

Developing Internationally Engaged Scientists and Engineers: A Multi-Faceted Evaluation to Inform Programmatic Decisions

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IMPACT

Alina Martinez
Carter Epstein
Amanda Parsad
John Tsapogas

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Overview



- Description of the program
- Goals of the evaluation
- Methods
- Findings
- Advancing evaluation in STEM and higher education

NSF and Globalization of STEM



NSF urged to take a leadership role in 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.”

International Research Fellowship Program (IRFP)



- Supported by the Office of International Science and Engineering (OISE) at the National Science Foundation (NSF)
- Funds postdoctoral fellowship for recent PhD recipients to conduct research with a host scientist/engineer in a foreign country
- Fellowships range from 9 to 24 months, can include a “re-entry” period upon return to U.S.
- Began in 1992 (Evaluation included 1992 to 2009 recipients)

IRFP Program Goals



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

Evaluation Goals



- Describe the program and participants' experiences
 - What are characteristics of applicants
 - What do fellows and hosts report about collaboration?
 - How do fellows compare to STEM PhDs nationally?
- Determine the impact of the program on fellows
 - Do fellows show greater international engagement than they would have otherwise?
 - Does participation have any unintended consequences for professional advancement?
- Inform IRFP program improvement and similar types of programs

Research Questions



1. What are the characteristics of IRFP applicants (fellows, unfunded)?
2. What motivates individuals to apply for the program, and what are their experiences during the application process?
3. What are the fellows and host scientists' experiences?
4. Does the extent to which former fellows engage in international collaborations differ from those of unfunded applicants?
5. Do fellows' post-award career activities and job characteristics differ from unfunded applicants?
6. What are the perceived outcomes of program participation?
7. Do the outcomes of participation extend beyond the direct participants?

Overview of Approach



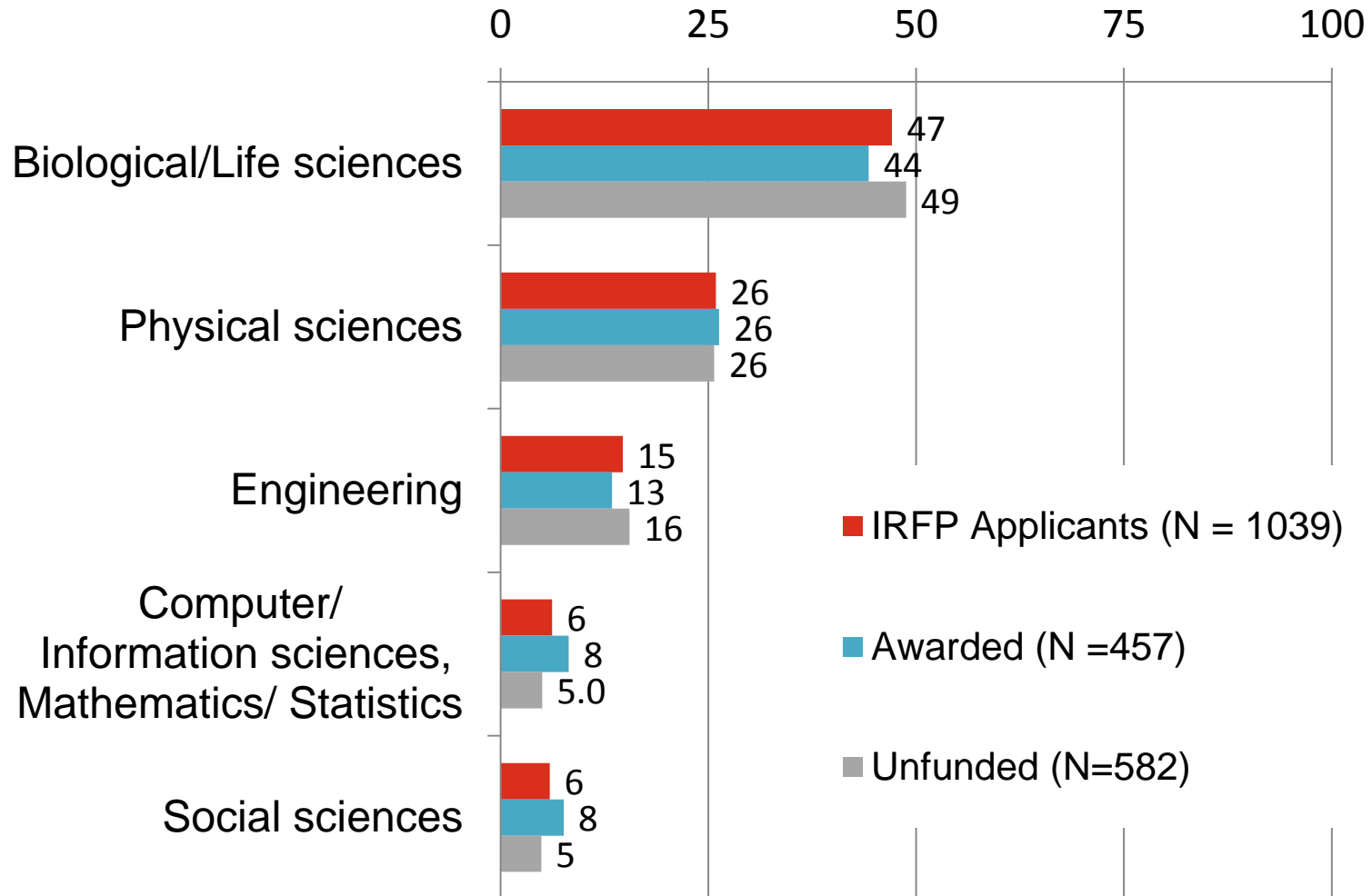
- Used **extant NSF data** to identify former fellows, unfunded applicants and hosts
- Collected **survey data** from fellows, unfunded applicants and former hosts
- Conducted **descriptive analyses** of program experiences, both fellows' and hosts' experiences
- Compared post-application outcomes of fellows to unfunded applicants using ***propensity score matching***
- **Compared fellows to nationally-representative sample** of U.S. STEM PhD degree-holders (Survey of Doctoral Recipients, SDR)

