

Comparing Industry versus Academic Environments to Develop Best Practices for Computing Postdocs

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CERP was created by the Committee on the Status of Women in Computing Research (CRA-W)/Coalition to Diversity Computing (CDC) Alliance and is funded by the National Science Foundation (NSF). Visit CERP online at http://cra.org/cerp/ or contact cerp@cra.org to learn more.

Executive Summary

Postdoctoral positions (postdocs) are ever growing in the field of computer science. Given that computing postdocs are still relatively new, the field of computing is in the unique position to mold the postdoc experience based on lessons learned from other evaluations of postdoc programs. The current report provides results from recent survey research and focus groups aimed at understanding the experiences of postdocs engaged in two distinct settings: Academia and Industry. Through comparing and contrasting postdocs' experiences in the two settings, the current report sheds light on (a) the defining characteristics of academic versus industry postdocs, and (b) best practices for computing postdocs.

Key Findings

Compared to Academic Postdocs, Industry Postdocs:

- Reported better management of professional responsibilities
- Had a more positive experience with their postdoc advisor
- Perceived a more welcoming work environment
- Received higher postdoc salaries that made it easier to live and relocate

Introduction

Recently, the field of computing has seen a dramatic uptick in postdoctoral positions, heretofore referred to as postdocs for brevity. Evidence for this can be found in the Computing Research Association's (CRA) annual Taulbee Survey (Zweben & Bizot, 2014), which estimates that the number of recent PhDs pursuing postdocs is greater than 300% of what it was in 1998 (60 in a 1998 sample of Ph.D. earners versus 235 in 2013 sample of Ph.D. earners). Accompanying this rapid increase in computing postdocs has been interest in what the postdoc experience looks like in computing, compared to what it ought to look like (see Jones & Gianchandani, 2012). For instance, the CRA's Center for Evaluating the Research Pipeline (CERP) recently evaluated a postdoc fellowship program orchestrated by the Computing Community Consortium (CCC), whose goal was to provide postdocs with financial and mentorship resources needed to develop into independent researchers. Another recent initiative of the CCC has been to fund consortiums of academic and industry postdoc training settings to contribute in developing best practices for postdoc experiences.

The goal of the current report is to contribute a novel perspective on postdoc experiences and successes by comparing postdocs in industry versus academic settings. Given that the goals and values of academia and industry settings are very different (e.g., academia focuses more heavily on undergraduate education and obtaining external funding than industry), it is likely that the way in which postdocs are trained in the two settings is also divergent. By comparing the subjective experiences and professional development of postdocs in industry versus academia, the current report offers the computing community a better understanding of "what works" in postdoctoral training settings.



Evaluation Method

Survey Measure. During the fall of 2013, CERP collected survey data from individuals who had previously completed a postdoc in either an academic or industry setting. The survey had been designed to evaluate the efficacy of a postdoctoral fellowship program called the CCC's CI Fellows Program. The program aimed to provide fellows with resources above and beyond the typical postdoc including higher salaries, supplemental funding for research expenses, and autonomy to develop their own research project¹. Applicants who had applied to the CI Fellows Program in 2009, 2010, or 2011 were recruited to complete a survey in 2013, which assessed individuals' experiences during prior postdoctoral experiences as well as current career status.

Eight-hundred-sixteen individuals were invited to complete CERP's survey, and 296 (36%) of those individuals participated. Of those, 190 individuals indicated that they had completed a postdoc since earning their PhD. Eighteen of those postdocs had been in an industry setting, 164 had been in academia, 7 had been in a government research setting, and 1 had been in a research hospital. In the current report, we focus on industry versus academic postdocs because the sample sizes for government and hospital research postdocs were too small to be included in our inferential analyses. Thus, our final sample was N = 182 (10% industry postdocs; 90% academic postdocs).

Demographic characteristics, including gender, U.S. citizenship status, race/ethnicity, marital status, disability status, and average age are displayed in Appendix A, Figures 2-8.

Focus Groups. During the spring of 2014, CERP conducted a focus group with prior CI Fellows in order to supplement survey findings. Three participants had completed a postdoc in industry and three had completed a postdoc in academia.

