



Developing International Research Collaborations among Postdoctoral Fellows: Key Findings from the Evaluation of NSF's International Research Fellowship Program

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Introduction

*Effective international S&E partnerships advance the S&E enterprise and energize U.S. innovation and economic competitiveness, but they also have great potential to improve relations among countries and regions and to build greater S&E capacity around the world.*¹

Over a decade ago, the National Science Board (NSB) highlighted the importance of international collaboration in its call for increased government commitment to promoting international science and engineering (S&E) research and education.² The NSB also identified the National Science Foundation (NSF) as having an important leadership role in international S&E research and education activities.³ A specific area of focus for NSF was promoting "...increased participation in international S&E activities by younger U.S. scientists and engineers from diverse backgrounds, especially those in the early stage of their careers, in order to develop an internationally competitive and globally-engaged S&E workforce."⁴

Among NSF's postdoctoral programs, the International Research Fellowship Program (IRFP) is unique in its emphasis on providing postdoctoral fellows with international research experiences.⁵ Established in 1992, IRFP provides financial support to postdoctoral scientists for a research experience abroad lasting from 9 to 24 months;⁶ there is no restriction on the geographical location of the hosting institution. IRFP aligns closely with the NSB's call for NSF to support the international science engagement of scientists and engineers.

NSF contracted with Abt Associates to conduct an evaluation of IRFP, to gather evidence about whether the IRFP program has achieved its goal of furthering the collaborative activities and international partnerships of early career STEM researchers. The evaluation found evidence that the IRFP program is meeting its goals, which are to:

- Introduce early career scientists and engineers to opportunities for international research collaboration;
- Build research capacity and global perspective of participants; and
- Forge long-term relationships between U.S. and foreign S&E researchers.

¹ National Science Board. 2008. *International Science and Engineering Partnerships: A Priority for U.S. Foreign Policy and Our Nation's Innovation Enterprise*. NSB-08-4. National Science Foundation, Arlington, VA, p. 1.

² National Science Board. 2001. *Toward a More Effective Role for the U.S. Government in International Science and Engineering*. NSB-01-187. National Science Foundation, Arlington, VA.

³ National Science Board. 2000. *Toward a More Effective NSF Role in International Science and Engineering, Interim Report*. NSB-00-217. National Science Foundation, Arlington, VA.

⁴ NSB. 2000, p. 10.

⁵ A list and descriptions of NSF postdoctoral opportunities can be found at http://www.nsf.gov/funding/education.jsp?fund_type=3

⁶ National Science Foundation. 2006a. IRFP Program Solicitation. Retrieved from http://www.nsf.gov/pubs/2006/nsf06582/nsf06582.html#pgm_desc_txt

This report summarizes the findings from the evaluation of IRFP, which was designed to investigate the characteristics of IRFP applicants and their motivations for participation, the host researchers' motivations for participating in the program, participants' experiences in and perceptions of the program, and outcomes of the program. The full evaluation report is available online at <http://www.abtassociates.com/Reports/2012/Evaluation-of-NSF's-International-Research-Fellows.aspx>.⁷

The importance of international collaboration cannot be overstated. Researchers and policymakers agree that while the United States remains a leader in S&E research and development, the nation cannot maintain this position without engaging in international collaborations. Promoting international engagement at all levels is crucial to fostering successful research partnerships and developing the next generation of S&E researchers. Providing early career researchers with an opportunity to engage in an international research experience may help them improve their own research capabilities and pursue future collaborations with international colleagues. This, in turn, could lead U.S. researchers to reap benefits such as increased visibility in the research community, access to more substantial funding and resources, and the opportunity to benefit from the expertise of international peers.