Response Rates



	Applicants			Hosts
	Overall	Awardees	Non-Awardees	
Target sample	1,660	581	1,079	557
Final survey sample	1,628	564	1,064	536
Complete & partial surveys	1,050	460	590	335
Complete surveys	1,039	457	582	328
Response Rate	64%	81%	55%	61%

Applicants' STEM fields

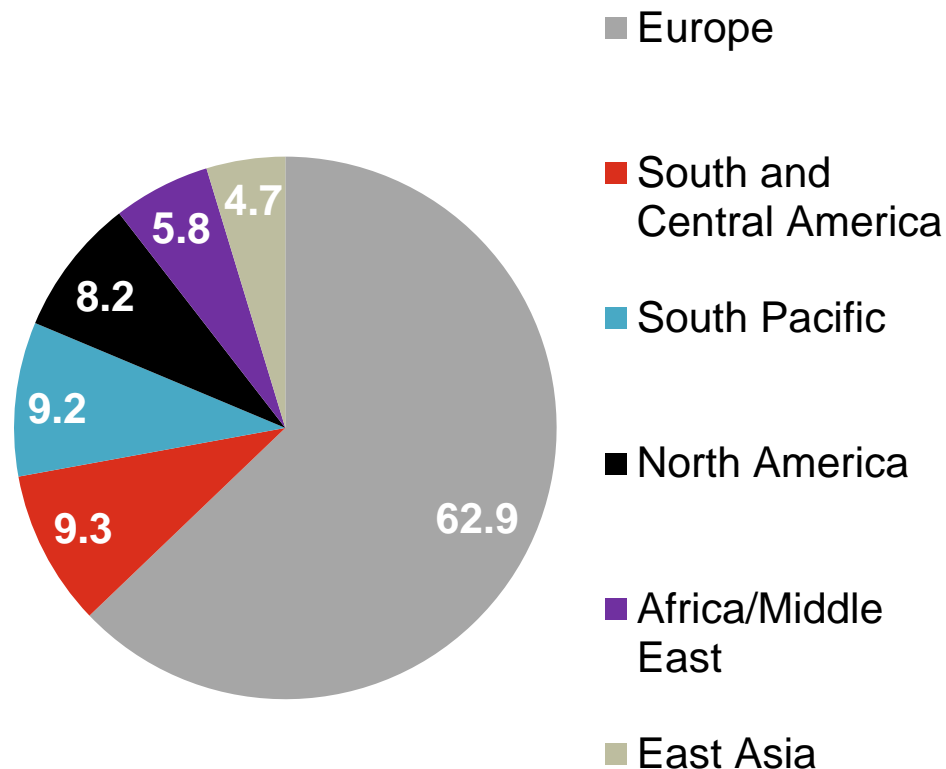
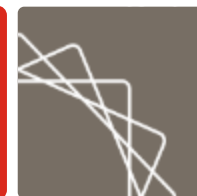


