

Increasing U.S. Competitiveness by Investing in Underrepresented, Entrepreneurial-Minded Postdocs in High-Tech Startups

Teddy Ivanitzki

American Society for Engineering Education (ASEE)

t.ivanitzki@asee.org

Rashida Johnson

American Society for Engineering Education (ASEE)

r.johnson@asee.org

Rachel Levitin

American Society for Engineering Education (ASEE)

r.levitin@asee.org

Abstract

Studies have shown that in the United States, women, Black, and Hispanic entrepreneurs are given a disproportionately tiny fraction of venture capital funding, especially when compared to their representation in the population. This investment discrepancy is not only socially unjust, but it also deprives the U.S. of the advantages in discovery and global competitiveness that could stem from these groups' increased participation in innovative sectors. This is particularly true within transdisciplinary startups, like smart energy or nanomedical technologies, all of which require crossdisciplinary experts. Every new entrepreneur in these fields experiences challenges in finding adequate support. These challenges exist at a time in the 21st century when U.S. innovation is facing unprecedented pressures in competition for primacy. In 1960, the U.S. research and development (R&D) expenditure for defense and private industries was approximately 69 percent of global spending on R&D. In 2016, however, the U.S. share of global R&D expenditure had decreased to just 28 percent due to China's substantial advances. If this trend continues, China's R&D expenditure measured by GDP will outperform those of the U.S. by 2030.

To ensure that the U.S. remains a world leader in R&D, the National Science Foundation (NSF) launched the Small Business Postdoctoral Research Diversity Fellowship (SBPRDF) followed by the Innovative Postdoctoral Entrepreneurial Research Fellowship (I-PERF). Both facilitate the professional development of underrepresented research fellows by offering them invaluable experience within research and technology companies. This paper provides a pathway for enhancing diversity in the startup and entrepreneurial landscapes, improving opportunities for researchers from underserved groups, and increasing the number of highly competent entrepreneurs within the U.S. STEM community. The startup companies involved in the program, which are also supported by the NSF, comprise a variety of new, mixed STEM fields that were unknown just a few decades ago.

Introduction

In 1960, the U.S. research and development (R&D) expenditure for private and defense industries comprised 69 percent of worldwide spending on R&D [1]. In 2016, however, the U.S. share of global R&D expenditure decreased to only 28 percent [2], mostly due to China's substantial growth and advances. Should this trend continue, China's R&D expenditure measured by GDP will eclipse that of the U.S. by 2030 [3]. In order to remain competitive and uphold its leadership in innovation, the U.S. needs to use all of the country's available talent. In the past, only privileged citizens were able to participate in high-tech startups. As a result, the National Science Foundation (NSF) started programs with the aim of engaging underrepresented citizens in a variety of entrepreneurial startups.

In FY 2013, the last year data was available, the Small Business Administration (SBA) awarded 5,159 Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Phase I and Phase II grants totaling more than \$2.5 billion [4]. On average, the SBA awards more than 5,000 grants to entrepreneurs every year to the tune of \$3.5 billion [5]. The 2013 SBA Annual Report disclosed that only about 15 percent of this funding was awarded to women and underserved minority groups [6], even though those groups represent approximately 50 percent of the U.S. population. For comparison, this is a significantly lower percent than that of science and engineering (S&E) doctorates awarded to women and underrepresented groups that year [7]. It also does not reflect the capacity or talent of those more than 90,000 underrepresented people who earned S&E doctorate degrees between 2005 and 2015 in the U.S. [8]. This trend led Congress to allow eligible agencies to use 3 percent of their small business grant budget set aside for administrative purposes to support underserved groups under the SBIR/STTR Reauthorization Act of 2011. As result, many agencies use this fund for outreach to underserved groups.

