Lessons Learned from the CCC Postdoc Best Practices Program

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About CERP

The Computing Research Association's (CRA) Center for Evaluating the Research Pipeline (CERP) evaluates the effectiveness of intervention programs designed to increase retention of individuals from underrepresented groups in computing, namely men from underrepresented racial/ethnic groups, and women of all racial/ethnic backgrounds. More generally, CERP strives to inform the computing community about patterns of entry, subjective experiences, persistence, and success among individuals involved in academic programs and careers related to computing.

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For more information about CERP, visit http://cra.org/cerp/.

Introduction

This report of the Computing Research Association (CRA) Center for Evaluating the Research Pipeline (CERP) was written as a capstone analysis of the Computing Community Consortium (CCC) Postdoc Best Practices Program, an initiative that funded three programs to transform the postdoctoral experience for recent PhD graduates.

Background

Postdoc positions are training opportunities whereby recent PhD recipients can deepen their expertise and/or research skills for one to three years, typically en route to permanent jobs (Jones, Gianchandani, Grimson, King, Seltzer, & Sproull, 2011; Louis, Holdsworth, Anderson, & Campbell, 2007). Postdocs who are allowed to flourish in their environment are more likely to have an advantage in their career trajectories towards successful science careers (Louis, et. al, 2007).

According to CRA Taulbee data, the number of postdocs in computing rose from 114 to 294 between 2005 and 2010, totaling a 157.89% increase. Postdoc positions comprised 34% and 58% of jobs awarded to new PhDs in North American PhD-granting departments in 2005 and 2010, respectively. All the while, the production of PhDs in computing rose an average of 10% per academic department during the same time period (Zweben & Bizot, 2018), but the number of academic and industry jobs became increasingly scarce as the economy took a downward turn in 2008[1]. These trends did not go unnoticed. In 2011, CRA issued a working paper on the role of postdocs in computer science (Jones, et. al, 2011), which later turned into a best practices memo of the CRA in 2012 (Jones & Gianchandani, 2012).

Computing Innovation Fellows

In response to the nation's economic instability and growing numbers of doctoral recipients turning to postdoc positions as a means for professional experience, the National Science Foundation called upon the CCC to develop and administer a short-term postdoc program for recent PhD graduates called the Computing Innovation Fellows, also known as CI Fellows. The CI Fellows program extended over a span of three cohorts of postdoc computing researchers between 2009 and 2011. The intention of the program was to provide a positive experience for computer science postdocs that would build strong career development skills necessary for the successful transition into full-time careers and long-term success. Across all three cohorts, 127 PhD recipients were awarded a CI Fellowship.

As the CI Fellows program came to a close, the community was left wondering what could be learned from the program, and how might the community extend a broad reach of best practices to the field that would foster positive postdoctoral experiences for computer science PhD awardees. Thus, the CCC Postdoc Best Practices Program (PostdocBP) was born. In September of 2013, the CCC released an RFP to the computing

[1] https://cra.org/ccc/leadership-development/cifellows/

community for the submission of proposals to develop, implement, and institutionalize best practices that support postdocs in computer science and engineering[2].

Postdoc Best Practices Program

In early 2014, three awards were made to academic institutions and consortiums located in Arizona (Arizona State University, Northern Arizona University, and University of Arizona), New York (Columbia University, City University of New York, Cornell University, and New York University), and Washington State (University of Washington). Each of these three sites employed evaluators to assess the individual programs. The CCC also enlisted the CRA Center for Evaluating the Research Pipeline (CERP) to provide an overall evaluation of PostdocBP utilizing the data collected and reports produced by the site-specific evaluators.

During the spring of 2016, the PIs and evaluators of PostdocBP held a meeting at Columbia University to discuss the project progress and strategize about overcoming any challenges encountered. During the meeting the PIs generated a plan for disseminating preliminary findings. Two primary reports were generated based on discussions at the PI meeting: a mid-project report and a *Communications of the ACM (CACM)* article[3].