IRFP Applicants



	All Applicants	Awarded	Unfunded
Gender			
Female	38.8%	38.0%	39.4%
Race/Ethnicity			
White non-Hispanic	85.7	86.7	85.2
Asian	5.3	4.6	5.7
Hispanic	4.9	4.4	5.2
Multiracial (two or more races)	2.4	2.4	2.4
Black or African American	1.6	1.7	1.5
American Indian or Alaska Native	0.1	0.2	0.0

IRFP Fellowship Locations



Top Reasons for Selecting Host/Location

- Specific person/institution (86%)
- Enhance skills or knowledge (84%)
- Collaborate with foreign scientist (60%)

Constructing a Comparison Group



- Fellows versus unfunded applicants
- Matched using **propensity score matching (PSM)**
 - Goal of PSM: eliminate inter-individual differences other than award receipt
 - PSM produces a **propensity score** = an individual's likelihood of receiving an IRFP award, given pre-existing characteristics
 - The propensity score is used to match fellows to unfunded applicants (i.e., to create a comparison group)

Quick overview of PSM



- A.** Use pre-existing characteristics that predict award receipt and outcomes
- B.** Calculate likelihood (*propensity*) that applicant would get award (based on A)
- C.** Make subgroups of fellows, unfunded with similar propensity scores
- D.** Estimate difference in outcomes for each subgroup and aggregate these impacts across the subgroups

Mean proposal score

Prior international experience

No. of publications

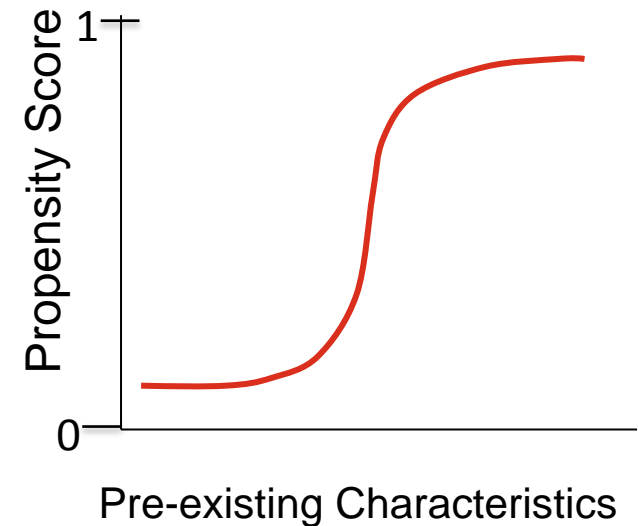
Gender, race, ethnicity

STEM field

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P-score	Fellows	Unfunded
.99-1.0	•••	
.97-.98		
.94-.96	••••••••••	••
.89-.95	••••••••••	••••••
.78-.88	••••••••••	•••••••
.72-.87	••••••••••	•••••••
.69-.86	••••••••••	••••••••••
.		
.		
.		
.40-.49	•••••••	••••••••••••••••••••
.34-.39	•••••••	••••••••••••••••
.25-.33	•••••	••••••••••••••
.11-.22	•••••	••••••••••••••
.07-.10	•••	••••••••••
.04-.06		••••
.01-.03		•