¹ For more information on the CI Fellows program, visit http://cifellows.org/

Evaluation Results

In the sections that follow, we present survey findings and complementary focus group findings concerning the experience of postdocs in industry versus academic settings. Given that the original intent of our survey was to evaluate the experiences of CI Fellows postdocs, our sample contained a considerable proportion of individuals whose postdoc had been supported by a CI Fellowship (36%). The CI Fellows postdoc was designed to be a qualitatively different experience than the "average" postdoc. As such, it was important to control for whether or not survey respondents' postdoc was or was not a CI Fellowship. To do so, all analyses on survey data that follow were run via a 2 Setting (Academia vs. Industry) x 2 Type (CI Fellow vs. Non-fellow) analysis of variance (ANOVA). In all cases, we only found that Postdoc Setting had a significant impact on postdocs' experiences, but Postdoc Type did not.

Management of Professional and Personal Responsibilities. Respondents indicated how well they felt they had managed aspects of their professional responsibilities (e.g., lab responsibilities) and their personal life (e.g., relationships with family) during their postdoc experience (individual survey items can be found in Appendix B). As shown in Table 1, postdocs in industry felt like they managed their professional responsibilities better than postdocs in academia, p < .05. Industry Postdocs also felt that they managed their personal responsibilities better than Academic Postdocs, though this trend was not significant, p = .17.

Table 1. Management of professional and personal responsibilities.

During your postdoc, how poorly or well did you feel like you managed the following?			
(1) Very poorly (2) Poorly (3) Neither poorly nor well 4) Well (5) Very well	Industry Postdoc	Academic Postdoc	
Professional responsibilities (5 items)	4.50*	4.10	
Personal responsibilities (3 items)	4.03	3.75	

Note. Values indicate mean score across respondents for each comparison group. * $p \le .05$.

Participants in the focus group discussed responsibilities and everyday tasks of their industry or academic postdoc. Each participant, regardless of setting, indicated that publishing was a main priority. Industry Postdocs also indicated that they appreciated their ability to focus solely on their work and not on mentoring students or applying for funding.

"So I think I enjoy the stuff that I can do in an industry lab ... being flexible if I need to take a break to just build something out. I don't want to have to stress out about students or funding or things like that... If you are stressed out in an academic environment, other careers and lives are at stake (students)... [working in] industry insulates me from doing any harm."

— Industry Postdoc

"For me, I don't need to do any teaching, but I do some mentoring [if] we have collaborations with the universities. I don't do the teaching and I don't do the grant proposals, but instead I do more of trying to get my stuff into products."

— Industry Postdoc

Satisfaction with Postdoc Experience. Respondents indicated their satisfaction with aspects of their postdoc experience, including opportunities and resources provided by their postdoc, skills preparation, and preparation for balancing work-life responsibilities (individual items are reported in Appendix B). Both groups indicated overall satisfaction with the opportunities and preparation provided by their postdoc experience and skills preparation, as indicated by means significantly above the midpoint of the scales, ps < .001 (see Table 2). Industry postdocs tended to show greater satisfaction with preparation for work-life balance, though this difference was not significant, p = .16.

Table 2. Satisfaction with postdoc experience.

How dissatisfied or satisfied are you with the following aspects of your postdoc?			
(1) Very dissatisfied (2) Dissatisfied (3) Neither dissatisfied nor satisfied (4) Satisfied (5) Very satisfied	Industry Postdoc	Academic Postdoc	
Opportunities and resources provided during postdoc (5 items)	4.27	4.12	
Skills preparation (9 items)	4.04	3.83	
Preparation for balancing work-life responsibilities (2 items)	3.83	3.47	

Note. Values indicate mean score across respondents for each comparison group.

The focus group discussion indicated that both industry and academic postdocs were indeed satisfied with the breadth of activities they were involved in during their training.

"I realized that I liked where I was because I liked the balance between going to conferences and publishing and maintaining ties to academia and doing papers/helping out with conferences but also having a tie to actual products, where my stuff is real and used."
—Industry Postdoc "I would say that I felt about the same amount of pressure as I did in grad school but there was more freedom to achieve those objectives than there was in grad school."