In 2016, CERP produced the mid-term project report that synthesized preliminary evaluation results produced thus far from each of the sites and compared quantitative measures collected from postdocs entering and exiting the programs (Stout & Wright, 2016). The CACM article was written by the PIs and took a programmatic perspective to the successes and challenges from each of the sites (Chitta, Chang, Curless, Dasgupta, Hirschberg, & Jones, 2018). Each of the reports highlighted overlapping elements from each program, such as the use of an Individual Development Plan (IDP), meetings with mentors and advisors, offering travel scholarships, and providing workshops and seminars for professional development. While the mid-term report discussed challenges from a program-specific perspective (e.g., attendance rates for workshops and engagement with mentors and advisors), the CACM article brought up various discussion topics for the broader community, such as whether CS needs a tailored IDP and how universities can determine efficient methods to better engage with postdocs.

Purpose of this Report

This report serves as a final overview and discussion of the CCC PostdocBP program from an evaluative perspective. CERP results discussed here (a) synthesize reports generated by the three sites' evaluation teams and PIs, and (b) draw conclusions that are intended to help guide the planning of future postdoc positions for computing researchers. This report also serves as a means to generate best practices learned from the program for the greater computing community. At the end, best practices are summarized, serving as both the conclusion of this report and as a stand-alone one-pager that can be distributed freely on its own.

[2] http://postdocbp.org/programs

[3] https://cacm.acm.org/magazines/2018/1/223892-ask-not-what-your-postdoc-can-do-for-you

Overview of the POSTDOCBP Award Recipients

The following overview of the three PostdocBP sites was based on the original CCC public announcement made in 2014.

A Foundational Model for Postdoctoral Programs in Computer Science & Engineering at Large Universities (AZ)

Arizona's Foundational Model for Postdoctoral Programs in Computer Science & Engineering at Large Universities (referred to as AZ throughout this report) is a consortium of three Arizona institutions: Arizona State University, Northern Arizona University, and University of Arizona. Arizona State University serves as the primary location. This program is led by Chitta Baral and Partha Dasgupta at Arizona State University.

The Arizona PostdocBP program was designed to build a statewide community for postdocs in computer science and engineering (CS&E) comprising three primary elements: a Synthesis Center, Champions, and Curriculum. The Synthesis Center was intended to serve as a "safe space" for postdocs to network and access resources made available to them. The purpose of the Champions was to provide postdocs a person outside of their primary advisor or mentor who would help foster postdocs' professional growth, while the curriculum was designed to facilitate the continued development of postdocs for the successful transition to permanent careers.

Advancing Computer Science Careers through Enhanced Networking and Training (ASCENT)

ASCENT, led by PIs Shih-Fu Chang and Julia Hirschberg, is a partnership between Columbia University, City University of New York, Cornell University, and New York University. The primary site for ASCENT is located at the Columbia University location. At this PostdocBP site, the consortium of institutions created the goal of connecting CS&E postdocs with local career professionals, provide training programs across campuses, and create a city-wide community for postdocs. ASCENT extended benefits of PostdocBP to non-PostdocBP fellows, also known as Affiliates, who were postdocs in the consortium but not necessarily in CS&E departments, working towards the goal of system change in postdoc culture.

Taking Collective Responsibility for the Postdoc Experience (UW)

Led by PI Brian Curless, and formally Gaetano Borriello (in memoriam), Taking Collective Responsibility for the Postdoc Experience (referred to as UW throughout this report) is a project of the University of Washington. With this award, UW intended to take collective responsibility for postdoc scholars at the institution starting with CS&E postdocs and help develop uniform best practices across the university and nationwide.

CERP Evaluation: Successes and Challenges

In this section, we discuss aspects of the PostdocBP program that were particularly effective and those which should be improved in time. For this qualitative analysis, we used the final evaluation reports prepared by the evaluators in each of the three sites. Although the main framework was similar among the three PostdocBP sites, the implementation of the project was unique in each site. Our analysis synthesizing the evaluation findings for the project as a whole is conducted with this caveat in mind. Furthermore, data collection and methodology used for evaluation were not uniform across the sites. For instance, the survey and interview questions varied from site to site. As such, the evaluation findings presented below focus on results within each site and do not make comparisons between the sites; however, commonalities across the site-specific evaluation reports and findings specific to each site are identified.