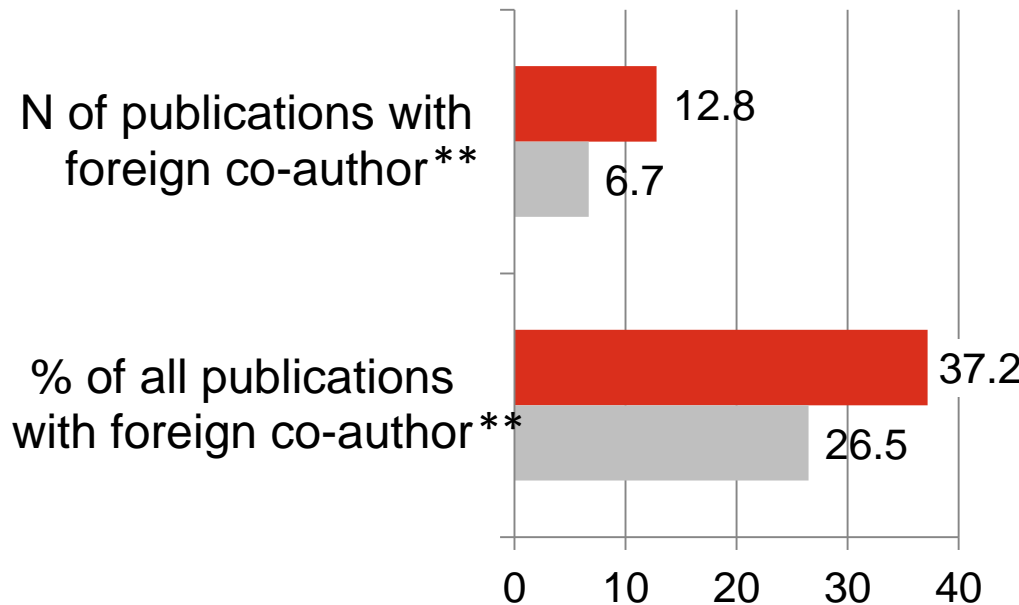
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$$Y_i = \beta_0 + \beta_1 T_i + \sum_{j=1}^{b-1} \beta_{j+1} S_i^j + \sum_{j=1}^{b-1} \beta_{j+b} T_i S_i^j + \sum_{n=1}^N \beta_{n+(b+3)} X_i^n + \varepsilon_i$$

IRFP Enhanced Fellows' Engagement in Productive International Research Collaborations



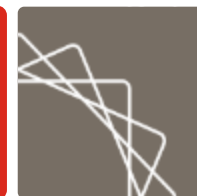
■ IRFP Fellows ■ Unfunded Applicants

- Covariates included**
- # years since PhD
 - Gender
 - Under-represented minority status
 - No. of pre-application publications
 - STEM discipline