- Academic Postdoc

"I participate [in] conferences... I publish and review papers and things like that -- I have that connection to the real world products and [apply] my research [to] products in order for people to use. That doesn't mean that on occasion I might need to engineer or program a little bit more than [a] pure researcher would, but I like that balance.." – Industry Postdoc

Ratings of Postdoc Advisor. Respondents indicated the extent to which their postdoc advisor engaged in positive behaviors (e.g., my postdoc advisor was respectful), and engaged in negative behaviors (e.g., my postdoc advisor micromanaged my work; see Appendix B for individual items). As shown in Table 3, industry postdoc indicated that their advisors tended to engage in more positive behaviors and less negative behaviors than Academic Postdocs' advisors.

Table 3. Ratings of postdoc advisor.

To what extent did your advisor		
(1) Not at all (2) A little (3) Somewhat (4) Mostly (5) Totally	Industry Postdoc	Academic Postdoc
Engage in positive behaviors (4 items)	4.26*	3.78
Engage in negative behaviors (2 items)	1.23+	1.60

Note. Values indicate mean score across respondents for each comparison group. $+ p \le .10$, * $p \le .05$.

Focus group participants echoed our survey results, in that industry postdocs talked about the supportive and encouraging nature of their advisors:

"I had the risk of sort of falling through the cracks because I was advised by two mentors-- I had a senior faculty mentor, who is the head of my industry labs, and my other mentor, who used to be a research scientist at my lab and then... transfer[ed to be] a professor at a university ... But I found my mentors to be very encouraging and reminding to go meet other faculty at the [nearby] university even though I was officially affiliated with the industry lab." – Industry Postdoc

Independence during Postdoc. As shown in the top row of Table 4, all past postdocs indicated that they had achieved at least some level of independence during their tenure (e.g., choosing their research topic; see Appendix B for individual items); there was no difference in independence across postdoc setting.

Consistent with our survey findings, our focus group did not indicate that industry versus academic settings were differentially conducive to independence during one's postdoc. Rather, all focus group participants indicated that they had a great deal of independence. This finding is not surprising, given that our focus group comprised solely individuals who had completed a CI Fellowship, which is associated with independent scholarship (see Cundiff, Wright, & Stout, 2014).

Supportiveness of Department. Industry Postdocs viewed their department as marginally more supportive (e.g., welcoming; encouraging) than Academic Postdocs (see bottom row of Table 4).

Table 4. Independence during postdoc and supportiveness of department.

(1) Not at all (2) A little (3) Somewhat (4) Mostly (5) Totally	Industry Postdocs	Academic Postdocs
Independence during postdoc (7 items)	4.10	3.96
Supportiveness of department (4 items)	4.28+	3.75

Note. Values indicate mean score across respondents for each comparison group. + p < .10.

During the focus group, whereas Industry Postdocs reported being treated as colleagues/employees, Academic Postdocs tended to construe the postdoc experience as isolating. Themes include department was welcoming, academic postdocs are expected to publish above teaching, and postdocs are not necessarily treated equal.

"I think I was fortunate... my two mentors [were my] champions and also the other research scientists were very welcoming and supportive of the junior researchers"—Industry Postdoc

"I did a three year postdoc and in fact, there is pressure not to do teaching and not to write grants because the goal then was that you should only be publishing. Although in my case it didn't turn out that way at all. In fact, ... wanted to try to teach and try to write grants. So, I basically just said 'it's okay if I don't publish as much'.... But at that time, my mentor was..., saying, 'You should be publishing and you shouldn't be wasting your time teaching.'... It was fine with me, but it was a stretch, and there was a constant pressure to know what I 'should' be doing." –Academic Postdoc

Professional Experiences during Postdoc. Table 5 shows the percentage of various professional experiences during Industry vs. Academic postdocs. Academic Postdocs were marginally more likely to have submitted a grant proposal as a principal investigator (PI) or Co-PI, and were significantly more likely to have mentored undergraduate and/or graduate students compared to Industry Postdocs. The majority of postdocs engaged in authoring journal articles and refereed conference papers, regardless of setting.

Table 5. Professional experiences during postdoc.

