (2.7%)	2 (2.6%)
Race		
American Indian/Alaskan Native	0	0
Asian	12 (16.4%)	8 (10.5%)
Black/African American	3 (4.1%)	3 (3.9%)
Native Hawaiian/Pacific Islander	0	1 (1.3%)
White	51 (69.9%)	63 (82.9%)
Multiple Races Identified	5 (6.8%)	1(1.3%)
Unknown	2 (2.7%)	0

Table B4

Comparison of NSF Fellows and Peers Interviewed: Citizenship Status

Citizenship Status	Fellows N=73	Peers N=76
U.S. Citizen	72 (98.6%)	59 (77.6%)
Permanent Resident	1(1.4%)	3 (3.9%)
International Student	N/A	14 (18.4%)

Table B5

Comparison of NSF Fellows and Peers Interviewed: Year in Program

Year in Program	Fellows N=73	Peers N=76
1	9 (12.3%)	11 (14.5%)
2	22 (30.1%)	21 (27.6%)
3	22 (30.1%)	13 (17.1%)
4	9 (12.3%)	21 (27.6%)
5, 6 or just comp leted	11(15.1%)	10 (13.2%)

APPENDIX C:
GRADUATE STUDENT FOLLOW-UP
SURVEY QUESTIONNAIRE

Respondent ID #___________________

GRADUATE STUDENT FOLLOW-UP SURVEY
Conducted by WestEd for
The National Science Foundation

Purpose of the study: This survey is being conducted for the National Science Foundation as part of its efforts to learn about the educational, professional career advancement, and scholarly achievements of graduate students. The survey is soliciting responses from a sample who began graduate programs between 1989 and 1993. The study is designed to collect information on the careers and accomplishments of graduate students who changed programs, left before completion, completed their degrees, or are still enrolled.

Use of information: The results of the survey will assist the National Science Foundation in assessing the effectiveness of its programs that support graduate education, will be used to consider modifications to current programs, and will inform and facilitate reporting as part of the Government Performance and Results Act. Any information that would permit identification of individual respondents will be held in strict confidence. Your response is voluntary and failure to provide some or all of the requested information will not in any way adversely affect you.

Privacy Act and Public Burden Statements. The information requested on this survey is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information from this data collection will be retained as part of the Privacy Act system of Records in accordance with the Privacy Act of 1974. Data submitted will be used in accordance with the criteria established by NSF for monitoring research and education grants, and in response to Public Law 99-383 and 24 USC 1885c. The information requested may be disclosed to qualified researchers and contractors or in order to coordinate programs and to a Federal agency, court or party in a court or Federal administrative proceeding if the government is a party. Information may be added to and maintained by the Education and Training System of Records 63 Federal Register 264, 272 (January 5, 1998).

Submission of information is voluntary. Public burden for this collection of information is estimated to average .75 hours per response, including the time for reviewing instructions. Send comments regarding this burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden to: Suzanne Plimpton, Reports Clearance Officer, Systems and Services Branch, Division of Administrative Services, National Science Foundation, Arlington, VA 22230. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. The OMB number for this survey is 3145-0136.

INSTRUCTIONS

Thank you for taking the time to complete this important questionnaire. Directions are provided for each question. Because not all questions will apply to everyone, you may be asked to skip certain questions.

- Please use a black pen or dark lead pencil
- When answering questions that require marking a box, please use an “X”.
- When this questionnaire was pilot tested, respondents commented that it would be useful to have a curriculum vita handy to assist in completing some of the questions.
- If you have any questions about completing this questionnaire, please call WestEd's toll free number at 877-221-2216 between 8:00 a.m. and 5:00 p.m. Pacific Time.

Please return the survey in the enclosed envelope within 7 days to:

Evaluation Research
WestEd
4665 Lampson Avenue
Los Alamitos, CA 90720

Thanks again for your help. We really appreciate it.

We will ask you to use codes that describe your fields of study in several of the questions in this survey.

Field of Study Codes

Biological/Life/Ag. Sciences

01 Biochem. & Molecular Biology
02 Cell & Developmental Biology
03 Molecular and General Genetics
04 Neuroscience
05 Pharmacology
06 Ecology, Evolution & Behavior
07 Physiology
08 Agricultural Sciences, Other
09 Biological and Life Sciences, Other

Health Sciences

11 Medicine (MD)
12 Nursing
13 Pharmacy
14 Veterinary Medicine
15 Public Health
16 Environmental Health
17 Health Administration
19 Health Sciences, Other

Physical Sciences

21 Chemistry
22 Physics
23 Mathematics
24 Computer Sciences
25 Geosciences
25 Statistics/Biostatistics
27 Astrophysics/ Astronomy
28 Oceanography
29 Physical Sci, Other

Engineering

31 Electrical Engineering
32 Mech. Engineering
33 Chemical Engineering
34 Civil Engineering
35 Materials Engineering
36 Aerospace Engr.
37 Biomedical Engr.
38 Industrial Engineering
39 Engineering, Other

Social and Behavioral Sciences

41 Psychology
42 Economics
43 Political Science
44 Sociology
45 Anthropology
46 Geography
49 Social Sciences, Other

Humanities

51 History
52 English Lang. and Lit.
53 Foreign Lang. and Lit.
54 American Studies
55 Archeology
56 Art History & Related
57 Philosophy
58 Performing Arts
59 Humanities, Other

Education

61 Teacher Education
62 Education, Other

Business and Management

71 Bus. Mgmt and Admin. Serv.
72 Communications
79 Business and Management, Other

Other Professional Fields

81 Architecture, Environ.Design
82 Home Economics
83 Law
84 Library Science
85 Public Administration
86 Social Work
87 Theology/Religious Ed.
89 Other Professional Fields, Other

90 **Other Fields, not included above**

Section 1: Graduate Education

In this section we ask you some questions about your experiences in graduate school.

1.1 What was the most recent doctoral program you were enrolled in? If you have never been enrolled as a doctoral student, please use the most recent master's program you were enrolled in.

Institution and Location	Field of Study Codes (page 2)	Degree Sought	Dates Enrolled
	Number	Type	

For the remainder of this survey, the graduate program identified above will be your **REFERENCE PROGRAM.**

1.2 Did you leave the first graduate program in which you enrolled without completing the degree you initially sought?

- ❑ Yes ⇒ Continue with Question 1.3
- ❑ No ⇒ Go to Question 1.7

1.3 Which program did you leave?

Institution and Location	Field of Study Codes (page 2)	Degree Sought	Dates Enrolled
	Number	Type	

1.4 What was your status when you left this program?

Mark all that apply.

1. ❑ Left with master's degree
2. ❑ Left at "All But Dissertation" status
3. ❑ Left with other credential
4. ❑ Left with no degree or credential

1.5 Which of the following influenced your decision not to complete the program you left?

Mark all that apply.

1. ❑ To accept employment in my field of study
2. ❑ To accept employment in another field
3. ❑ The possibility of more employment opportunities in a different field
4. ❑ The possibility of making more money in a different field
5. ❑ My chosen work does not require a PhD
6. ❑ To move with my faculty adviser to a new institution
7. ❑ To enter a different graduate program
8. ❑ Financial problems
9. ❑ Medical reasons
10. ❑ Family or other personal reasons
11. ❑ Problems meeting academic requirements
12. ❑ Problems with my dissertation adviser
13. ❑ A non-supportive department climate
14. ❑ The environment for minority students in my program
15. ❑ The environment for women students in my program

1.6 Of items 1-15 above, which one was the *most* important in making the decision to leave your graduate program? Place number in space. _______

1.7 Please evaluate the following aspects of your REFERENCE PROGRAM.

Mark one box for each item.

	Aspect of Program	Excellent	Satisfactory	Poor	Not Applicable
1.	Overall advice and guidance	❑	❑	❑	❑
2.	Curriculum..	❑	❑	❑	❑
3.	Instruction	❑	❑	❑	❑
4.	Training in research methods	❑	❑	❑	❑
5.	Research experience	❑	❑	❑	❑
6.	Training for TA position	❑	❑	❑	❑
7.	Support from dissertation/thesis adviser......................	❑	❑	❑	❑
8.	Assistance on job search...	❑	❑	❑	❑
9.	Environment for minority students	❑	❑	❑	❑
10.	Environment for women students.................................	❑	❑	❑	❑
11.	Perceived reputation of the program.............................	❑	❑	❑	❑
12.	Perceived reputation of the university..........................	❑	❑	❑	❑

1.8 Which of the following best describes your assessment of the career expectations of members of the faculty in your department during your REFERENCE PROGRAM?

Choose one.

1. ❑ Faculty did not counsel students on career choice.
2. ❑ Faculty encouraged both academic and non-academic jobs.
3. ❑ Faculty mainly encouraged graduate students to pursue academic jobs.
4. ❑ Faculty mainly encouraged non-academic jobs.

1.9 Did you receive support from your REFERENCE PROGRAM in each of the following areas?

Mark all that apply.

1. ❑ Opportunities to learn about proposal writing
2. ❑ Help in publishing my work
3. ❑ Opportunities to present my research
4. ❑ Funds to attend professional meetings

1.10 Did your graduate experience in your REFERENCE PROGRAM involve the activities listed?

Mark all that apply.

1. ❑ Working on a team with people other than your adviser
2. ❑ Collaborating with another person
3. ❑ Undertaking interdisciplinary research
4. ❑ Learning organizational or managerial skills
5. ❑ Opportunities to interact with professionals in the field who were not academics

1.11 Which of the following skills should be developed in graduate school for your subsequent professional success?

Mark all that apply.