Study Findings

Findings from the evaluation of IRFP revealed important benefits of the program, on both an individual and a collective basis

Key Findings

To align with the program goals, the evaluation paid particular attention to the opportunities for international research collaborations, the experiences to develop research capacity and global perspectives, and the relationships between U.S. and foreign researchers. Specifically, the evaluation examined the following questions:

1. Does the extent to which former fellows engage in international collaborations differ from that of unfunded applicants?
2. Do fellows' post-award career activities and job characteristics differ from those of unfunded applicants?
3. What are the perceived outcomes of program participation?
4. Do the outcomes of program participation extend beyond the direct participants?

The evaluation provides evidence that the IRFP experience leads to greater levels of international research engagement among fellows.

⁷ Martinez, A., Carter, E., Parsad, A. & Whittaker, K. 2012. Evaluation of NSF's International Research Fellowship Program: Final Report. Abt Associates Inc., Cambridge, MA.

- There are statistically significant and positive differences between fellows and unfunded applicants on the number of international postdoctoral fellowships held.
- IRFP fellows had a larger number of publications with a foreign co-author compared to non-funded applicants, and the percentage of publications with a foreign co-author was also greater for fellows. These differences were statistically significant.

Importantly, this international focus does not come at the expense of research productivity or professional advancement.

- Fellows and their peers were equally likely to hold multiple postdoctoral appointments, and were equally productive researchers, equally likely to hold a faculty rank of assistant, associate, or full professor, and equally likely to be tenured.
- Career outcomes of IRFP fellows, and applicants overall, compare well against national STEM PhD holders on employment, publications, and international collaborations, suggesting that IRFP attracts a talented pool of applicants.

Former IRFP fellows also reported that they reaped positive career outcomes from their participation in IRFP.

- About four-fifths of fellows (79 percent) reported that participating in IRFP had qualified them for a broader range of career options, and 68 percent said that IRFP had made them more competitive for jobs.
- Fellows reported that IRFP had opened up new areas for investigation (71 percent).

The IRFP was a major contributing factor to obtaining my tenure-track faculty position. It also was a defining period in development of my research and the experience has provided me with a lot of the tools and skills I

The relationships developed during IRFP seed subsequent professional collaborations and activities that endure beyond the fellowship period.

My career was completely changed with that experience. I believe that research experience was the major factor in every career move I have made since then. Currently I have numerous collaborators from that research group, as well, and this continues to enrich my life/ professional experience (IRFP fellow)

- Nearly three-quarters (71 percent) of IRFP fellows reported that they had made important connections to researchers in their host country.
- Most fellows reported that the fellowships offer opportunities for professional relationships that endure beyond the fellowship period, through subsequent collaborations with their hosts and/or additional communications (46 percent each). Half of all former fellows said that participation in IRFP made them more committed to international research collaboration.

Further, the program demonstrates potential to reach beyond its immediate participants.

- More than three-quarters of former IRFP fellows reported that post-fellowship, they taught colleagues, students or peers methods learned during their fellowship (78 percent), and shared resources or tools acquired during this time (75 percent).
- Hosts also served as a mechanism for extending the effects of the program to other scientists. Twenty-five percent of former IRFP hosts reported that a collaboration with a U.S. researcher resulted from their participation in the IRFP program.

Additional Findings

The evaluation was also designed to address the following questions:

1. What are the characteristics of people who apply for and participate in the IRFP program?
2. What motivates individuals to apply for and participate in the program, and what are individuals' experiences during the application process?
3. What are the program experiences of program participants and managers?

Since 1992, IRFP has received 1,660 applications from individuals, with varied backgrounds, interested in pursuing their research in settings abroad.

- IRFP is a fairly selective program, accepting just over one-third (35 percent) of applications overall since its inception, and it has become more competitive over time.
- Nearly half of the proposed research projects were proposed in the life sciences (47 percent), and about one-quarter in the physical sciences (26 percent).
- IRFP applicants proposed research in regions that spanned the globe, although a majority (60 percent) identified locations in Europe.
- Graduate advisors are reported to be supportive of their students' applications; 72 percent of applicants reported their advisors actively encouraged or supported their decision to apply.