Did you experience any of the following during your postdoc?	Industry Postdoc	Academic Postdoc
PI/Co-PI on submitted grant proposal	11%+	31%
Author on a journal publication	50%	65%
Author on a refereed conference paper	72%	82%
Author on a non-refereed conference paper	11%	20%
Author on a paper or presenation currently in progress	39%	26%
Mentored undergraduate or graduate students	39%*	73%
Collaborated with researchers outside of program	11%	13%

Note. Respondents could select more than one option. Values represent percentage within each group. $+ p \le .10$, * $p \le .05$.

As seen earlier in the Management of Professional and Personal Responsibilities secion, Academic Postdocs' training is focused more on grant writing and working with students compared to Industry Postdocs. However, both types of postdocs are oriented towards publications, as illustrated from the following focus group excerpt:

"...our lab does a lot of work with academic-type research, so we go to several conferences a year, I publish a lot of papers, and we do collaborations with universities. We have interns come in for the summer from universities and one of the goals of that is to get a top journal paper or a conference paper out of it." – Industry Postdoc

Current Work Setting. Respondents indicated their current work setting, which largely mirrored the type of setting of their postdoc (see Table 6); that is, most Industry Postdocs are currently employed in industry (82%), and more Academic Postdocs are currently employed in academia (67%).

Table 6. Career interest immediately following postdoc.

Which type of position were you most interested in after you finished your postdoc?	Industry Postdoc	Academic Postdoc
Academia	18%	67%
Industry	82%	31%
Government	0%	2%

Note. Respondents could select only one option. Values represent percentage within each group.

Salary. Respondents reported their pre-tax postdoc salary and their current salary on a 9-point scale ranging from (1) Less than \$29,999 to (9) More than \$100,000, with \$10,000 increments. Industry postdocs reported significantly higher salaries than Academic Postdocs. Further, current industry employees earned higher salaries than academic employees.

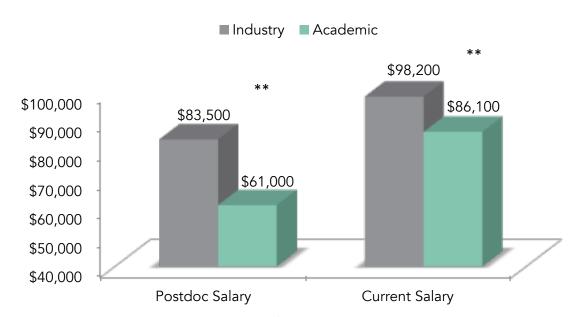


Figure 1. Salaries of Respondents' Postdoc and Current Job.

Note. Values indicate means across repondents for each comparison group. Means have been converted to corresponding salary amounts. The graph starts at \$40,000 to better show mean differences. ** p < .01.

All focus group participants had taken employment positions in the same setting as their postdoc (i.e. academic postdoc to academic job). When asked why the participant took an academic versus industry job (visa versa), a repeated theme was that the setting suited each individual's works style and career goals. Depictions of industry versus academic work settings also mirrored the trends in professional experiences across postdoc settings in Table 5, where industry settings emphasize teaching and grant writing less than academic settings. Examples are shown below.

"In the future, I think I might be interested [in] teach[ing], but at the moment I have good momentum with what I'm doing and I enjoy what I'm doing and it is kind of nice to not have any pressure of where's my funding, where does it come from. I already have funding, I already know that I can have a number of interns and things like that."—Industry Postdoc currently working in industry

"I actually wanted to be a professor for a really long time [for two reasons]: one is the connection you get with the students, even after twenty years and I think that's what I want. And I want to be in academia. Although I was an intern at an industry company, and I really liked the work there, it was really intense. Everybody was contributing, but I don't think I could sustain that kind of work there except for short periods of times." –Academic Postdoc currently working in academia

Ambiguity of the Industry Postdoc. A recurring theme that emerged from the focus group is that, relative to Academic Postdocs, the Industry Postdoc is not well understood. Whereas Academic Postdocs tend to be treated as training positions, it is not clear whether Industry Postdocs are trainees or temporary positions en route to a permanent position in industry:

"My mentor had never had a postdoc before, and they didn't even know how they would hire me, and he managed to get me on as a regular employee. The company viewed me as a regular employee so when they went to hire me full time, [they said] 'we don't have to do anything, you're already hired full time' and so I didn't even have to sign a new contract to stay on."