1. ❑ Working on a team with people other than your adviser
2. ❑ Collaborating with another person
3. ❑ Undertaking interdisciplinary research
4. ❑ Learning organizational or managerial skills

1.12 Knowing what you know now, if you were considering graduate education for the first time, what would your decision be?

Choose one.

1. ❑ Not pursue graduate education
2. ❑ Pursue an academic master's degree (MA, MS, etc.)
3. ❑ Pursue a professional master's degree (MBA, MSW, etc.)
4. ❑ Pursue a PhD in the same field
5. ❑ Pursue a PhD in a different field
6. ❑ Pursue a medical degree (MD)
7. ❑ Pursue a law degree (JD)
8. ❑ Pursue another type of professional degree

Professional Accomplishments While in Graduate School

Please include in this section activities that were accomplished while in graduate school (include all graduate programs in which you enrolled).

1.13 How many papers did you present at professional meetings during your graduate education?

	Number of Papers Presented
Regional/National meetings	
International meetings	

1.14 How many publications did you produce while in graduate school? Include publications that were in press.

	Primary Author (Number)	Other Co-Author (Number)
Refereed journal articles		
Non-refereed articles (i.e., newspaper and magazine articles, book reviews)		
Book chapter/edited book		
Book published		

1.15 How many patents were you involved in applying for while in graduate school? (Number)________

1.16 Please list awards, service, and other professional accomplishments during graduate school.

Undergraduate and Graduate Education Background

In the table below please provide information on your postsecondary education including all colleges and universities attended and degrees received (if any) as indicated in the example. Start with most recent graduate or professional program attended and include your undergraduate degree. Include graduate and professional programs you did not complete. Use the codes for the field of study provided on page 2.

Example

Institution and Location			Years Attended		Field of Study Codes (page 2)	Degree Sought	Degree Earned	Year Awarded
Institution			From	To	Number	Type	Type	
University of California			*1990*	*1996*	*01*	*PhD*	*PhD*	*1996*
Branch or City	State or Province	Country (if not U.S.)						
Berkeley	*CA*							

Institution and Location			Years Attended		Field of Study Codes (page 2)	Degree Sought	Degree Earned	Year Awarded
Institution			From	To	Number	Type	Type	
Branch or City	State or Province	Country (if not U.S.)						
Institution			From	To	Number	Type	Type	
Branch or City	State or Province	Country (if not U.S.)						
Institution			From	To	Number	Type	Type	
Branch or City	State or Province	Country (if not U.S.)						
Institution			From	To	Number	Type	Type	
Branch or City	State or Province	Country (if not U.S.)						
Institution			From	To	Number	Type	Type	
Branch or City	State or Province	Country (if not U.S.)						

1.18 Has graduate or professional study been your primary activity since you entered GRADUATE SCHOOL?

- ❑ Yes ⇒ Go to Section 3 page 14
- ❑ No ⇒ Continue to Section 2

Section 2: Career Activities

We are interested in your professional employment history (including postdoctoral positions) since graduate school. Please start by telling us your job(s) on January 10, 1999, and then provide employment information for prior years when graduate school was not your primary activity. If you held multiple positions at one time, use a separate line for each position. If there are periods when you were not in the workforce, please show this on a separate line and enter a reason from List A. If you held the same position for several years, you can show this my checking the "no change" box.

EMPLOYMENT STATUS (LIST A)	**TYPE OF ORGANIZATION (LIST B)**	**TYPE OF POSITION (LIST C)**	**PRIMARY RESPONSIBILITIES UNDERTAKEN/SUPERVISED (LIST D) (LIST NO MORE THAN 2 CODES IN THE ORDER OF IMPORTANCE)**
1. **Employed** 2. **Not in workforce** a. Medical condition b. Seeking employment c. Voluntarily out of workforce, not seeking employment 3. **Further education** (exclude postdoctoral study) 4. **Retired**	1. Small business /industry (< 25) 2. Other business/industry 3. Self-employed 4. State/local government/agency 5. Federal government/agency 6. National laboratory 7. International organization 8. Other non-profit organization 9. University that grants Ph.D. 10. College or university that does not independently grant the Ph.D. 11. 2-yr/community college 12. Elementary or secondary school 13. Medical school 14. Hospital/clinic 15. Military 16. Other	1. **Higher Education Sector** 2. Postdoctoral fellow (includes temporary academic appointment with reduced/no teaching requirement) 3. Non-tenure-track faculty 4. Tenure-track faculty 5. Tenured faculty 6. Researcher (not faculty) 7. Administrator/manager (not faculty) 8. Clerical/support 9. Other 10. **Business, non-profit, government, schools sectors** 11. Owner/partner 12. Administrator/manager 13. Professional 14. Clerical/support 15. Consultant 16. Other	1. Research and development 2. Teaching/training 3. Student services 4. Human resources services 5. Information technology services 6. Legal services 7. Clinical/medical services 8. Manufacturing/engineering-related services 9. Public relations 10. Writing/editing 11. Marketing/sales 12. Finance 13. Planning/budgeting 14. Administration/management, general/other 15. Other

AN EXAMPLE: **This person held a full-time faculty position as of January 10, 1999. In 1998 she held a part-time teaching position for part of the year, and was unemployed while looking for a job for part of the year. She graduated from her program at the end of 1997, and until then graduate study had been her primary activity since first entering graduate school.**

Year	**Name of Organization and branch, if any** (write in)	**Name of Department** (write in)	**State or Country** Use state abbreviation Write in name of country	**Full-time/ Part-time** FT/PT	**Employment Status** Use code list (A)	**Type of Organization**	**Type of Position** Use code list (C)	**Primary Responsibility** Use Code list (D)
1999 Job 1	*Michigan St. U.*	*Economics*	*MI*	*FT*	*1*	*9*	*3*	*2/1*
1998 Job 1			*CA*		*2b*			
Job 2	*CSU Los Angeles*	*Economics*	*CA*	*PT*	*1*	*10*	*2*	*2*

Year	**Name of Organization and branch, if any** (write in)	**Name of Department** (write in)	**State or Country** Use state abbreviation Write in name of country	**Full-time/ Part-time** FT/PT	**Employment Status** Use code list (A)	**Type of Organization** Use code list (B)	**Type of Position** Use code list (C)	**Primary Responsibility** Use Code list (D)

Year	Name of Organization and branch, if any (write in)	Name of Department (write in)	State or Country Use state abbreviation Write in name of country	Full-time/ Part-time FT/PT	Employment Status Use code list (A)	Type of Organization Use code list (B)	Type of Position Use code list (C)	Primary Responsibility Use Code list (D)
Jan 10 1999 Job 1								
Job 2								
Job 3								
1998 Job 1	❑ No change							
Job 2								
Job 3								
1997 Job 1	❑ No change							
Job 2								
Job 3								
1996 Job 1	❑ No change							
Job 2								
Job 3								
1995 Job 1	❑ No change							
Job 2								
Job 3								

Year	**Name of Organization and branch, if any** (write in)	**Name of Department** (write in)	**State or Country** Use state abbreviation Write in name of country	**Full-time/ Part-time** FT/PT	**Employment Status** Use code list (A)	**Type of Organization** Use code list (B)	**Type of Position** Use code list (C)	**Primary Responsibility** Use Code list (D)
1994 Job 1	❑ No change							
Job 2								
Job 3								
1993 Job 1	❑ No change							
Job 2								
Job 3								
1992 Job 1	❑ No change							
Job 2								
Job 3								

Year	**Name of Organization and branch, if any** (write in)	**Name of Department** (write in)	**State or Country** Use state abbreviation Write in name of country	**Full-time/ Part-time** FT/PT	**Employment Status** Use code list (A)	**Type of Organization** Use code list (B)	**Type of Position** Use code list (C)	**Primary Responsibility** Use Code list (D)
1991 Job 1	❑ No change							
Job 2								
Job 3								
1990 Job 1	❑ No change							
Job 2								
Job 3								
1989 Job 1	❑ No change							
Job 2								
Job 3								

Professional Accomplishments Since Graduate School

Please include in this section activities that were completed after graduate school. Do not include activities that you already reported earlier as graduate school accomplishments.

2.2 What postdoctoral fellowships have you been awarded? If you did not receive a postdoctoral fellowship, mark here ❑ and go to the next question.

Name of Postdoctoral Fellowship Awarded	Did you accept this award?	
	Yes	No
1.	❑	❑
2.	❑	❑
3.	❑	❑
4.	❑	❑

2.3 How many papers have you presented since graduate school?

	Number of Papers Presented
National meetings	
International meetings	

2.4 How many of the following publications have you produced since graduate school? (Include publications in press.)

	Primary Author (Number)	Other Co-Author (Number)
Refereed journal articles		
Non-refereed articles (i.e., newspaper and magazine articles, book reviews)		
Book chapters/edited books		
Books published		

2.5 How many patents have you been involved in applying for since graduate school? (Number)_________

2.6 What grants/contracts have you been awarded as Principal Investigator? If you have not received a grant as PI, mark here ❑ and go to the next question.

Type of Agency	Number of Grants or Contracts	Total Amount (Including Overhead)
Federal government		
State government		
Local government		
Foundation		
Business/industry		
Employing organization		

2.7 What teaching activities have you undertaken since graduate school?

Mark all that apply.