This section begins with an overview of the evaluation methods used by the PostdocBP evaluators. We then provide a synthesis of the final PostdocBP evaluation results, as reported by the three sites' evaluation teams, in order draw conclusions that can help guide the planning of future postdoc positions in such a way that maximizes the benefit of these positions for computing researchers.

PostdocBP Evaluation Methods

Each PostdocBP implementation site had an evaluation team focused on determining the efficacy of the program in their respective sites. Data from the participants were collected in the form of annual and exit surveys and interviews, collected either as part of the application process or through separate surveys. The ASCENT evaluation team collected annual survey data, event attendance data, and exit survey data. AZ evaluators collected their data through annual surveys and exit interviews, while UW evaluators conducted annual surveys, exit interviews, and an exit survey. Changes over time based on the annual and exit surveys were discussed in the final evaluation reports by the ASCENT and UW teams; changes over time were not reported by the AZ team.

Results

This section is organized thematically, including engagement in activities, skills development (e.g., communication, management and leadership, and career planning), and career outcomes.

Engagement in PostdocBP Activities

The events organized by each site took various forms, but they had the same underlying framework and goals. The events were organized with the goals of PostdocBP in mind, with events focusing on career development and integration; increasing visibility; and supervision, guidance, and support.

Across all three sites, networking events attracted the largest number of participants. As noted in ASCENT evaluation report, all activities that were part of the PostdocBP initiative had some networking components in them; however, activities that had networking as their main purpose were particularly popular among postdocs. The networking events were organized as informal gatherings (e.g., Discussions with Champions in

AZ, lunch with CSE Department Chair in UW), social networking events (e.g., BBQs in ASCENT), or more formal networking activities (e.g., visits to industry offices in ASCENT).

Seminar and workshop activities tended to have relatively lower attendance, but the level of attendance in these events also varied based on the focus on the workshop/seminar. These activities were largely targeted towards career development and more specific areas such as communication skills, grant writing, and teaching. Overall career development events were more commonly attended than those that focused on a specific skill area. That said, there was a high-level attendance in events that focused on a particular technical skill, as was the case in AZ's "Deep Learning Series" seminars.

Skills Development

The PostdocBP initiative focused on a number of skill areas to support postdocs' professional development. Three major skill areas were communication, management and leadership, and career planning.

Communication Skills

Across all three sites, postdocs reported having the highest levels of proficiency in communications skills related to presenting research findings and writing scientific publications. On the other hand, teaching in a classroom setting and writing grant proposals were rated to be the skills in which the postdocs felt least proficient. Changes over time reported in the ASCENT and UW reports also indicated that postdocs reported the greatest increases in writing grant proposals and scientific publications, as well as training and mentoring individuals. Teaching in a classroom setting remained an area in which the postdocs felt less than proficient.

Management and Leadership Skills

Postdoc participants across the three sites reported higher levels of proficiency in providing guidance and advice, leading and motivating others, and planning projects relative to the other management and leadership-related skills such as delegating responsibilities. While the AZ participants rated their proficiency in time management relatively higher among the list of management and leadership skills, this area was one of the lowest reported proficiency for the postdocs in the other two sites. Furthermore, both ASCENT and UW reported a slight decrease over time in their proficiency in time management.

Career Planning Skills

Postdoc participants were asked to rate the degree to which the postdoc prepared them in a number of career planning skills (reported by ASCENT and UW only) and the degree to which they felt proficient in those areas (reported by each site), including identifying career options, maintaining a professional network, preparing application materials, and interviewing. Among these skills, the postdocs felt most proficient in identifying career options, maintaining a professional network, and preparing application materials. ASCENT and UW postdocs in both sites reported the least amount of preparation in terms of interviewing. ASCENT and UW postdocs also rated interviewing skills as least proficient, although this was not the case for AZ. The changes over time reported by ASCENT and UW showed that, overall, participants reported increases in their proficiency of, and perceptions of the preparation afforded to them in, career planning skills.