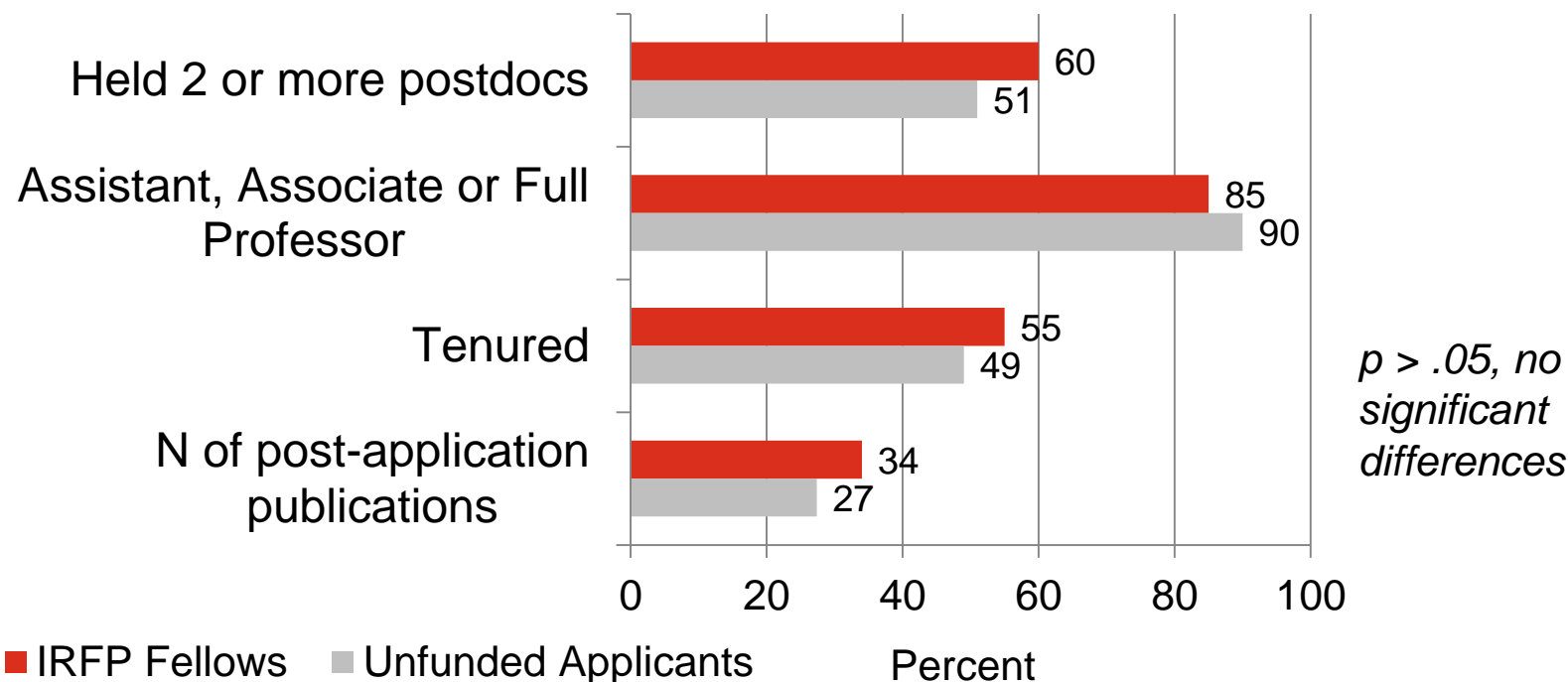
** $p < .01$

- Compared to unfunded applicants, former IRFP Fellows were more likely to establish productive international research collaborations

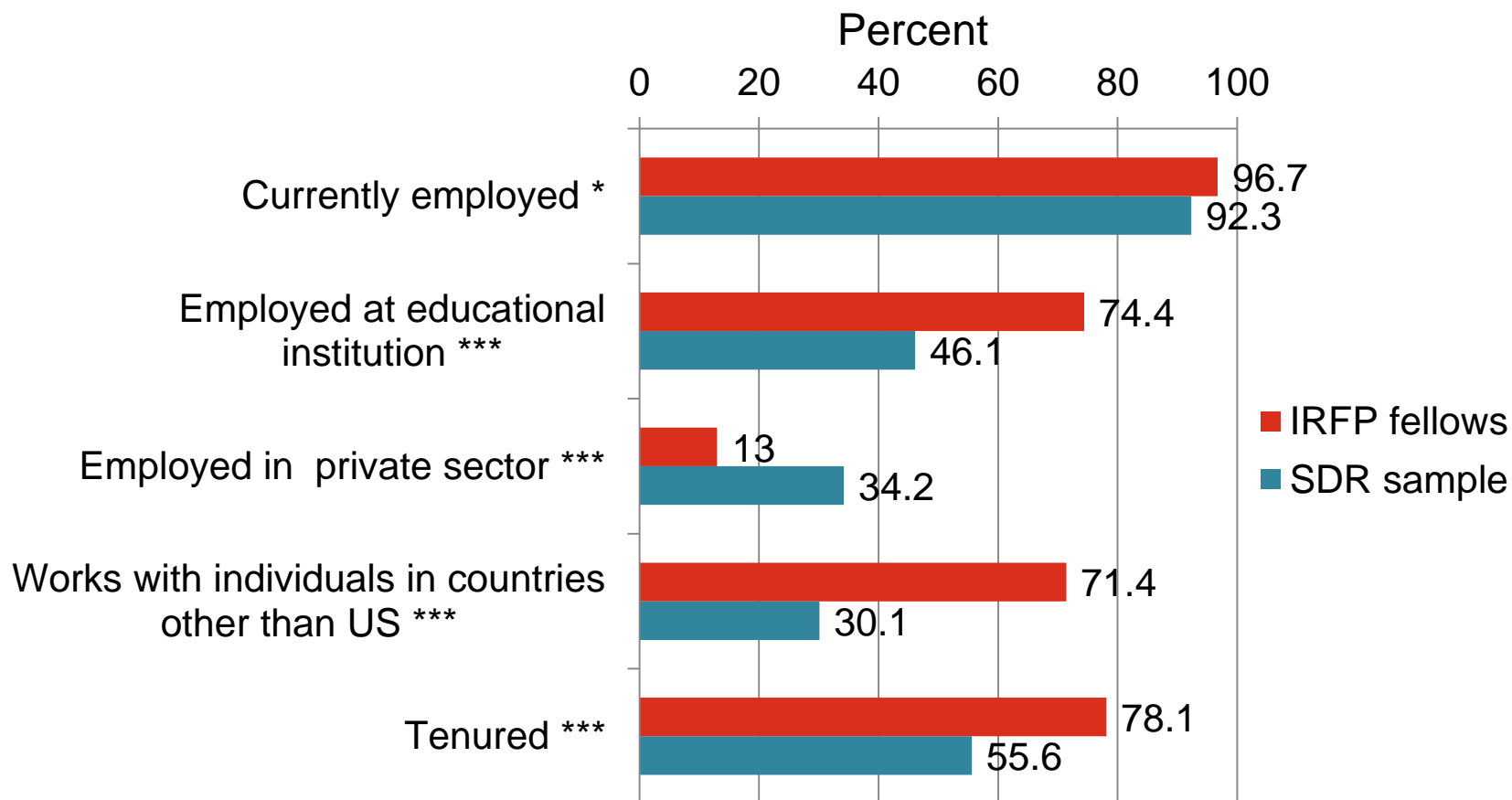
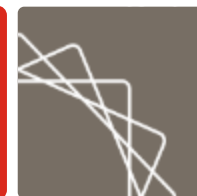
IRFP Fellows' Professional Advancement and Productivity Did Not Suffer