1.	❑	Taught course(s) in K-12	11.	❑	Participated in curriculum development
2.	❑	Taught undergraduate course(s)	12.	❑	Mentored/tutored elementary students
3.	❑	Taught graduate course(s)	13.	❑	Mentored/tutored junior/senior high students
4.	❑	Developed new course(s)	14.	❑	Mentored undergraduates
5.	❑	Taught interdisciplinary course(s)	15.	❑	Mentored graduate students
6.	❑	Team taught course(s)	16.	❑	Member of master's thesis committee
7.	❑	Taught distance education course(s), including Internet	17.	❑	Chair of master's thesis committee
8.	❑	Taught course(s) on-site in business/industry	18.	❑	Member of dissertation committee
9.	❑	Taught course(s) on-site in other non-academic settings	19.	❑	Chair of dissertation committee
10.	❑	Used computers for instruction	20.	❑	Other (please specify)____________________

2.8 What professional service have you undertaken since graduate school?

Mark all that apply.

		Service
1.	❑	Conference presentation proposal reviewer
2.	❑	Manuscript/chapter reviewer
3.	❑	Departmental committee
4.	❑	Institutional/company-wide committee
5.	❑	Professional organization committee
6.	❑	Local community/government committee/panel
7.	❑	State-level committee/panel
8.	❑	National committee/panel
9.	❑	Off-campus peer review panel, accreditation and certification team
10.	❑	Member of editorial board of professional journal
11.	❑	Editor of professional journal
12.	❑	Other (please specify)____

2.9 Please list honors and awards you have received.

2.10 Please list any other professional accomplishments since graduate school that you wish to tell us about.

Section 3: Financial Support in Graduate School

3.1 Indicate financial support and employment while enrolled in graduate school full time.

Mark all that apply.

Graduate Assistantship

1. ❑ Research Assistantship
2. ❑ Teaching Assistantship
3. ❑ Administrative Assistantship

Employed

4. ❑ On Campus
5. ❑ Off Campus
6. ❑ **1.17** Held Fellowship or Traineeship

3.2 What graduate fellowships did you apply for as a graduate student? If you did not apply for any fellowships as a graduate, mark here ❑ and go to next question.

Name of Fellowship	Awarded?		Number of years available	Number of years held
	No	Yes / Accepted? Yes		
1.	❑	❑ ⇒		
2.	❑	❑ ⇒		
3.	❑	❑ ⇒		
4.	❑	❑ ⇒		
5.	❑	❑ ⇒		
6.	❑	❑ ⇒		

3.3 Have you heard of the NSF Graduate Research Fellowship program (including the Minority Graduate Fellowship)?

❑ No ⇒ Please go to Section 4 page 19
❑ Yes ⇒ Continue with Question 3.4

3.4 When did you first hear of the NSF Graduate Research Fellowship Program?

Choose one.

1. ❑ Before I began undergraduate studies
2. ❑ While I was an undergraduate
3. ❑ During my first year in graduate school
4. ❑ Later in my graduate program
5. ❑ After I left graduate school

3.5 How did you learn about the NSF Graduate Research Fellowship program?

Mark all that apply.

1. ❑ From other students
2. ❑ From the university administration (e.g., Graduate Division, Career Counseling Center, Financial Aid)
3. ❑ From my undergraduate adviser/program
4. ❑ From my graduate faculty adviser/program
5. ❑ From attendance at a conference
6. ❑ By exploring the NSF Web site
7. ❑ From materials I received in the mail
8. ❑ Other (please specify) ______________________________

3.6 Have you ever applied for an NSF Graduate Research Fellowship (including the Minority Graduate Fellowship)?

❑ Yes ⇒ Go to Question 3.8
❑ No ⇒ Continue with Question 3.7

3.7 Why didn't you apply for a NSF Graduate Research Fellowship?

Mark all that apply.

1. ❑ I did not think I would have a chance of success
2. ❑ I had too many graduate credits to apply
3. ❑ NSF does not offer fellowships in my field of study
4. ❑ Other fellowships offered higher stipends
5. ❑ I already had funding for my graduate studies
6. ❑ I am/was not a U.S. citizen
7. ❑ I am/was not a permanent U.S. resident
8. ❑ I did not know about it when I was a senior or first-year graduate student
9. ❑ Too much work to complete application process
10. ❑ Other (please specify) ______________________________

If you did not apply for an NSF Graduate Research Fellowship, please go to Section 4 on page 19.

The rest of the questions in this section are to be answered only by persons who applied for an NSF Graduate Research Fellowship, including the Minority Graduate Fellowship.

3.8 If you applied for an NSF fellowship as a senior, which of the following items were important in your decision to apply? If you did not apply as a senior, mark ❑ here and go to Question 3.9.

Mark all that apply.

1. ❑ Encouraged by undergraduate adviser
2. ❑ Encouraged by college or university administrative unit
3. ❑ Encouraged by peers/fellow students
4. ❑ Encouraged by family
5. ❑ Encouraged by graduate department I wanted to attend
6. ❑ My institution ran a workshop on how to apply
7. ❑ Information on NSF Web-site
8. ❑ NSF Program materials
9. ❑ Other (please specify) ______________________________

3.9 If you applied for an NSF fellowship as a first-year graduate student, which of the following items were important in your decision to apply? If you did not apply as a first year graduate student mark ❑ here and go to the next question.

Mark all that apply.

1. ❑ Encouraged by graduate adviser
2. ❑ Encouraged by graduate department
3. ❑ Encouraged by peers/fellow students
4. ❑ Encouraged by family
5. ❑ My institution ran a workshop on how to apply
6. ❑ Information on NSF Web-site
7. ❑ NSF program materials
8. ❑ Received Honorable Mention in previous application
9. ❑ Received other encouragement in previous application
10. ❑ Other (please specify) ______________________________

3.10 Were you awarded an NSF Graduate Research Fellowship?

Choose one.

❑ No, I was never awarded an NSF fellowship ⇒ Please go to Section 4 page 19
❑ Yes, I was awarded a fellowship on my first application ⇒ Continue with Question 3.11
❑ Yes, I was awarded a fellowship on my second application ⇒ Continue with Question 3.11

3.11 Did you accept the NSF Graduate Research Fellowship?

Choose one.

❑ Yes ⇒ Go to Question 3.13
❑ No ⇒ Continue with Question 3.12

3.12 Why did you not accept the NSF Graduate Research Fellowship?

Mark all that apply.

1. ❑ I received another financial award that offered a higher stipend
2. ❑ I received another financial award that offered better non-stipend support (i.e., expenses for research or travel)
3. ❑ I decided not to pursue my graduate studies at that time
4. ❑ Other (please specify) ______________________________

Now go to Section 4 page 19.

Questions 3.13 through 3.16 are for individuals who have held NSF Graduate Research Fellowships, including Minority Graduate Fellowships.

3.13 What were the advantages of having an NSF Graduate Research Fellowship?

Mark all that apply.

1. ❑ Full-time study allowed for a quicker start in program
2. ❑ Will/did shorten my time to degree completion
3. ❑ Reputation among faculty as a good student
4. ❑ Perception by peers as being a good student
5. ❑ Better opportunity to choose research projects
6. ❑ I was an asset to faculty to work on their projects because I had my own funding
7. ❑ Having it on my CV helped/will help in job search
8. ❑ Financial support (stipend)
9. ❑ Tuition assistance (cost of education allowance)
10. ❑ Other (please specify)____

3.14 What were the disadvantages to holding an NSF Graduate Research Fellowship?

Mark all that apply.

1. ❑ No office space provided by department
2. ❑ Less opportunity to work with faculty on their research projects (RA)
3. ❑ Less opportunity to work collaboratively with other students
4. ❑ Less opportunity to teach (TA)
5. ❑ Isolated from other students in program
6. ❑ Could not live on stipend alone
7. ❑ Support only lasted 3 years
8. ❑ Other (please specify) ____

3.15 Did your institution offer you financial support after your fellowship ended?

Choose one.

❑ Yes
❑ No
❑ Not applicable, did not need additional aid

3.16 In your field, are there fellowships or other sources of student support that are more desirable than the NSF Graduate Research Fellowship. If so, why?

	Fellowship or Other Source (please write in)	Larger Stipend	Longer Duration	More Prestige	Other-please specify:
1.		❑	❑	❑	
2.		❑	❑	❑	
3.		❑	❑	❑	

Section 4: Demographics

4.1 Are you...

- ❑ Female
- ❑ Male

4.2 What is your date of birth?

Month	*Day*	*Year*

4.3 Ethnicity.

Choose one.

- ❑ Hispanic or Latino
- ❑ Not Hispanic or Latino

4.4 Race.

Choose one or more.

- ❑ American Indian or Alaska Native
- ❑ Asian
- ❑ Black or African American
- ❑ Native Hawaiian or Other Pacific Islander
- ❑ White

4.5 Citizenship when I began my REFERENCE PROGRAM.

Choose one.

- ❑ U.S. Citizen or national*
- ❑ Permanent Resident
- ❑ Other non-U.S. Citizen (temporary resident)

4.6 Disability status.

Choose one or more.

- ❑ Hearing Impairment
- ❑ Visual Impairment
- ❑ Mobility/Orthopedic Impairment
- ❑ Other (please specify) ____
- ❑ None

❑ **Check here if you do not wish to provide any or all of the above information.**

* The term "national of the United States" designates a citizen of the United States or a native resident of a possession of the United States, such as American Samoa. It does not refer to a citizen of another country who has applied for United States Citizenship.