Career Outcomes

The three sites collected data on a variety of career related outcomes. ASCENT postdocs were asked about the size of their professional network before and after their postdoc experience. The Fellows reported increases in their academic and industry networks. All three sites asked the postdocs about their job prospects in the academic and industry job markets. In all three sites, the postdocs' perception of the industry job market was more positive than the academic job market. ASCENT team noted that this perception was true even for those who found a job in academia. When asked about their competitiveness in the academic and industry job markets, AZ postdocs rated their competitiveness in the industry job market higher than the academic job market.

Discussion

This report provided an overall assessment of the outcomes related to the PostdocBP initiative by synthesizing the evaluation results reported by each implementation site. Although the particulars of the program differed in each of the three sites, each of the programs focused on engaging postdocs in professional development activities, building technical and soft skills, and improving postdocs' career outcomes. Based on our overall evaluation of the programs, we offer some discussion points and recommendations based on the major themes of this report to increase the professional benefits of postdoc positions in the CS&E community and beyond.

Engagement in PostdocBP Activities

Being engaged in various activities has been shown to be an important part of ensuring postdocs are gaining necessary experience and skills, strengthening their professional networks, and becoming more integrated into their discipline. However, a major issue gleaned from PostdocBP is keeping postdocs' interest in programmatic activities persistent over time. Attracting postdocs to PostdocBP events was reported as a key difficulty in the evaluation reports. One potential solution is providing incentives to postdocs. For instance, offering lunch or coffee at events may make these events more appealing. As a case in point, all activities that included lunch were among the most commonly attended activities in all three sites. An alternative solution might be integrating activities less popular with those that are more popular. Further, inviting individuals with whom the postdocs might be interested in networking to speak at events may increase overall attendance rates.

In some instances, there was a mismatch between the events that were more heavily attended and the skill areas in which the postdocs reported lower levels of proficiency. For instance, participants rated their proficiency in teaching in a classroom setting, writing grant proposals, and writing for non-scientists relatively lower than other skills; however, the ASCENT evaluation report found that teaching and writing workshops had low attendance rates. Similarly, attendance in the undergraduate research night event offered by UW had relatively lower levels of attendance but could have provided postdocs an opportunity to improve their teaching and mentoring proficiency. Emphasizing the relevance of these skills and providing feedback on the postdocs' development in these areas may encourage active participation in the events that help build such skills.

Another challenge of postdoc engagement in PostdocBP activities was related to the location of such activities. While UW was contained in a single institution, both ASCENT and AZ consisted of consortiums of institutions. The ASCENT site had active participation proportional to their postdoc pools from NYU and CUNY, but postdocs at Cornell University were geographically too far removed from where the bulk of ASCENT activities took place. This was also the case for AZ, who reported problems engaging postdocs from the University of Arizona and Northern Arizona University. Most of AZ events were held at ASU.

Skills Development and Career Outcomes

As mentioned above, there were often times a mismatch between the postdocs' engagement in particular activities and the degree to which they felt proficient in a number of skills offered through PostdocBP events. It will be important to create awareness of each skill set important for career development, which could be accomplished by actively engaging in these discussions during postdocs' interactions with advisors and mentors. An example of the PostdocBP sites striving to create awareness of skill sets and goals individualized for each postdoc, Individual Development Plans (IDP), or progress reviews very similar to IDPs, were integrated into the programs. While the PostdocBP fellows were required to complete an IDP as part of the ASCENT program, AZ and UW did not necessarily make the completion of the IDP a requirement; however, UW postdocs used an online system every six-months to log their progress in preparation for meetings with their advisors (Baral, et. al. 2018).

Based on their experience using an IDP structured for the natural science discipline, ASCENT team reported that an IDP specific to CS&E should be adapted in order to be more beneficial. The ASCENT team reported taking steps towards revising this instrument. Because the IDP is an instrument created to help individuals carefully evaluate their career goals, an IDP specific to CS&E would be beneficial to the broader community as more students enter and graduate from the field to enter the workforce.