The private sector tells a similar story. Diversity VC, a nonprofit partnership promoting diversity in venture capital, reported in 2019 that, in a comprehensive survey [9] of around 10,000 founders receiving venture capital backing, only 9 percent were women, and a mere 1 percent were Black. According to former SBA Administrator Maria Contreras-Sweet, "Only 1 percent of VC capital flows to Hispanic or Black entrepreneurs. Does anyone honestly believe these communities are the source of just 1 percent of our best business ideas?" Researchers who study this issue assert that women and minorities are not receiving investments because they are not connected to venture capital networks, and they do not know where to look.

Solving the Problem on the Horizon

In order to accelerate innovation, increase participation of underrepresented minorities in new startups, and ensure U.S. competitiveness in the global market, the National Science Foundation (NSF) introduced the Small Business Postdoctoral Research Diversity Fellowship (SBPRDF) program already in 2011 [10]. They selected the American Society for Engineering Education (ASEE) to manage it. The SBPRDF provided an opportunity to measurably increase the participation of underrepresented minorities in small business research and high-tech entrepreneurship, thereby accelerating U.S. innovation. Throughout the grant cycle for the SBPRDF, the program administrators and ASEE conducted surveys regarding program

effectiveness so that the next iteration, NSF's Innovative Postdoctoral Entrepreneurial Research Fellowship (IPERF) program, could expand what worked and correct what didn't.

In the first iteration of the program, the SBPRDF invested in a total of 79 S&E Ph.D. recipients, placing them in research positions at eligible National Science Foundation (NSF) Phase II SBIR companies. ASEE facilitated these placements. These individuals acquired real-life entrepreneurial research experience, bringing the latest innovative theories and techniques from the academic community to the country's entrepreneurial technology sector. By working with cutting-edge startup companies where research and development are accomplished within a framework of expected business outcomes and constraints, research fellows learned to work in multidisciplinary teams and apply their academic expertise to realize products in a globally competitive environment. The program aimed to establish mutually beneficial relationships between the companies and the fellows.

The Phase II SBIR program companies received help from highly talented postdoctoral research fellows to accelerate their enterprise; at the same time, underrepresented groups such as women, African Americans, Hispanic Americans, American Indians, and Hawaiian/Pacific Islanders received valuable experience in small business innovative research. Since the program's inception in 2011, ASEE's involvement with the SBPRDF program has brought much success. However, ASEE realizes that opportunities exist for the program to not only better serve its fellows' professional development, but also address minority-owned firms' lack of participation in research supporting high-tech entrepreneurship and the federal government's needs.

The SBPRDF program placed 79 fellows in 77 different Phase II Active SBIR companies from 2011 to 2018. Program participant surveys conducted in 2014 and 2019 [11] found many positive outcomes. One of these was that the proportion of underrepresented groups in the applicant pool and the proportion of those selected exceeded those of newly graduated engineering doctoral students.

Based on the final SBPRDF report [11], among 79 fellows, women and underrepresented minorities represented more than 40 percent of program participants. Additionally, 40 percent of the SBIR host companies hired their fellows as full-time employees for performance testing and prototype commercialization. Seventy-two percent of the postdocs noted that the SBPRDF fellowship gave them a competitive edge in the job market, with some further reporting that they gained valuable grant writing and business experience. Of all the fellows in the SBPRDF program, 43 percent of the participants were offered employment by their host companies and 84 percent believed that the fellowship experience enhanced their professional qualifications.

A longitudinal survey conducted in December 2021 of 50 SBPRDF fellows who left the program over three years ago showed that, even though 40 percent were hired by the host companies, only a tiny fraction (5 percent) were still working at those startups. A majority of the others found jobs either within the larger industry (30 percent) or other startup companies (30 percent). The remaining fellows went into various governmental labs or administration positions. There were three primary reasons cited by the fellows for not being offered an employment by their host companies:

- 1) The company did not have enough funding resources to extend an offer of permanent employment to the fellow. Interviews with the leaving fellows described a correlation between the size of the company and funding available to the fellow. In small businesses that employed a maximum of four to five members, the funding was relatively short, especially for employees commanding salaries in excess of \$80,000 per year; however, in enterprises with more than 10 members, the funding was more readily available.
- 2) The fellow was not interested in pursuing a career with the host company.
- 3) It was too early for either or both the fellows and the host companies to make an employment decision.