Section 5: Final Reflections

5.1 We would like to hear about any aspects of your graduate school experience not raised in the survey that have had a major influence on your career choices and accomplishments. Please use this space to describe.

Thank You for Completing This Survey

Please return this questionnaire in the envelope provided.

WestEd
Evaluation Research
4665 Lampson Ave
Los Alamitos, CA 90720
(562) 598-7661

APPENDIX D: INSTITUTIONS INCLUDED IN THE DISCIPLINARY SAMPLE

- California Institute of Technology
- Cornell University
- Harvard University
- Massachusetts Institute of Technology
- Ohio State University
- Princeton University
- Rice University
- Stanford University
- University of California, Berkeley
- University of California, Los Angeles
- University of California, San Diego
- University of Illinois, Urbana-Champaign
- University of Michigan
- University of Washington
- University of Wisconsin, Madison
- Yale University

APPENDIX E: SITE VISIT PROTOCOLS

P1-Graduate Division Protocol

We want to get an understanding of the significance of NSF fellowships to the institution and identify key policies and practices that influence the **institutional context** for fellows. This protocol may also be used (in an abridged form) for other university administrators interviewed.

Participants

- Dean of Graduate Studies (or Associate Dean, if the Dean is unavailable)
- Staff with fellowship and/or graduate student support responsibilities
- Possibly: data analyst who tracks patterns or conducts internal surveys of graduate students

Questions

DEAN: How significant to the university is enrollment of NSF fellows?

STAFF: What has been the pattern of enrollment of NSF fellows over time and by department?

ALL: What would be the impact on the university if there were no NSF fellowships? [Look for evidence of institutional interest in fellows – special programs, staff, internal research.]

ALL: What is your perception of the NSF Graduate Research Fellowship? Its strengths and weaknesses? What other graduate fellowship programs are considered better, and why?

DEAN: Who determines the level of support for graduate students?

STAFF: What are the major sources of funding, amounts of stipends, duration of support? How is the NSF "Cost of Education" allowance (currently $10,500 per year) used? If less than tuition and fees, is it supplemented, and how? If there is a surplus, how is it used? [Note current tuition/fees.]

DEAN: What part do NSF fellowships play in financial planning for graduate education?

ALL: Does the Graduate Division encourage eligible first-year graduate students to apply for NSF fellowships?

ALL: Other comments on the value of NSF fellowships to the university

Collect any data or materials that they have prepared for the visit.

Exit Interview

- Raise any issues that have come up during the departmental visits.
- Clarify policies, if necessary.
- Ask for any additional data needed.
- Thank them for participating in the study; answer any questions.

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P2-Departmental Protocol: Faculty

University departments have different cultures and are the institutional decision point for graduate programs including curriculum, admissions, and student support. We want to get an understanding of the **departmental context** for NSF fellows in the four disciplines that are our focus.

Participants

- Graduate Program Coordinator (titles vary–this is the faculty member most directly responsible for the graduate program)

- Faculty (especially those who have worked with NSF fellows or previously served as coordinator)

- Possibly: the Department Chair [For departments with no fellows interview the Chair or Graduate Program Coordinator only.]

Questions

1. What do you see as the primary benefit to the fellow of having an NSF Graduate Research Fellowship? What does it mean to the faculty that a graduate student is an NSF fellow? What other fellowship programs are considered better in this discipline, and why?

2. Does being an applicant for, or a recipient of, an NSF fellowship influence admissions decisions? How competitive is the department with other institutions for top students? Are eligible first-year graduate students encouraged to apply for an NSF fellowship?

3. Do NSF fellows complete their Ph.D.s at the same rate and in the same time as other graduate students? Are the educational experiences of NSF fellows comparable to non-fellows? If there are differences, what are they? [Look for evidence of integration into the graduate program versus isolation or independence and for whether this is advantageous to the fellow or not.]

4. What are the career aspirations of your Ph.D. students? How many accept postdoctoral appointments? How many aspire to and achieve faculty status? Do NSF fellows have different opportunities or make different choices compared to non-fellows? [If yes, explore how and why.]

5. What would happen to your department's graduate program if there were no NSF fellowship program?

6. Other comments on the benefits of NSF fellowships to department and to fellows? [Examples?]

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P3-Departmental Protocol: Staff

Each department will have an office devoted to graduate students. The principal staff person in this office knows a great deal about the graduate students and maintains departmental records. We want to know about departmental norms and practices and how NSF fellows fit in this department.

Participant

Usually the head of this office is a Student Affairs Officer or Student Services Officer.

Questions

1. What are the departmental patterns for the graduate program; for example, Ph.D./master's ratios, gender, ethnicity, international students? [This may have been requested in advance but ask for an explanation of data provided.] How many Ph.D. students are admitted each year? Master's students? What are the enrollment patterns for NSF fellows in the department (since 1989 if available)?

2. How are graduate students supported through the Ph.D. in the department? How many students receive full support? What is the usual level of stipend support and other assistance? What, if any, supplements are provided to NSF fellows during the fellowship? How are they supported in years they do not have the fellowship? Do NSF fellows complete the Ph.D. at the same rate and in the same time as other graduate students?

3. What are the TA and RA opportunities and expectations in the department? Do the same opportunities and expectations apply to NSF fellows as to other students? Are there better fellowships in this discipline? If so, why are they better for the student?

4. When do most NSF fellows use the three years (1-3, 2-4) of the fellowship? Are there departmental policies on use of fellowship funds? How many defer years? Are eligible first-year graduate students encouraged to apply for NSF fellowships?

5. What are the career goals of Ph.D. students? How many accept postdoctoral appointments? How many receive faculty positions? Are there different patterns of career choices between NSF fellows and other graduate students?

6. Other observations or comments on what it means to be an NSF fellow in this department?

7. Collect any data or materials that they have prepared for the visit.

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P4 – Graduate Student Protocol: NSF Fellows

We want to understand the graduate student experience of NSF fellows in each department and how NSF fellows assess the advantages and any disadvantages of being an NSF fellow. For each current or former NSF fellow, collect the following information: race/ethnicity; gender; year in program; years of fellowship (1-3, 2-4); citizenship; disability status; and undergraduate institution. Form provided.

Questions

1. When and how did you first learn of the NSF Graduate Research Fellowship program? When did you first apply? Were you successful the first time? If not, did you receive an honorable mention? Why did you decide to reapply? Was your award a Minority GRF or Women in Engineering award? What other fellowships did you apply for, and which did you receive?

2. If you received the award as a college senior, did you enroll in the institution that you identified as your first choice on the application? If not, why did you enroll in your current institution? Did receipt of the NSF fellowship influence your decision? Have you transferred institutions? If so, why? Did having the NSF fellowship influence this decision? Have you changed degree programs, or are you considering it? If so, from what program, to what program, and why?

3. What do you think are the advantages of being an NSF Graduate Research fellow? How has it helped you in your graduate program? Are there disadvantages to being a fellow? Is the NSF stipend sufficient? [$15,000] What benefits beyond the stipend, if any, have you received from NSF?

4. What additional support have you received during your fellowship? For the years that you are not receiving NSF fellowship support, what support have you or will you receive? Have you worked during your fellowship? If so, how many hours and what kind of work (include TA or RA work)? Do you think that this work has complemented your education? Increased your time to completion? Both? Neither?

5. Are your experiences and opportunities different from your peers who do not have NSF fellowships, for example, to TA or RA? Have you ever felt isolated from other graduate students because of your fellowship? Do you and other NSF fellows have any group identity or activities apart from other graduate students? [Look for evidence that they know or work with other fellows in the department.]

6. What were your career goals entering your graduate program? Have they changed? Have you had any professional accomplishments, such as presenting papers or publishing, as a graduate student? If so, what are they? How have faculty here influenced your career choices or assisted your early career professional development?

7. What do you think you will be doing in 10 years?

8. Other comments or observations on what it has meant to you to be an NSF fellow?

Collect CVs from fellows.

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NSF FELLOWS INFORMATION SHEET

NAME: ____

YEAR IN PROGRAM: _______ DEPARTMENT:______________________________

YEARS OF NSF FELLOWSHIP: (e.g.: 1-2-3, 2-3-4, etc.)________________________

UNDERGRADUATE INSTITUTION:____

MAJOR:____

GENDER: ❑ FEMALE ❑ MALE

ETHNICITY: (choose one)
- ❑ Hispanic or Latino
- ❑ Not Hispanic or Latino

RACE: (select one or more)
- ❑ American Indian or Alaska Native
- ❑ Asian
- ❑ Black or African American
- ❑ Native Hawaiian or Other Pacific Islander
- ❑ White

CITIZENSHIP: (choose one)
- ❑ U. S. Citizen
- ❑ Permanent Resident
- ❑ Other non-U. S. Citizen

DISABILITY STATUS:
(select one or more)
- ❑ Hearing Impairment
- ❑ Visual Impairment
- ❑ Mobility/Orthopedic Impairment
- ❑ Other (please specify)______________
- ❑ None

❑ Check here if you do not wish to provide any or all of the above information.

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P5-Graduate Student Protocol: Program Peers

We want to understand the graduate student experience of non-NSF fellows in the same graduate programs and how the NSF fellowship is perceived by program peers. As time permits, encourage group discussion of the following questions and look for comments that show how an NSF fellowship is distinguishable from other sources of support. These will be 60-minute group interviews with approximately five graduate students from each department.