The Future of Postdocs in CS&E

Our analysis of the lessons learned from the three implementation sites showed that actively working on postdocs' professional development results in many benefits. For example, it increased postdocs' proficiency in a number of skills they need to succeed as researchers (e.g., career planning, proposal writing, and time management). Postdocs expanded and strengthened their professional network and increased their confidence to succeed in a competitive job market. The PostdocBP program was successful in accomplishing its goals of learning about the postdoc experience and identifying best practices for supporting postdocs in their path to becoming successful computing researchers. Experiences of the three PostdocBP implementation sites provided the community with important information to work on improving the benefits of postdoc positions.

Looking ahead, an important consideration that was identified by Baral et. al. (2008) is the sustainability of these efforts. Baral and colleagues noted that strategies used to support graduate students can be applicable to postdocs as well. Further, they recommended working with universities' offices that support postdocs and collaborating across similar disciplines to share the costs of these efforts. To this end, UW worked with their Office of Postdoctoral Affairs (OPA) during the PostdocBP implementation. Similarly, ASU opened a postdoctoral affairs office to aid in responding to the needs of postdocs university-wide.

While there are costs associated with implementing strategies aimed at improving the postdoctoral experience, there are clear benefits to doing so, especially because postdoctoral positions are sought after by many PhD recipients in STEM fields. For instance, a study published in *Science Magazine* showed that among a sample of PhD students at 39 research-intensive U.S. universities surveyed between 2010 and 2013, 53% of PhD students in chemistry, physics, engineering, and computer sciences planned to pursue a postdoc upon graduation. Moreover, 43% of students in those fields believed that at least one year of postdoc training was

required for a PhD-level position in industry, although the majority of PhD students who planned to pursue a postdoc were interested in academic careers (Sauermann & Roach, 2016). As PhD recipients continue to turn to postdoctoral positions for professional training prior to holding a permanent position, it is imperative that the CS&E community learn from the PostdocBP initiative and strive to create a cohesive environment conducive to producing successful researchers. In the next section, we will outline key lessons learned from the PostdocPB program, which is organized such that it can be used as a stand-alone one-pager to disseminate to the broader community.

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Lessons Learned from the Postdoc Best Practices Program

Prioritize geographical proximity for multi-institutional partnerships

When institutions with large geographical spread form a partnership for postdoctoral affairs, many postdocs are unable to attend organized events unless they are local. This is especially true when a lead institution hosts the majority of events. Future multi-institutional partnerships should prioritize close geographical proximity so that any postdoc within the partnering institutions can attend all events, regardless of location.

Regularly review progress with the postdocs

Systematic evaluation of progress helps postdocs stay on track and increases the quality of mentoring. Conducting these reviews using 3-6 month progress reports or individual development plans (IDP) can facilitate a productive assessment of progress. Adapting the reporting tools and/or IDP for the computing field will increase their usability.

Match skill-sets with professional development opportunities

Postdocs may choose to attend activities on topics they feel more comfortable with or perceive as more immediately relevant to their careers; however, it is important to build all skills necessary for successful careers. Advisors and mentors should help identify the skills that are in greater need of improvement by closely reviewing progress reports and IDPs with each postdoc. Then, actively encourage professional development opportunities that are targeted towards refining those specific skills.

Organize a variety of skill development activities

Because postdocs are busy and may not be able to attend each event organized by their institution (or partnering institution), offering a variety of formats for skill development activities may help accommodate postdocs' schedules and increase attendance rates. For example, live-streaming workshops or hosting webinars would help engage postdocs in professional development activities who still need to manage the demands on their time. Furthermore, this approach can reduce the amount of resources and time required of the faculty/department. These online formats, in addition to hands-on activities held in person (e.g., job market preparation; grant writing), are important aspects to the overall postdoc training experience.

Facilitate networking

Networking is a key component of postdoc professional development and future success as researchers in the field. During advising or mentoring sessions, identify opportunities for the postdoc to participate in that are tailored to building strong communication and networking skills. Further, incorporate networking opportunities into organized workshops and seminars, even for specialized topics.

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