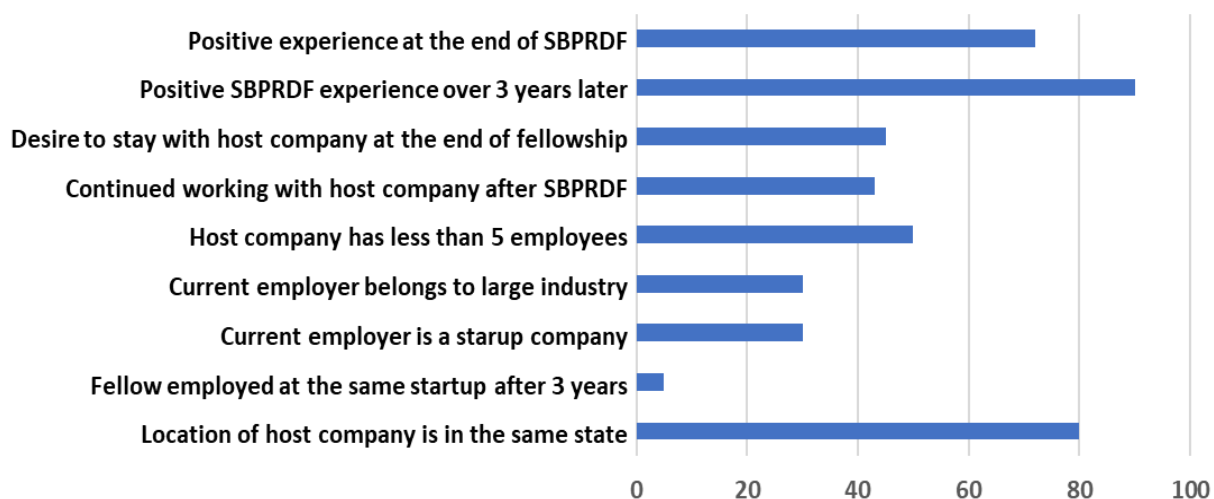


Fig. 1: SBPRDF survey directly after the fellowship and three years later

An interesting survey finding was the increase of participants who reported a positive program experience three years after the program ended. While the majority of the fellows—72 percent—reported a positive experience immediately following the program, even more saw the value in it as time went on. Three years later, 90 percent of the participants described their experience as either “extremely valuable” or “valuable.”

In 2019, the program hired an independent evaluator to conduct a survey to understand the financial impacts of fellowship on the participants. About half of the mentors reported that they gave stock options to their fellows. More than 70 percent of the mentors who did not give them stock options reported they would be willing to do so in the future in hopes of attracting a post-doctoral fellow to their company. One-third of the fellows said they were offered stock options and/or other deferred compensation when hired by their company. Fifty percent of the fellows who received stock options reported that they were able to exercise their options and participate in a liquidity event.

The evaluator also noted that, while the SBPRDF program has been quite successful, there was still room for improvement. They recommended that the SBPRDF be more engaged with the fellows both during and after the fellowship. The program should also facilitate the formation of a community engaging current fellows and program alumni. Additionally, fellows reported that expectations for the fellowship could and should be better laid out and that fellows

wanted opportunities to meet and learn from the experiences of other fellows. Those issues are explicitly addressed in the recently awarded grant proposal entitled, “NSF Innovative Postdoctoral Entrepreneurial Research Fellowship (I-PERF), NSF #1853888” in 2019. Based on additional programs developed specifically for I-PERF, the ASEE team was able to improve both the program quality and fellows’ satisfaction levels. Details will be published at the end of I PERF in 2023.