For each program peer, collect the following information: citizenship; race/ethnicity; gender; year in program; disability status; and undergraduate institution. Form provided.

Questions

1. Why did you choose to enroll in this graduate program? Was your decision influenced by financial support available?

2. What are the sources of support for your graduate program through to your Ph.D.? Do you receive support beyond a stipend or salary? Do you work, and, if so, for how many hours, and what kind of work (include TA and RA work)? Do you think that this work has complemented your education? Increased your time to completion? Both? Neither?

3. Did you ever apply for an NSF Graduate Research Fellowship? If so, was it as a college senior or first-year graduate student? Did you receive an award? Did you receive an honorable mention? Did you reapply if you did not receive an award the first time? f you declined an NSF fellowship, what were your reasons?

4. Do you think that NSF fellows in your graduate program have any advantages that you do not? If so, what are they? Are your experiences and opportunities in graduate school different from NSF fellows, for example, to be a TA or RA?

5. What were your career goals entering your graduate program? Have they changed? Have you had any professional accomplishments, such as presenting papers or publishing, as a graduate student? If so, what are they? How have faculty here influenced your career choices or assisted your early career professional development?

6. What do you think you will be doing in 10 years?

7. Other comments or observations on your experience as a graduate student?

Collect CVs from program peers.

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GRADUATE STUDENT INFORMATION SHEET

NAME: ____

YEAR IN PROGRAM: _______ DEPARTMENT: ____________________________

UNDERGRADUATE INSTITUTION: ____

MAJOR: ____

GENDER: ❑ FEMALE ❑ MALE

ETHNICITY: (choose one)
- ❑ Hispanic or Latino
- ❑ Not Hispanic or Latino

RACE: (select one or more)
- ❑ American Indian or Alaska Native
- ❑ Asian
- ❑ Black or African American
- ❑ Native Hawaiian or Other Pacific Islander
- ❑ White

CITIZENSHIP: (choose one)
- ❑ U. S. Citizen
- ❑ Permanent Resident
- ❑ Other non-U. S. Citizen

DISABILITY STATUS:
(select one or more)
- ❑ Hearing Impairment
- ❑ Visual Impairment
- ❑ Mobility/Orthopedic Impairment
- ❑ Other (please specify)__________________
- ❑ None

❑ Check here if you do not wish to provide any or all of the above information.

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APPENDIX F: SITE VISIT CODING PLAN

Tag	Code
ADMIT	Admissions decisions & recruitment of NSF fellows
ADV	Advantages of GRF
APP	Application for GRF – how they learned about it & decision to apply
CAREER	Careers–choices & aspirations both short-term and 10 years
COE	Cost of Education use
DEC	Decliners–reasons given
DEF	Deferral use or pattern
DEMO	Demographics of department-context
DIS	Disadvantages of GRF
ENROLL	Enrollment choices & changes–the portability factor
FAC	Faculty influence on careers
FELL or PEER	Fellow or peer or other–USE ONE with other tag to identify speaker
FUNDING	Funding of graduate students–policies; levels of support
GRF	Comments, perceptions, and suggestions
INT	Integration and identity
PUB	Early career success-publications & presentations in graduate school
SOURCES	Other sources of support
SUPP	Supplementing NSF stipend
TTD	Time to degree–expectations & decisions to leave
UNIV	Impact and policies–university and department
WORK	Work while in graduate school

APPENDIX G: TABLES REFERENCED IN TEXT

Transition Point One

G1 Top Five Institutions of Baccalaureate Graduation by Discipline Group for NSF Fellows: 1979-1993
G2 Selected Characteristics of Applications and Fellows by Program Component: 1979 and 1993
G3 Selected Characteristics of Applications and Fellows by Gender: 1979 and 1993
G4.1 Success Rates of GF Applicants by Type of Undergraduate Institution
G4.2 Success Rates of MGF Applicants by Type of Undergraduate Institution
G5 Destination Institutions by Discipline Group for GF Fellows: 1979-1993
G6 Destination Institutions by Discipline Group for MGF Fellows: 1979-1993

Transition Point Two

G7 Advantages and Disadvantages of the NSF Graduate Research Fellowship
G8 Eleven-Year Doctoral Completion Rates by Gender and Discipline
G9 Completion Rates of 1979-1988 NSF Fellows and Non-Awardees Completing Doctoral Study by 1999 by Gender and Quality Group
G10 Completion Rates of NSF Fellows and Non-Awardees Completing Doctoral Study by 1999 by Discipline and Quality Group
G11 Completion Rates of GF Fellows and MGF Fellows by Discipline Group
G12 Eleven-Year Doctoral Completion Rates by Fellowship Type and Discipline
G13 Completion Rates of MGF Fellows and Non-Awardees by Discipline Group
G14 Completion Rates of 1979-1988 NSF Fellows and Non-Awardees Completing Doctorate by 1999 by Program Category and Quality Group

Transition Point Three

G15.1 Type of Organization of Employment for Disciplinary Fellows and Peers as of January 1999
G15.2 Type of Organization of Employment for WENG and MGF Fellows as of January 1999
G16.1 Type of Position Held by Disciplinary Fellows and Peers in January 1999
G16.2 Type of Position Held by WENG and MGF Fellows in January 1999
G17.1 Primary Responsibility in Employment for Disciplinary Fellows and Peers in January 1999
G17.2 Primary Responsibility in Employment for WENG and MGF Fellows in January 1999
G18.1 Professional Productivity of Disciplinary Fellows and Peers since Graduate School
G18.2 Professional Productivity of WENG and MGF Fellows since Graduate School
G19.1 Teaching and Professional Service for Disciplinary Fellows and Peers since Graduate School
G19.2 Teaching and Professional Service for WENG and MGF Fellows since Graduate School

Tables for Transition Point One

Table G1

Top Five Institutions of Baccalaureate Graduation by Discipline Group for NSF Fellows: 1979-1993

Engineering/Math/ Physical Sciences		Biological/Life Sciences		Social/Behavioral Sciences	
MIT	7%	Harvard	4%	Harvard	9%
Princeton	4%	UC Berkeley	4%	Yale	4%
UC Berkeley	4%	Cornell	4%	Princeton	4%
Harvard	4%	Yale	3%	Stanford	4%
Stanford	3%	Stanford	2%	U.C. Berkeley	4%
Total percentage of Fellows from top five institutions	22%	Total percentage of Fellows from top five institutions	17%	Total percentage of Fellows from top five institutions	24%

Table G2
Selected Characteristics of Applications and Fellows by Program Component: 1979 and 1993

	Applications				Fellows			
	GF		MGF		GF		MGF	
	1979	1993	1979	1993	1979	1993	1979	1993
Number of applications	3768	7316	520	1318				
Number of fellows (may include multiple counts for those who submitted multiple applications)					466	739	58	131
Percentage who are:								
White	90.4%	75.0%	0	0	90.3%	71.2%	0	0
Asian/Native Pacific Islander	2.6%	7.8%	0	3.9%	2.8%	10.3%	0	7.6%
African American	2.3%	9.0%	69.0%	54.2%	1.5%	6.2%	55.2%	35.9%
Hispanic	1.4%	6.3%	26.7%	37.5%	1.7%	9.6%	36.2%	48.1%
Native American/Alaskan	0.2%	0.8%	4.2%	4.5%	0.2%	1.8%	8.6%	8.4%
Unknown	3.2%	1.1%	0	0	3.4%	0.9%	0	0
Percentage from RU1 BA institution	48.6%	52.5%	26.5%	40.3%	61.6%	69.1%	32.8%	66.4%
Engineering	13.2%	24.8%	10.4%	26.8%	10.3%	30.6%	5.2%	34.4%
Math/Computer Science	10.8%	10.9%	6.0%	11.7%	10.9%	10.6%	3.4%	9.2%
Physical Sciences	21.5%	14.7%	14.6%	9.3%	20.8%	12.7%	19.0%	6.9%
Life Sciences	31.4%	28.6%	31.0%	23.1%	34.1%	23.7%	32.8%	22.9%
Social Sciences	15.9%	14.7%	25.0%	21.2%	16.7%	15.7%	24.1%	18.3%
Behavioral Sciences	7.1%	6.3%	13.1%	7.9%	7.1%	6.8%	15.5%	8.4%
Mean age	23.4	24.6	25.0	25.4	23.0	23.8	24.1	24.5
Mean Quantitative GRE	692	698	495	586	758	750	586	695
Mean Verbal GRE	615	603	448	494	700	669	564	608
Mean GPA	3.6	3.5	unk	3.25	3.8	3.8	unk	3.6
Mean years since BA	.8	1.6	1.6	1.9	0.8	1.2	1.9	1.6