[The IRFP fellowship] allowed me to [do] research that was possible only by working in collaboration with the host institution and conducting fieldwork in the host country. I chose this country specifically because regional biogeography allowed me to follow the path of inquiry that I had hoped to examine. (IRFP applicant)

The IRFP applicants represent early career scientists with varied motivations for participating in the program, although the motivations reflect the value that these scientists and engineers place on foreign collaborations.

- A large majority of applicants cited the desire to conduct research with a specific person or at a specific institution (87 percent), and to enhance their skills or knowledge as a researcher (82 percent) as the reasons for applying to IRFP. Over half also noted their desire

to collaborate with a foreign scientist in general (60 percent) and to enhance their resume (57 percent).

- In selecting a specific host country, applicants were primarily motivated by the presence of a host who was conducting research relevant to their own interests (87 percent), followed by resources at the host institution that were helpful in their research (52 percent).

Funded fellows are hosted by research scientists in foreign institutions, who also express a variety of motives for participating in the program. Specifically,

- Many foreign hosts had prior academic and professional experiences in the U.S., although 66 percent had never hosted a postdoctoral fellow from the U.S.
- The large majority of foreign host scientists (83 percent) reported that they agreed to host fellows because of the specific research projects proposed; the next most commonly reported rationale was an interest in creating an international environment in their research group (60 percent).

Overwhelmingly, IRFP participants were satisfied with the program and found the fellowship valuable.

- Former fellows and hosts offer strong endorsement for the IRFP program. All former IRFP fellows would recommend the program to a colleague, and the large majority of hosts (84 percent) would recommend, or have already recommended, to others that they host an IRFP postdoctoral fellow from the U.S.
- Over 90 percent of fellows were somewhat or very satisfied with the quality of research they were able to conduct as part of IRFP (92 percent) and the timing of the fellowship with respect to their career goals (97 percent).
- Over 80 percent of fellows were satisfied with many aspects of their host, including the match between research interests, the host's expertise and contributions to the research, their inclusion in collaborations, and frequency of meetings.
- Hosts noted that IRFP fellows compared favorably to other postdoctoral fellows with whom hosts had worked; 56 percent of hosts were much or somewhat more satisfied with IRFP fellows compared to other postdoctoral fellows, and another 28 percent were equally satisfied.
- Hosts generally strongly agreed or agreed (72 and 24 percent, respectively) that their IRFP fellow had sufficient knowledge and expertise, and that the fellow integrated well with their research group (66 and 26 percent, respectively).

[The fellow] led a large experimental study still ongoing that represented one of the most ambitious and interesting experiments ever conducted in my lab. This study also brought in other collaborators (students and PIs) and represents one of the most satisfying collaborations of my career. (IRFP host)

The fellowships provided opportunities for collaborations and advances in research. A majority of fellows credited their IRFP fellowship with allowing them to make substantial advancements in their research, and hosts and fellows agreed they worked collaboratively on important aspects of research projects.

- About two-thirds commented that their IRFP fellowship provided the chance to familiarize themselves with the scientific enterprise in their host site (65 percent) and to make substantial advancements in their research (64 percent).
- Hosts and fellows most commonly cited collaborating on activities that involved developing project ideas and hypotheses, interpreting results, and planning follow-up work.
- Hosts and fellows agreed that fellows worked mostly independently collecting data, carrying out simulations, and keeping records or tracking supplies and resources.

IRFP also offers fellows a broad range of professional opportunities beyond the chance to conduct quality research at their host institution, including opportunities to network with colleagues from other than their host institution, attend lectures in their field, and give talks at their host institution.

- Other professional activities featured prominently in the experiences of many fellows. Specifically, IRFP provided fellows with the opportunity to network with colleagues from institutions outside their host institution (90 percent), attend lectures in their field (89 percent), visit other institutions (89 percent), attend conferences (84 percent), and give talks at their institution (71 percent).
- Fellows also experienced a variety of cultural activities including sightseeing (96 percent) outdoor activities that explore geography (95 percent), museums (89 percent), and festivals or holidays (85 percent).