The project team focused on developing intensive, low-cost online communications rather than person-to-person engagement. The team and the fellows also discussed and agreed on the most important training topics to be offered to them. These topics included: i) How to start a business, startup prerequisites, and how to influence others to their own ideas; ii) the ABC’s of seeking SBIR/STTR research funding and how to find the most important websites; iii) an introduction to intellectual property (IP) for high-tech entrepreneurially minded postdocs; iv) management, mentors, and money: decoding chasms of research commercialization; and v) managing the pressure and stress of a startup environment during a pandemic.

ASEE offered one-on-one consultations to fellows looking for advanced information on their next career steps, especially pertaining to entrepreneurship; approximately 15 hours of e-counseling were delivered. The consultants came from the venture capital field, and the majority of those came from underrepresented groups. Topics of these consultations included: mentoring and commercialization aspects, transitioning from academia to start-up, time management/prioritization, and how to manage work-life balance, especially during a pandemic.

The I-PERF host companies have signed up and committed to offering a mentor from their companies to collaborate closely with the accepted fellows during their postdoctoral appointment as a condition of participating in this program. Additionally, every six months, the mentors deliver progress reports summarizing their interaction with the fellow. The progress report includes progress assessments of the research project, a list of joint publications, and areas of possible future collaboration with the fellow. ASEE has been evaluating these reports and giving informal feedback to the fellows, especially if they were seeking a second-year award extension.

Details of Ethnic and Racial Distribution in SBPRDF versus I-PERF

Our fellowship cohort was composed of underrepresented minority (URM) groups including African Americans, Hispanics, American Indians, Alaska Natives, and Pacific Islanders. In the following chart, “URM/W” is the sum of all women in the program, (i.e., non-URM women and URM men and women in the program). “URM+W” represents the number of URM women in the program, and “URM+M” denotes the number of URM males in the program. Finally, “W” represents the sum of all women in the program as of September 2021.

Our overarching goal of increasing the participation of women/underrepresented groups in the I-PERF program has so far achieved great success. In two years of outreach activities, 48 fellows joined the I-PERF program. More than 70 percent were women or held URM status. The remaining 20 percent were of Middle Eastern or Asian descent (i.e., not defined as underrepresented minorities). This is a significant increase over the previous SBPRDF grant project, which was composed of 56 percent URM/W. We attribute our success in reaching more

diverse candidates to increasing our advertising in dedicated markets such as Historically Black Colleges and Universities (HBCUs), the Society for Advancement of Chicanos and Native Americans in Science (SACNAS), and the National Postdoctoral Association (NPA). We also required a diversity statement with the application, which was meant to illustrate the candidates' involvement in supporting underrepresented groups. These both contributed to our increased success of engaging URM/W groups in I-PERF vs. SBPRDF.

	URM/W	W	URM	URM+W	URM+M
IPERF FY 2021	72%	49%	32%	9%	23%
IPERF FY 2020	65%	43%	39%	8%	22%
SBPRDF Final	56%	37%	27%	5%	21%

Conclusion

The I-PERF project has so far resulted in increasing the participation of women/underrepresented groups in entrepreneurship. Their engagement in entrepreneurial activities should help increase the socioeconomic status of those individuals and the groups who are often left lower on the economic ladder. Through I-PERF, these highly educated but theoretically oriented fellows will learn on-the-job the practical skills of modern entrepreneurship. They will have the choice of either staying and joining the high-tech startup or launching their own business after this fellowship. The professional development and education they receive will be invaluable both to them and to the overall goal of unravelling the diversity gap in high-tech entrepreneurship and leadership in the United States.

Acknowledgments

This material is based upon work supported by the National Science Foundation (NSF) Innovative Postdoctoral Entrepreneurial Research Fellowship (IPERF), under Grant No. 1853888.