Table G3

Selected Characteristics of Applications and Fellows by Gender: 1979 and 1993

	Applications				Fellows			
	Women		Men		Women		Men	
	1979	1993	1979	1993	1979	1993	1979	1993
Number of applications	1447	3858	2841	4776				
Number of fellows (may include multiple counts for those who submitted multiple applications)					146	379	378	491
Percentage by gender	34%	45%	66%	55%	29%	43%	71%	57%
Percentage who are:								
White	74.9%	59.1%	81.8%	67.2%	77.4%	56.5%	81.5%	63.5%
Asian/Native Pacific Islander	1.8%	7.1%	2.5%	7.2%	2.1%	12.4%	2.6%	7.9%
African American	15.9%	20.2%	7.5%	12.4%	10.3%	15.8%	6.3%	6.7%
Hispanic	4.1%	11.2%	4.6%	11.0%	5.5%	10.6%	5.6%	19.1%
Native American/Alaskan	0.9%	1.7%	0.6%	1.1%	2.7%	4.0%	0.5%	1.8%
Unknown	2.4%	0.8%	3.0%	1.0%	2.1%	0.8%	3.4%	0.8%
Percentage from RU1 BA institution	37.2%	45.5%	50.4%	54.9%	47.9%	64.6%	62.4%	71.9%
Engineering	5.0%	18.5%	16.9%	30.4%	1.4%	33.2%	13.0%	29.5%
Math/Computer Science	6.6%	8.0%	12.0%	13.5%	2.7%	6.3%	13.0%	13.4%
Physical Sciences	12.6%	10.6%	24.9%	16.5%	11.6%	6.9%	24.1%	15.7%
Life Sciences	39.9%	34.8%	27.0%	22.1%	47.3%	29.0%	28.8%	19.3%
Social Sciences	22.0%	18.6%	14.4%	13.4%	21.9%	16.1%	15.9%	16.1%
Behavioral Sciences	13.9%	9.6%	4.8%	4.0%	15.1%	8.4%	5.3%	5.9%
Mean age	24.1	24.9	23.3	24.5	23.4	24.3	22.9	23.6
Mean Quantitative GRE	611	642	701	713	684	718	760	759
Mean Verbal GRE	590	571	602	598	691	648	682	669
Mean GPA	3.6	3.5	3.6	3.5	3.8	3.7	3.8	3.8
Mean years since BA	1.2	1.8	0.8	1.5	1.2	1.6	0.8	1.1

Table G4.1
Success Rates of GF Applicants by Type of Undergraduate Institution

		Numbers and Success Rates			Percentages by Type of Undergraduate Institution		
		1979-1983	1984-1988	1989-1993	1979-1983	1984-1988	1989-1993
RU1	Applicants	7400	9722	14187	49.3%	50.8%	53.8%
	Fellows	1310	1605	2352	62.1%	67.4%	68.6%
	Success rate	18%	17%	17%			
Doc/RU2	Applicants	2629	3358	4497	17.5%	17.5%	17.1%
	Fellows	302	299	457	14.3%	12.6%	13.3%
	Success rate	11%	9%	10%			
LA1	Applicants	2236	2670	3584	14.9%	13.9%	13.6%
	Fellows	321	297	373	15.2%	12.5%	10.9%
	Success rate	14%	11%	10%			
All other	Applicants	2739	3403	4081	18.3%	17.8%	15.5%
	Fellows	178	180	247	8.5%	7.6%	7.2%
	Success rate	7%	5%	6%			
Total	Applicants	15004	19153	26349	100.0%	100.0%	100.0%
	Fellows	2111	2381	3429	100.0%	100.0%	100.0%
	Success rate	14%	12%	13%			

Table G4.2
Success Rates of MGF Applicants by Type of Undergraduate Institution

		Numbers and Success Rate			Percentage by Type of Undergraduate Institution		
		1979-1983	1984-1988	1989-1993	1979-1983	1984-1988	1989-1993
RU1	Applicants	525	966	2108	28.0%	33.3%	39.7%
	Fellows	109	150	355	38.2%	58.6%	62.0%
	Success rate	21%	16%	17%			
Doc/R2	Applicants	340	524	880	18.2%	18.1%	16.6%
	Fellows	57	40	64	20.0%	15.6%	11.2%
	Success rate	17%	8%	7%			
LA 1	Applicants	147	205	325	7.8%	7.1%	6.1%
	Fellows	35	28	46	12.3%	10.9%	8.0%
	Success rate	24%	14%	14%			
All other	Applicants	861	1203	1998	46.0%	41.5%	37.6%
	Fellows	84	38	108	29.5%	14.8%	18.9%
	Success rate	5%	3%	5%			
Total	Applicants	1873	2898	5311	100.0%	100.0%	100.0%
	Fellows	285	256	573	100.0%	100.0%	100.0%
	Success rate	15%	9%	11%			

Table G5

Destination Institutions by Discipline Group for GF Fellows: 1979-1993

Engineering/Math/Physical Sciences		Biological/Life Sciences		Social/Behavioral Sciences	
Stanford	15%	UC Berkeley	8%	MIT	13%
MIT	15%	Stanford	7%	Harvard	12%
UC Berkeley	11%	Harvard	7%	Stanford	11%
Harvard	6%	Cornell	7%	UC Berkeley	7%
Princeton	6%	MIT	5%	U. Chicago	6%
Total percentage of Fellows in top five institutions	53%	Total percentage of Fellows in top five institutions	34%	Total percentage of Fellows in top five institutions	48%
Ca. Inst. Technology	5%	U. Wisconsin	5%	U. Michigan	5%
Cornell	4%	U. Washington	5%	Princeton	4%
U. Illinois	3%	UC San Francisco	3%	U. Pennsylvania	4%
Carnegie Mellon	3%	UC San Diego	3%	Yale	4%
U. Wis consin	2%	Yale	3%	Cornell (tie) U. Wisconsin (tie)	3% 3%
Total percentage of Fellows top ten institutions	69%	Total percentage of Fellows in to ten institutions	53%	Total percentage of Fellows in top ten institutions	67%

Table G6

Destination Institutions by Discipline Group for MGF Fellows: 1979-1993

(* = an institution that also appears in the first 10 destinations for GF fellows)

Engineering/Math/ Physical Sciences		Biological/Life Sciences		Social/Behavioral Sciences	
MIT*	13%	UC Berkeley*	8%	UC Berkeley*	9%
Stanford*	12%	Stanford*	5%	Stanford*	9%
UC Berkeley*	12%	Cornell*	4%	Harvard*	8%
Cornell U.*	4%	MIT*	4%	U. Michigan*	8%
U. Illinois*	4%	UC San Diego*	4%	MIT*	6%
Total percentage of Fellows in top five institutions.	48%	Total percentage of Fellows in top five institutions	25%	Total percentage of Fellows in top five institutions	40%
U. Texas	3%	UC San Francisco*	4%	Princeton*	4%
Georgia Inst. Tech	3%	Harvard*	3%	Cornell*	4%
Princeton U.*	3%	NC State-Raleigh	3%	Yale*	3%
Rice U.	3%	UC Davis	3%	Johns Hopkins	2%
Harvard*	2%	U. Michigan	2%	UC Santa Cruz	2%
Total percentage of Fellows in top ten institutions	59%	Total percentage of Fellows in top ten institutions	38%	Total percentage of Fellows in top ten institutions	55%

Tables for Transition Point Two

Table G7

Advantages and Disadvantages of the NSF Graduate Research Fellowship

	Disciplinary Fellows	WENG Fellows	MGF Fellows
	Percentage responding yes		
Advantages			
Full-time study allowed for a quicker start in program	57%	51%	58%
Will/did shorten my time to degree completion	37%	33%	30%
Reputation among faculty as a good student	70%	74%	60%
Perception by peers as being a good student	50%	35%	45%
Better opportunity to choose research projects	34%	56%	49%
I was an asset to faculty to work on their projects because I had my own funding	36%	72%	61%
Having it on my CV helped/will help in job search	67%	59%	66%
Financial support (stipend)	84%	89%	89%
Tuition assistance (COE Allowance)	65%	74%	69%
Other	7%	12%	6%
Disadvantages			
No office space provided by department	2%	10%	5%
Less opportunity to work with faculty on their research projects (RA)	5%	5%	5%
Less opportunity to work collaboratively with other students	4%	13%	7%
Less opportunity to teach (TA)	23%	18%	18%
Isolated from other students in program	6%	3%	4%
Could not live on stipend alone	9%	17%	15%
Support only lasted 3 years	46%	42%	46%
Other	12%	12%	11%
Did institution offer financial support after fellowship ended?			
Yes	76%	61%	65%
No	7%	9%	11%
Not applicable	17%	30%	24%

Table G8
Eleven-Year Doctoral Completion Rates by Gender and Discipline

	Women Fellows		Men Fellows		Difference
	Number	% Completed	Number	% Completed	
Engineering					
1979-1983	44	56.8%	289	65.5%	-8.7
1984-1988	103	64.1%	386	68.5%	-4.4
Comp Sci/Math					
1979-1983	35	42.8%	204	66.7%	-23.9
1984-1988	49	37.1%	244	66.0%	-28.9
Physical Sciences					
1979-1983	110	68.2%	394	81.8%	-13.6
1984-1988	115	76.6%	404	82.3%	-5.7
Biological Sciences					
1979-1983	340	71.0%	416	69.8%	+1.2
1984-1988	375	78.5%	388	78.7%	-0.2
Social Sciences					
1979-1983	158	47.5%	234	62.4%	-14.9
1984-1988	166	56.5%	225	65.0%	-8.5
Behavioral Sciences					
1979-1983	107	68.3%	67	68.6%	-0.3
1984-1988	109	78.9%	72	76.5%	+2.4
Total					
1979-1983	794	63.6%	1603	70.4%	-6.8
1984-1988	917	71.5%	1719	73.6%	-2.1

Table G9
Completion Rates of 1979-1988 NSF Fellows and Non-Awardees Completing Doctoral Study by 1999 by Gender and Quality Group

