

## **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 is 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 pittance 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.