References

- [1] Congressional Research Service (2018). The Global Research and Dev. Landscape & Implications for the Department of Defense, p. 5. Retrieved on Feb. 14, 2022, from: <https://crsreports.congress.gov/product/details?prodcode=R45403>
- [2] Congressional Research Service (2018). The Global Research and Dev. Landscape & Implications for the Department of Defense, p. 11. Retrieved on Feb. 14, 2022, from: <https://crsreports.congress.gov/product/pdf/R/R45403/4>

- [3] Congressional Research Service (2018). The Global Research and Dev. Landscape & Implications for the Department of Defense, Fig. 6, p. 11. Retrieved on Feb. 14, 2022, from: <https://crsreports.congress.gov/product/pdf/R/R45403/4>
- [4] Small Business Innovation Research, Annual Report, 2013. Retrieved on Feb. 14, 2022, from: https://www.sbir.gov/sites/default/files/annual_reports/FY13_SBIR_STTR_AR_Final.pdf, p. 3.
- [5] SBA, Leveraging America's Seed Fund, SBIR/STTR, March 2020. Retrieved on Feb. 14, 2022 from: https://www.sbir.gov/sites/default/files/SBA_SBIR_Overview_March2020.pdf, p. 4.
- [6] Small Business Innovation Research, Annual Report, 2013. Retrieved on Feb. 14, 2022, from: https://www.sbir.gov/sites/default/files/annual_reports/FY13_SBIR_STTR_AR_Final.pdf, p. 15.
- [7] NSF/NCES, Survey of Earned Doctorates Report, 2020. Retrieved on Feb. 14, 2022, from: <https://nces.nsf.gov/pubs/nsf22300/report/u-s-doctorate-awards>, Fig. 5 & Fig. 6.
- [8] NSF/SED, Science and Engineering Doctorates Report. NSF 17-306, 2016. Retrieved on Feb. 14, 2022 from: <https://www.nsf.gov/statistics/2017/nsf17306/report/who-earns-a-us-doctorate/race-and-ethnicity.cfm>, Science & Engineering Doctorates, Chart 1.
- [9] Azevodo, M., Crunchbase News, Untapped Opportunity: Minority Founders Still Being Overlooked, Feb. 27, 2019. Retrieved on Feb. 14, 2022, from: <https://news.crunchbase.com/news/untapped-opportunity-minority-founders-still-being-overlooked/>
- [10] Tull, D., Award Abstract #1059286, NSF-IIP, Small Business Postdoctoral Research Diversity Fellowship Program. Retrieved on Feb. 14, 2022, from: https://www.nsf.gov/awardsearch/showAward?AWD_ID=1059286
- [11] Tull, D., ASEE/NSF Small Business Postdoctoral Research Diversity Fellowship Program (SBPRDF), 1552305 - Final Project Report to NSF, 10/2019.

Biographies

TEDDY IVANITZKI is one of ASEE's directors within the fellowships and research opportunities (FRO) department. He has more than 25 years of experience in managing the commercialization of technologies within IT industries and as the CTO/CEO of multiple high-tech startups in Europe and the United States. Prior to joining ASEE, Dr. Ivanitzki was managing director of the Ethiopian Institute of Technology in Mekelle, Ethiopia; previously, he served as dean of the College of Engineering and IT at DeVry University in Houston, Texas.

RASHIDA JOHNSON has more than twelve years of experience managing government grants and contracts awarded to the American Society for Engineering Education. Ms. Johnson has expertise in contract administration, budget tracking and management, proposal development,

financial reporting, the monitoring and evaluation of project goals, and the general administration of the grant life cycle. Ms. Johnson has also been integral to developing outreach strategies for attracting the highest and most uniquely qualified postdoctoral talent. Ms. Johnson holds a master's degree in public policy from Georgetown University and Bachelor of Arts degree in government and international relations from Smith College.

RACHEL LEVITIN has more than twelve years of experience managing government grants and contracts awarded to the ASEE on behalf of the DoD and NSF. Ms. Levitin has expertise in program administration, project management and reporting, proposal development, event production, multimedia storytelling, public speaking, and customer service. Ms. Levitin's communications background provides ASEE with a unique and creative approach toward adhering to the society's mission of advancing innovation, excellence, and access at all levels of education for the engineering profession. Ms. Levitin holds a Bachelor of Arts degree in communications: journalism from American University.