		Men			Women			Total		
		NSF Fellows		Q2	NSF Fellows		Q2	NSF Fellows		Q2
		Q1	Q2	Non-Awd	Q1	Q2	Non-Awd	Q1	Q2	Non-Awd
Math	% Completed	74.2	76.0	66.0	63.6	63.0	71.4	74.0	72.3	66.1
	Number	155	87	105	11	32	7	166	119	112
Comp Science	% Completed	66.0	50.0	76.0	41.7	41.4	75.0	63.2	48.1	54.4
	Number	105	102	87	12	29	4	117	131	90
Physical Sci	% Completed	84.0	83.6	78.0	75.0	73.8	57.9	82.7	80.5	76.9
	Number	474	324	371	76	149	19	550	473	390
Engineering	% Completed	74.7	61.3	51.3	73.5	59.8	57.1	74.6	60.9	51.6
	Number	388	287	318	49	97	21	437	384	339
EMP Total	% Completed	78.0	71.0	64.4	70.9	65.1	60.8	76.9	69.0	64.2
	Number	1122	800	880	148	307	51	1270	1107	931
Bio/Life Sci	% Completed	76.0	75.0	78.0	79.9	74.4	57.1	77.1	74.6	72.2
	Number	522	282	406	293	422	147	815	704	553
Social Sciences	% Completed	69.3	60.8	56.5	52.0	60.4	54.9	64.0	60.6	56.2
	Number	293	166	237	127	197	71	420	363	308
Behavioral Sci	% Completed	76.1	70.6	83.8	84.0	68.2	64.8	80.4	68.9	75.4
	Number	88	51	72	106	110	54	194	161	126
Soc/Beh. Sci Total	% Completed	71.0	63.1	63.0	66.5	63.2	59.2	69.2	63.2	61.8
	Number	381	217	309	233	307	125	614	524	434
All Fields	% Completed	70.5	70.2	67.5	73.3	68.3	58.5	75.3	69.4	66.1
	Number	2025	1299	1595	674	1036	323	2699	2335	1918

Table G10
Completion Rates of NSF Fellows and Non-Awardees Completing Doctoral Study by 1999 by Discipline and Quality Group

	I: EMP			II: BLS			III: B&S			IV: Total		
	NSF Fellows		QG 2-Non	NSF Fellows		QG 2-Non	NSF Fellows		QG 2-Non	NSF Fellows		QG 2-Non
	QG 1	QG2	Award	QG 1	QG2	Award	QG 1	QG2	Award	QG 1	QG2	Award
Graduated within 6 years of award												
1979-1983	54.6%	46.8%	41.8%	42.0%	40.8%	41.2%	39.9%	30.9%	35.4%	47.8%	41.3%	40.0%
1984-1988	53.4%	49.0%	38.4%	48.0%	43.4%	52.2%	42.3%	33.9%	30.4%	49.4%	44.1%	40.5%
1989-1993	40.8%	37.3%	41.8%	47.0%	42.0%	48.4%	42.4%	37.6%	31.8%	42.6%	38.5%	41.1%
Graduated within 11 years of award												
1979-1983	76.0%	66.4%	63.6%	71.7%	68.9%	67.4%	63.0%	57.2%	58.4%	71.6%	65.1%	63.4%
1984-1988	75.3%	68.1%	61.8%	79.2%	77.6%	75.3%	70.2%	61.4%	57.1%	75.2%	69.5%	64.5%
Graduated within 16 years or more of award												
1979-1983	78.2%	69.2%	65.7%	73.5%	71.2%	69.0%	66.5%	62.8%	65.0%	74.0%	68.4%	66.4%

Table G11

Completion Rates of GF Fellows and MGF Fellows by Discipline Group

	I: EMP		II: BLS		III: B&S		IV: Total	
	GF	MGF	GF	MGF	GF	MGF	GF	MGF
Graduated within 6 years of award								
1979-1983	52.3%	39.4%	43.7%	23.9%	36.6%	30.0%	46.2%	30.9%
1984-1988	52.6%	38.4%	46.3%	43.4%	40.8%	27.2%	48.4%	35.9%
1989-1993	41.5%	25.6%	44.2%	50.1%	41.9%	35.2%	42.3%	33.8%
Graduated within 11 years of award								
1979-1983	72.7%	50.2%	72.8%	51.1%	62.6%	49.5%	70.6%	50.3%
1984-1988	73.4%	58.5%	78.7%	75.1%	69.1%	52.2%	74.1%	61.0%
Graduated within 16 years or more of award								
1979-1983	74.7%	53.8%	74.4%	55.6%	67.1%	51.3%	73.0%	53.6%

Table G12
Eleven- Year Doctoral Completion Rates by Fellowship Type and Discipline

	MGF Fellows		GF Fellows		Difference
	Number	% Completed	Number	% Completed	
Engineering					
1979-1983	26	38.4%	306	66.8%	-28.4
1984-1988	51	55.0%	438	69.0%	-14.0
Comp Sci/Math					
1979-1983	18	39.0%	221	65.2%	-26.2
1984-1988	16	37.6%	277	66.1%	-28.5
Physical Sciences					
1979-1983	40	62.5%	464	80.2%	-17.7
1984-1988	32	75.0%	487	81.6%	-6.6
Biological Sciences					
1979-1983	88	51.1%	668	72.8%	-21.7
1984-1988	69	75.1%	694	78.7%	-3.6
Social Sciences					
1979-1983	71	45.1%	321	58.9%	-13.8
1984-1988	58	44.7%	333	64.2%	-19.5
Behavioral Sciences					
1979-1983	42	57.1%	132	72.0%	-14.9
1984-1988	30	66.7%	151	80.2%	-13.5
Total					
1979-1983	285	50.3%	2112	70.6%	-20.3
1984-1988	256	61.0%	2380	74.1%	-13.1

Table G13
Complet*ion Rates of MGF Fellows and Non-Awardees by Discipline Group*

	I: EMP			II: BLS			III: B&S			IV: Total		
	NSF MGF Fellows		QG 2-Non Award	NSF MGF Fellows		QG 2-Non Award	NSF MGF Fellows		QG 2-Non Award	NSF MGF Fellows		QG 2-Non Award
	QG 1	QG2		QG 1	QG2		QG 1	QG2		QG 1	QG2	
Graduated within 6 years of award												
1979-1983	35.3%	42.0%	16.7%	23.1%	24.5%	16.1%	35.3%	25.9%	7.9%	31.5%	30.4%	13.4%
1984-1988	39.4%	37.8%	36.1%	44.3%	42.3%	35.4%	27.3%	27.3%	11.1%	37.2%	34.5%	28.8%
1989-1993	26.4%	25.2%	18.9%	53.9%	42.5%	41.6%	36.6%	32.2%	24.0%	36.1%	30.9%	26.0%
Graduated within 11 years of award												
1979-1983	49.9%	50.0%	27.8%	56.5%	46.8%	42.0%	58.9%	42.0%	34.2%	55.7%	45.8%	34.4%
1984-1988	67.2%	45.9%	58.5%	79.3%	69.1%	51.6%	59.2%	45.5%	37.0%	68.3%	51.4%	50.1%
Graduated within 16 years or more of award												
1979-1983	58.7%	52.0%	30.6%	61.7%	50.9%	45.2%	62.9%	45.2%	42.1%	61.3%	48.9%	39.2%

Table G14

Completion Rates of 1979-1988 NSF Fellows and Non-Awardees Completing Doctorate by 1999 by Program Category and Quality Group

		Graduate Fellows			Minority Graduate Fellows			Total		
		NSF Fellows		Q2	NSF Fellows		Q2	NSF Fellows		Q2
		Q1	Q2	Non-Awd	Q1	Q2	Non-Awd	Q1	Q2	Non-Awd
Math	% Completed	74.8	73.6	67.3	60.0	55.6	50.0	74.0	72.3	66.1
	Number	151	110	104	15	9	8	166	119	112
Comp Science	% Completed	65.5	49.6	54.8	0	16.7	50.0	63.2	48.1	54.4
	Number	113	125	84	4	6	6	117	131	90
Physical Science	% Completed	83.0	81.8	78.1	78.9	64.7	60.0	82.7	80.5	76.9
	Number	512	439	365	38	34	25	550	473	390
Engineering	% Completed	76.2	62.7	53.6	57.9	44.7	33.3	74.6	60.9	51.6
	Number	399	346	306	38	38	33	437	384	339
EMP Total	% Completed	78.0	70.5	65.8	64.2	51.7	45.8	76.9	69.0	64.2
	Number	1175	1020	859	95	87	72	1270	1107	931
Bio/Life Sci	% Completed	77.7	76.5	75.2	72.0	58.7	48.4	77.1	74.6	72.2
	Number	733	629	491	82	75	62	815	704	553
Social Sciences	% Completed	65.9	64.2	59.1	52.5	45.7	38.6	64.0	60.6	56.2
	Number	361	293	264	59	70	44	420	363	308
Behavioral Science	% Completed	81.6	73.6	81.9	75.0	52.8	42.9	80.4	68.9	75.4
	Number	158	125	105	36	36	21	194	161	126
Soc/Beh Sci Total	% Completed	70.7	67.0	47.6	61.1	48.1	40.0	69.2	63.2	61.8
	Number	519	418	369	95	106	65	614	524	434
All Fields	% Completed	76.3	71.6	68.4	65.4	52.2	44.7	75.3	69.4	66.0
	Number	2627	2067	1719	272	268	199	2699	2335	1918

Table G15.1
Type of Organization of Employment for Disciplinary Fellows and Peers as of January 1999