- Industry Postdoc

"It seems like this postdoc designation is just a way for them to hire you on a short-term contract, right? I mean if a contract [didn't exist] that said 'we are going to hire you for two years as a postdoc', then they would have hired you as a research staff member."

— Academic Postdoc

"There was no postdoc position at my lab but ... there had actually been another CI Fellow [at my lab] the year before me so they had been through that process before, but ...it isn't typical to have a postdoc position [in my lab]." – Industry Postdoc

Focus group participants also puzzled over whether Industry Postdocs can return to academia after working in industry; the overarching perception was that a re-entry into academia was possible:

"I know people who went to industry not as postdocs but as research staff and they came back to be faculty a couple years later." – Academic Postdoc

"I didn't see [working in industry] as being a way to cut myself off from the academic world. In a way, it does give a different perspective that could become useful. Should I have wanted or would want to go back to academia, the experience of being in an industry setting is helpful." – Industry Postdoc

"It doesn't matter if your position was named 'postdoc' or 'research staff' or if you did something different entirely. As long as you still have publications and it looks like you're still doing research, I think it's still possible to go back to academia." – Academic Postdoc

Summary and Conclusion

Results suggest that Industry Postdocs yield relatively more postitive experiences compared to Academic Postdocs in a number of ways. For one, Industry Postdocs indicated that they were better able to manage their professional responsibilities. Industry Postdocs also reported better experiences with their postdoc advisor than Academic Postdocs. This outcome is particularly important, as advisors have the potential to serve as "champions" for postdocs and can be a critical nexus for a postdoc's burgeoning professional networks. In addition, advisors serve as a key resource for professional development advice and as role models for how one ought to conduct oneself professionally. The Industry Postdoc setting was also reported to be more welcoming and encouraging than the Academic Postdoc setting. This report also sheds light on commonalities across postdoc settings. For instance, although Academic Postdocs gained more experience with grant writing and mentoring students than Industry Postdocs, both groups were publishing journal articles and refereed conference proceedings to a large degree. Both groups of postdocs also indicated an overall high level of statisfaction with their postdoc experience. In sum, the current report sheds light on the experience of postdocs in industry, which is not well-understood to date, and highlights strengths of Industry Postdocs that can be applied to improve the Academic Postdoc experience.

Together, these findings contribute to existing dialogue concerning "best practices" for postdocs in computing. Specifically, our data suggest that some practices in industry versus academia may be more palatable for postdocs (e.g., treating postdocs as colleagues rather than trainees).

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Appendix A: Sample Characteristics

Figure 2. Gender of respondents.

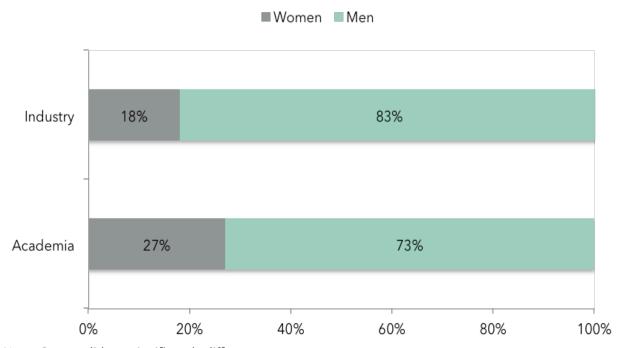
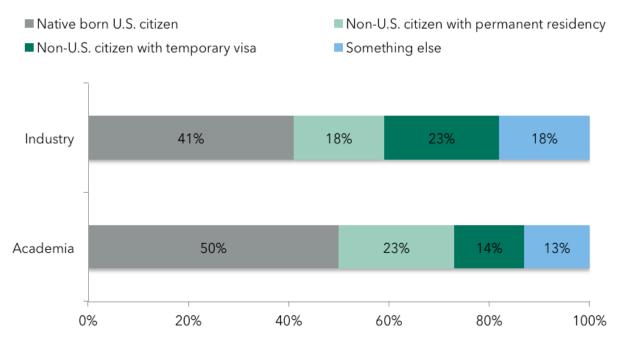




Figure 3. Citizenship status of respondents.



Note. Groups did not significantly differ.

Figure 4. Race/ethnicity of respondents.