- IRFP fellows' greater international engagement did not limit their professional advancement or productivity relative to unfunded applicants



IRFP Fellows vs. US STEM-PhDs: Employment Characteristics

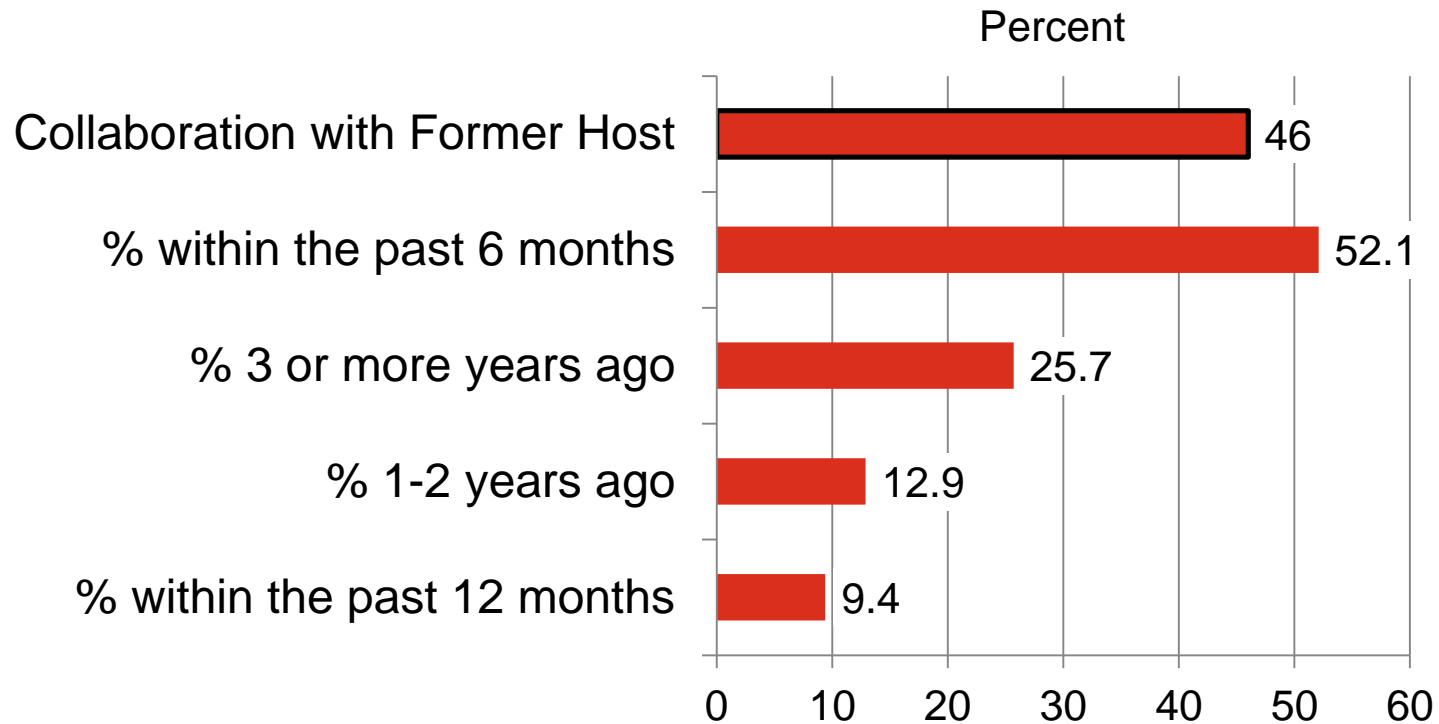


* $p < .05$ ** $p < .01$ *** $p < .001$

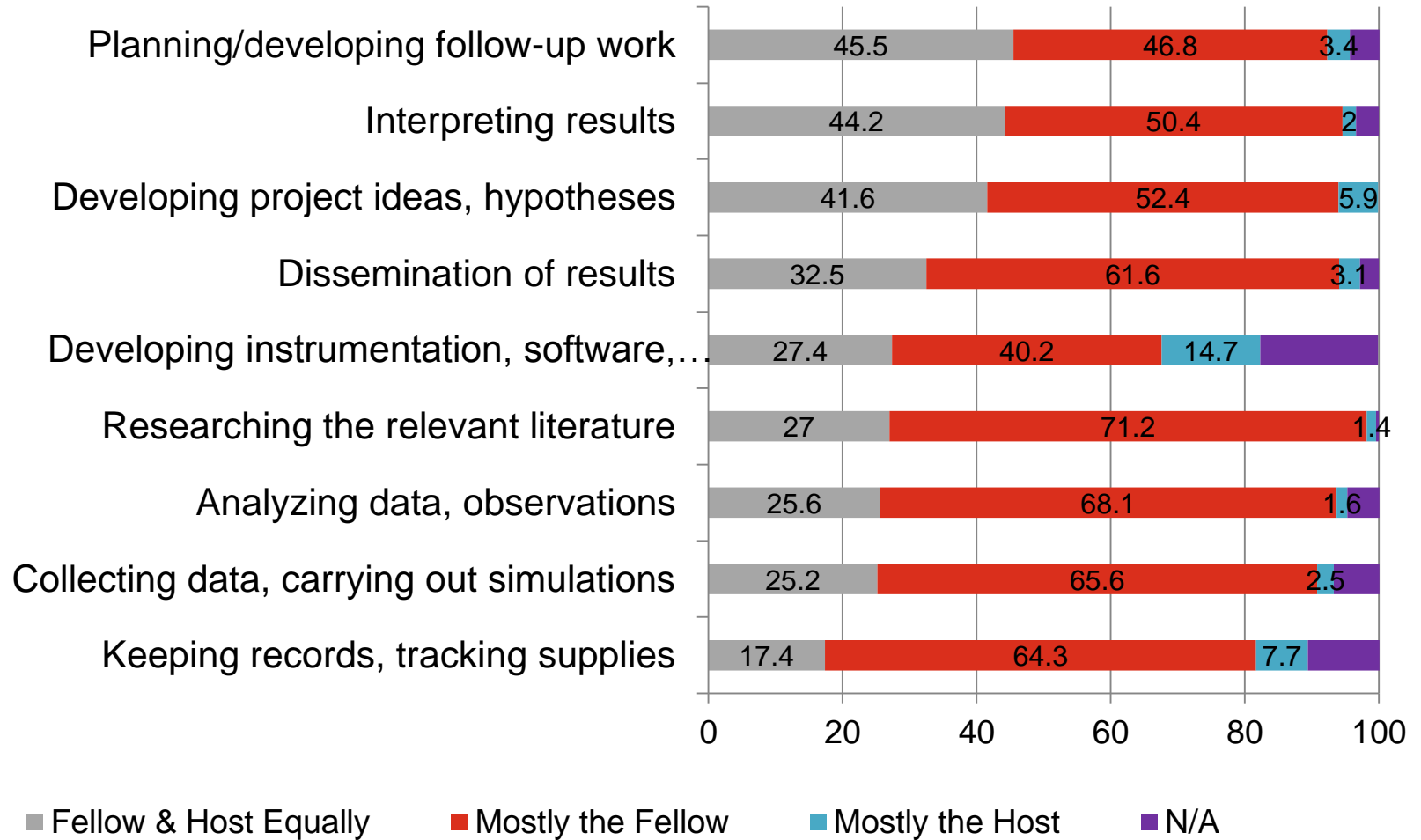
Just under Half of Former IRFP Fellows Have Sustained their Collaboration with Former Host



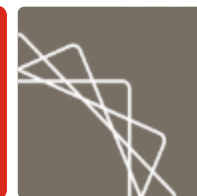
- 46% of former IRFP fellows have sustained research collaborations with their former hosts



IRFP Fellows' Research Activities and Collaboration with Host



IRFP Broader Reach



Activities Undertaken by Former IRFP Fellows' to Share Benefits of Their Fellowship

Percent

Taught colleagues or students research methods learned during IRFP fellowship

78.1

Shared resources or tools with colleagues

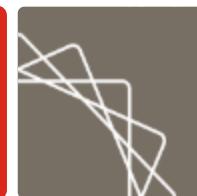
75.4

One IRFP fellow said:



“I recommend [IRFP] most highly to every grad student who comes through my office (I have also led informal postdoc workshops where I strongly encourage students to apply). The opportunity to spend an extended amount of time dedicated to research in a different cultural setting...was an incredible experience. I moved on to the job market with renewed energy, new perspectives on my research, and a greater appreciation for international collaboration (and a stronger CV).”