	Mech. Engineering		Mathematics		Biochemistry		Economics	
	Peer	Fellow	Peer	Fellow	Peer	Fellow	Peer	Fellow
Number responding	25	34	26	33	23	15	34	44
Doctoral university + medical school	24%	27%	12%	52%	48%	53%	29%	61%
Those with master's degrees	20%	17%			17%			50%
Those with doctoral degrees	14%	21%	8%	43%	29%	29%	25%	45%
Other higher education			19%	9%	9%		6%	2%
Federal government or National Lab			19%		4%		9%	9%
Other non-profit/ international/other		3%		9%	17%	7%	12%	11%
Elementary/sec education			4%			7%	6%	
Military	4%							
Small business	12%	6%	4%	6%		7%	3%	
Other business	52%	62%	19%	18%	13%	7%	9%	16%
Those with master's degrees	60%	61%	17%	25%		33%	27%	50%
Those with doctoral degrees	14%	25%	5%	8%	7%		33%	10%
Self-employed	4%		4%			13%	3%	
Blank	4%	1%	15%	2%	4%	1%		

Table G15.2

Type of Organization of Employment for WENG and MGF Fellows as of January 1999

	WENG Fellows	MGF Fellows				
		All MGF respondents	Engineering	M/CS/PS	BLS	SBS
Number responding	79	35	34	Data not tabulated because of small numbers and low completion rate for this question.		
Doctoral university + medical school	9%	26%	18%			
Those with master's degrees	4%	12%	8%			
Those with doctoral degrees	10%	11%	12%			
Other higher education	4%	3%	5%			
Federal government or National Lab	44%	6%	9%			
Other non-profit/ international/other	7%	3%	33%			
Elementary/secondary education						
Military		6%	5%			
Small business	6%	6%	5%			
Other business	55%	37%	41%			
Those with master's degrees	52%	35%	46%			
Those with doctoral degrees	31%	7%	18%			
Self-employed	2%	3%	5%			
Blank	6%	6%	9%			

Table G16.1
Type of Position Held by Disciplinary Fellows and Peers in January 1999

	Mechanical Engineering		Mathematics		Biochemistry		Economics	
	Peers	Fellows	Peers	Fellows	Peers	Fellows	Peers	Fellows
Number responding	25	34	26	33	23	15	34	44
Postdoctoral fellow		6%	15%	39%	52%	47%		
Non-tenure track faculty		3%	4%	15%			3%	
Tenure-track faculty	12%	6%	19%	12%	9%	7%	35%	61%
Tenured faculty								3%
Researcher (not faculty)	8%	3%			4%		3%	3%
Administrator/manager								
Clerical/support								
Other	4%	3%			13%			
Total, higher education	24%	20%	36%	63%	77%	53%	44%	66%
Owner/partner		3%				13%	9%	
Administrator/manager	8%	6%				7%	3%	
Professional	52%	61%	39%	27%	17%	20%	29%	32%
Those with masters	53%	61%	33%	50%	17%	33%	33%	50%
Those with doctorate	9%	25%	16%	13%	7%	8%	22%	22%
Clerical/support								
Consultant	8%	3%					13%	
Other	4%		7%					3%
Total, All other	72%	74%	48%	30%	18%	40%	56%	34%
Blank	4%	6%	15%	6%	4%	7%		

Table G16.2

Type of Position Held by WENG and MGF Fellows in January 1999

	WENG Fellows	MGF Fellows				
		All MGF Fellows	Engineering	M/CS/PS	BLS	SBS
Number responding	53	35	22			
				Data not tabulated because of small numbers for this questions		
Postdoctoral fellow	2%					
Non-tenure track faculty	2%	3%	5%			
Tenure-track faculty	8%	17%	5%			
Tenured faculty	4%	6%				
Researcher (not faculty)	3%	3%	5%			
Administrator/manager						
Clerical/support		3%	20%			
Other	2%	3%	20%			
Total, higher education	18%	31%	14%			
Owner/partner	6%					
Administrator/manager	4%		0			
Professional	59%	51%	68%			
Those with masters	44%	47%	69%			
Those with doctorate	35%	53%	29%			
Clerical/support						
Consultant	8%	6%	5%			
Other		6%	5%			
Total, All other	77%	63%	80%			
Blank	6%	6%	9%			

Table G17.1
Primary Responsibility in Employment for Disciplinary Fellows and Peers in January 1999

	Mechanical Engineering		Mathematics		Biochemistry		Economics	
	Peer	Fellow	Peer	Fellow	Peer	Fellow	Peer	Fellow
Number Responding	25	34	26	33	23	15	34	44
Research and/or development	56%	56%	30%	76%	65%	60%	53%	75%
Those with master's			6%					
Teaching/training	8%	3%	27%	9%	13%		11%	7%
Information technology			4%	3%				
Legal services			8%		4%		9%	
Finance								
Manufacturing/engineering related services	20%	27%				7%		3%
Those with master's	7%		17%					
Writing/editing	4%					7%		3%
Marketing/sales							3%	
Finance			4%				12%	3%
Planning/budget	4%							
General admin./ management	4%	3%	8%				3%	5%
Other		6%	4%		13%	13%	6%	3%
Blank	4%	6%	15%	6%	4%	7%		

Table G17.2
Primary Responsibility in Employment for WENG and MGF Fellows in January 1999

	WENG Fellows	MGF Fellows	
		All MGF	Engineering
Number Responding	50	35	22
Research and/or development	40%	49%	50%
Those with masters	11%		
Teaching/training	6%	9%	5%
Information technology	4%	6%	
Legal services	2%		
Finance			
Manufacturing/engineering related services	32%	14%	23%
Those with masters	3%		
Writing/editing		3%	5%
Marketing/sales		3%	
Finance			
Planning/budget		3%	5%
General administrative/management		3%	
Other	4%	3%	5%
Blank	8%	6%	9%

Table G18.1
Professional Productivity of Disciplinary Fellows and Peers since Graduate School

	Mechanical Engineering		Mathematics		Biochemistry		Economics	
	Peer	Fellow	Peer	Fellow	Peer	Fellow	Peer	Fellow
Number responding	25	34	26	33	23	14	35	44
Presentations (National and/or International)								
0	56%	59%	54%	30%	57%	36%	46%	21%
1	16%	15%	15%	12%	13%	36%	11%	5%
2 or more	28%	27%	31%	58%	30%	29%	43%	75%
Non-Refereed Articles Published								
0	92%	85%	100%	84%	91%	86%	77%	54%
1	4%	9%		6%	9%	7%	3%	16%
2 or more	4%	6%		9%		7%	20%	30%
Refereed Articles Published								
0	72%	85%	65%	28%	57%	43%	69%	21%
1	20%	6%	8%	16%	17%	21%	9%	16%
2 or more	8%	9%	27%	56%	26%	36%	23%	64%
At Least One Book or Chapter Published	4%		4%	13%	9%	7%	17%	32%
At Least One Grant or Contract as PI	17%	3%	4%	9%	5%	3%	7%	48%

Table G18.2
Professional Productivity of WENG and MGF Fellows since Graduate School

	WENG Fellows	MGF Fellows	
		All MGF	Engineering
Number responding	57	35	22
Presentations (National and International)			
0	72%	57%	68%
1	7%5	14%	5%
2 or more	21%	29%	27%
Non-Refereed Articles Published			
0	91%	91%	95%
1	4%	3%	5%
2 or more	6%	6%	
Refereed Articles Published			
0	76%	77%	77%
1	9%		
2 or more	15%	24%	23%
At Least One Book or Chapter Published	7%	12%	14%
At Least One Grant or Contract as PI	6%	13%	5%

Table G19.1

Teaching and Professional Service for Disciplinary Fellows and Peers since Graduate School

	Mechanical Engineering		Math		Biochemistry		Economics	
	Peer	Fellow	Peer	Fellow	Peer	Fellow	Peer	Fellow
Number responding	16	24	21	27	16	10	31	41
Teaching Activities since Graduate School								
Taught an undergraduate course	38%	25%	62%	82%	19%	0	42%	66%
Taught a graduate course	25%	17%	10%	52%	13%	0	36%	68%
Team taught a course	25%	4%	0	11%	13%	0	10%	15%
Taught on site in bus/industry	25%	17%	10%	7%	6%	0	16%	2%
Mentored/tutored junior/senior high school	13%	8%	24%	11%	25%	10%	3%	0
Mentored undergraduates	19%	25%	52%	37%	38%	20%	26%	51%
Mentored graduate students	25%	13%	19%	26%	38%	20%	29%	54%
Member, dissertation committee	13%	0	0	22%	0	0	13%	56%
Professional Service since Graduate School								
Reviewed manuscript/chapter	39%	28%	27%	63%	27%	60%	45%	77%
Institutional/company-wide committee	17%	24%	0	22%	20%	10%	26%	31%

Table G19.2
Teaching and Professional Service for WENG and MGF Fellows since Graduate School

	WENG Fellows	MGF Fellows	
		All MGF	Engineering
Number responding	37	25	15
Taught an undergraduate course	22%	36%	20%
Taught a graduate course	14%	24%	20%
Team taught a course	14%	8%	13%
Taught on site in business/industry	27%	20%	13%
Mentored/tutored junior/senior high school	14%	16%	20%
Mentored undergraduates	27%	28%	20%
Mentored graduate students	16%	20%	20%
Member, dissertation committee	5%	16%	7%
Reviewed manuscript/chapter	31%	36%	33%
Institutional/company-wide committee	19%	28%	13%

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