Most participants did not cite specific challenges, but those that were mentioned illustrate areas that might deserve attention of future fellows or hosts.

- Forty percent of fellows reported no noteworthy difficulties during their fellowship. The most common challenges were related to logistics (32 percent) and language difficulties (20 percent), followed by inadequate access to space or resources (16 percent), and not enough guidance from the host researcher or research group (15 percent).
- Only one-third of hosts reported any challenges experienced in hosting an IRFP fellow. Specific challenges in hosting an IRFP fellow were identified by less than 10 percent of hosts, including noting that the fellow did not devote enough time to the research collaboration (10 percent), and the fellow worked too independently or did not work well as a collaborator (8 percent).

Evaluation Approach

The evaluation employed quasi-experimental impact analyses to compare the outcomes of fellows to those of unfunded applicants, using pre-award characteristics of applicants to mitigate the potential threat of selection bias. To reduce the risks associated with selection bias, the study

incorporated propensity score analysis (PSA) to construct groups of awardees and non-awardees that were statistically similar across a number of pre-existing characteristics. A secondary set of comparative analyses between IRFP applicants (and fellows) and a nationally representative sample of STEM doctorates from the Survey of Doctoral Recipients (SDR) was used to situate the outcomes of IRFP program participants and applicants within the national S&E context. The evaluation also used descriptive analyses to explore the pre-award international research experiences and other characteristics of IRFP applicants and host scientists; to understand what motivated STEM doctoral recipients to apply for an IRFP postdoc and what led IRFP host scientists to collaborate with an IRFP fellow; and to describe the experiences of IRFP participants (i.e., fellows and hosts), both during and after the period of the postdoctoral fellowship.

Data for the evaluation were drawn from extant sources, and surveys were administered to collect information from program applicants (both those who received IRFP fellowships and those who did not) and IRFP foreign hosts. Extant data came from NSF's administrative records on applicants and from the Survey of Doctoral Recipients (SDR). The core data for the evaluation were gathered through online surveys completed—from January through March, 2011—by IRFP applicants and hosts.

The target populations for the study included all individuals who had applied to the IRFP program from its inception in 1992 through 2009, as well as the research scientists who served as foreign hosts during this period. Responses were received from 457 IRFP fellows and 582 unfunded applicants; responses rates were 81 percent and 55 percent, respectively, and estimates were adjusted for non-response. Surveys were received from 328 hosts, for a 61 percent response rate.

Summary

Findings from this evaluation provide ample evidence that IRFP fulfills its promise of providing opportunities for collaborations among U.S. and foreign researchers in settings abroad. Unique among NSF postdoctoral programs, IRFP provides early career post-PhD scientists the opportunity to engage in overseas scientific research and collaborations with scientists outside the U.S. This study of IRFP examined the characteristics and motivations of IRFP participants, the opportunities for research and professional growth provided through IRFP, and the professional outcomes related to the program.

The evaluation found evidence that the IRFP program is meeting its goals to: introduce early career scientists and engineers to opportunities for international research collaboration; build research capacity and global perspective of participants; and forge long-term relationships between U.S. and foreign S&E researchers. The contributions of the IRFP program in each of these areas are summarized below.

Opportunities for International Research Collaboration

IRFP is a selective program that offers international research opportunities to interested individuals. Both unfunded applicants and successful fellows reported being attracted to the program because it offered them an opportunity to conduct research with individuals in foreign settings and at

institutions outside the U.S. Foreign hosts reported that the proposed research topics were engaging, as was the potential to create international collaborations in their research group.

IRFP attracts a talented pool of applicants from among the pool of national STEM PhD holders, who reported interest in the contributions that opportunities abroad may make in their own research. After their experiences, half of all former fellows said that participation in IRFP made them more committed to international research collaboration.