Hosts' Reasons for Participating



Hosts' motivations for hosting the IRFP Fellow	Percent of Hosts (N=382)
I was interested in the project proposed by the Fellow	82.9
To create an international environment in my research group	59.5
To attract students/postdocs to my research	48.8
Knew or knew of, or previously collaborated with the Fellow	47.0
Interested in establishing or maintaining collaboration with a US researcher	43.9
Knew or knew of, or previously collaborated with Fellow's doctoral advisor	43.3
To learn new methodologies, approaches, or tools	35.4
Previous positive experience with other US postdoctoral or visiting researchers (not IRFP-funded)	30.5
Knew or knew of, or previously collaborated with researchers at Fellow's institution	20.7

IRFP Hosts' Satisfaction With the Research Collaboration



One IRFP Host said:



“[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 PI's) and represents one of the most satisfying collaborations of my career.”

IRFP: Reported Program Challenges



Reported by Fellows

Percent

None

40

Logistical difficulties

32

Language difficulties

20

Inadequate access to space/ resources

16

Not enough guidance from Host

15

Reported by Hosts

Percent

None

65

Fellow did not devote enough time/effort to the project

10

Fellow worked too independently, did not work well as collaborator/team player

8

IRFP: Challenges by Region



Percent of Fellows Encountering Difficulties by Region	East Asia (N=22)	Europe (N=263)	South & Central America (N=46)	Africa & Middle East (N=29)	North America (N=42)	South Pacific (N=47)
Logistical difficulties*	55.4	28.4	49.9	46.2	25.8	16.7
Communication or language difficulties*	45.1	23.7	15.5	20.8	11.8	0.0
Inadequate access to facilities, equipment, resources*	40.3	13.0	32.3	22.2	12.1	6.2
None*	4.9	39.1	35.7	34.4	47.5	60.1

Fellows' recommendations



- Fellows appreciated NSF's flexibility with respect to starting dates (e.g., unanticipated family, health events)
- Extend the fellowship duration
- Provide logistical guidance in advance (e.g., via IRFP alumni)
- Some language training might be beneficial, even in countries where hosts speak English
- Discuss with host in advance the availability of resources and availability of host, presence on site

From the Participants



My time as an IRFP [Fellow] was transformative both personally and professionally. It was a terrific experience whose benefits I continue to reap even 10 years later I met wonderful colleagues with whom I still collaborate I have been back numerous times, most recently with students from my home institution.... and have recommended the program to younger colleagues. -- *IRFP Fellow*

[IRFP] is an experience which is culturally enriching, and scientifically productive. Research at the forefront of science requires combining the best researchers and facilities on the world. It is often necessary to combine equipment and expertise by people on different continents, if one really wants to get the best possible results. --*IRFP Host*

Conclusions



- The IRFP program effectively fosters international collaboration for U.S. scientists and engineers
- Benefits include international collaborations that persist beyond the duration of the fellowship period
- IRFP does not constrain fellows' professional advancement
- Experiences extend beyond the specific participants and seed additional international S&E research activities

Trends and Future Directions



- Propensity score matching is a feasible approach to evaluating merit-based programs
 - Requires much data on pre-treatment characteristics
- Nationally-representative data provide an important context for findings
 - Increasing attention to using extant data sources and nationally-fielded surveys
- Locating individuals in academic STEM easier than locating those in the non-academic STEM workforce
- Prospective designs could ameliorate many of the challenges of evaluating merit-based (and other) programs

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- Abt SRBI: Paul Schroeder, Andy Weiss and their survey team
- Abt collaborators: Karla Whittaker, Kristen Neishi, David Cook, Mike McLaughlin, Luba Katz, Beth Gamse; Nicole DellaRocco, Morgan Sharoff, Stephanie Althoff, Jan Nicholson, Melissa O'Connor

Contact information:

Carter Epstein

Carter_epstein@abtassoc.com

Alina Martinez

Alina_Martinez@abtassoc.com

Amanda Parsad

Amanda_Parsad@abtassoc.com



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jtsapoga@nsf.gov