IRFP fellows indicated that they engaged in research collaborations while abroad, and an overwhelming majority of fellows were satisfied with the quality of research conducted as part of IRFP and the timing of the fellowship with respect to their career goals. Hosts and fellows agreed they worked collaboratively on developing project ideas and hypotheses, interpreting results, and planning follow-up work. A majority of fellows also credited their IRFP fellowship with allowing them to make substantial advancements in their research.

Further, IRFP offers fellows a broad range of professional opportunities beyond the opportunity to conduct quality research at their host institution, including opportunities to network with colleagues from other than their host institutions, attend lectures in their field, attend conferences, and give talks at their host institution.

Hosts provided positive comments about their experiences with IRFP and the fellows specifically. A majority agreed that their IRFP fellow had sufficient knowledge and expertise for the research conducted and that the fellow integrated well with their research group. Further, hosts noted that IRFP fellows compared favorably to other postdoctoral fellows with whom hosts had worked.

Research Capacity and Global Perspectives

A unique feature of IRFP is its focus on providing international research experiences for postdoctoral fellows. Individuals who participate in IRFP develop their knowledge and research skills, broaden their perspectives, and contribute to the global understanding and research enterprise more broadly. A majority of fellows credited IRFP with opening up new areas for investigation and familiarizing them with the scientific enterprise in their host site. Three-quarters of fellows also observed that IRFP qualified them for a broader range of career options, and two-thirds felt it contributed to making them more competitive for jobs.

The evaluation provides evidence that these experiences lead to greater levels of international research engagement among fellows. Fellows ranked consistently higher than unfunded applicants on several facets of international research, including the number of international postdoctoral fellowships, the number of publications with a foreign co-author, and the percentage of publications with a foreign co-author. The fellows' research productivity is consistently higher across all three measures.

Importantly, this international focus did not come at the expense of research productivity or career advancement. Specifically, fellows and their peers were equally likely to hold multiple postdoctoral appointments, and were equally productive researchers, equally likely to hold a faculty rank of assistant, associate, or full professor, and equally likely to be tenured.

Further, the program demonstrates potential to reach beyond the immediate participants. More than three-quarters of former IRFP fellows shared resources or tools acquired during their international postdoctoral fellowship and taught colleagues, students or peers methods learned during this time.

Long-Term Relationships between U.S. and Foreign Researchers

The relationships developed during IRFP seed subsequent professional collaborations and activities. Many IRFP fellows developed professional relationships that endured beyond the fellowship period, through subsequent collaborations with their hosts and/or additional communications. The continuing collaborations reported by a large proportion of former fellows and hosts included co-authored papers and exchanged ideas, data, results or tools. They also visited each other at their respective institutions, and co-advised students. Also, there is evidence that the collaborations may be seeding networks, as fellows interact with hosts' research groups, and as hosts establish collaborations with other U.S. researchers as a result of their participation in the IRFP program.

Conclusion

The evaluation demonstrated that participants derive important benefits from the program, on an both individual and a collective basis. Former fellows and hosts strongly endorsed the IRFP program, and would recommend IRFP to their students and colleagues. IRFP offers an opportunity for interested researchers to develop their international research collaborations early in their careers. The experiences during IRFP seed relationships that often are sustained and that generate international research collaborations across geopolitical boundaries. As such, IRFP has a central role in NSF's efforts to respond to the NSB's charge that NSF play a leadership role in international S&E research and education activities, and specifically in promoting international S&E among early career scientists and engineers.

This is a great program. It helped launch my career. I didn't know the quality of people I would be working with, but really got very lucky. They took me under their wing, and I met many researchers at several different institutions over the course of the fellowship. The country benefits greatly from a program like this. During the 13 years since completing the fellowship, I've been working on various ... research projects as a principal investigator. The small amount of funds that the U.S. government invested in me during the IRFP I believe enabled my subsequent research contributions to these government agencies and goals.... Keep funding this program. It has a great deal of payback. (IRFP fellow)