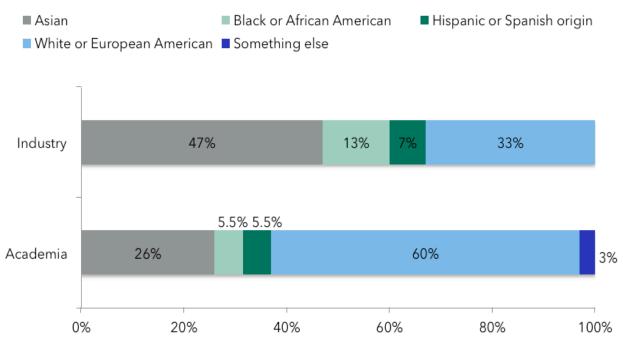


Figure 5. *Marital status of respondents.*

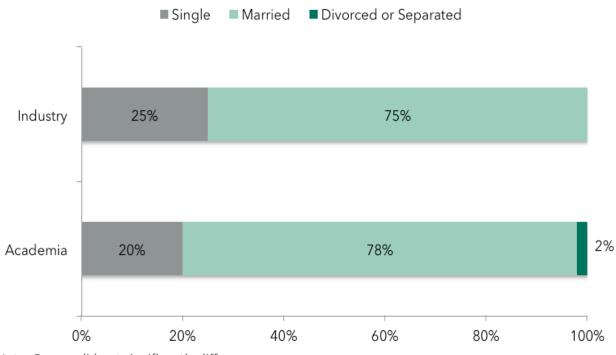


Figure 6. Disability status of respondents.

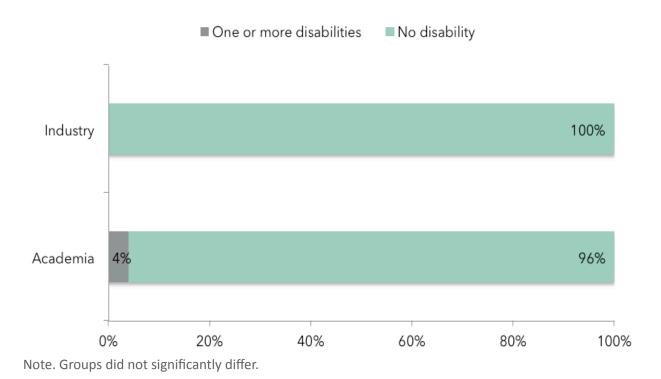
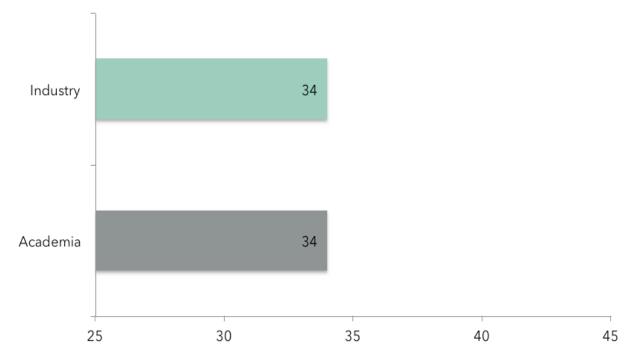


Figure 8. Average age of respondents.





Appendix B: Aggregate Survey Items

We determined reliability for multi-item constructs using Cronbach's alpha (α). Alpha levels \geq .70 are considered acceptable. Items for each construct were averaged together to form composite scores. Individual items are listed below.

Management of Professional and Personal Responsibilities

We assessed survey respondents' feelings of how poorly or well they managed professional responsibilities (5 items) and personal responsibilities (3 items) during their postdoc. Individual items are listed below.

During your postdoc, how poorly or well did you feel like you managed the following?

(1) Very poorly (2) Poorly (3) Neither poorly nor well (4) Well (5) Very well

Management of professional responsibilities ($\alpha = .84$)

- Lab responsibilities
- Research responsibilities
- Career development
- Relationship with your advisor
- Relationships with co-workers or colleagues

Management of personal responsibilities ($\alpha = .86$)

- Activities outside of work
- Relationships with friends
- Relationships with family

Satisfaction with Postdoc Experience

We assessed respondents' satisfaction with their postdoc experience across three constructs: opportunities and resources provided during postdoc (5 items), skills preparation (9 items), and preparation for balancing work-life responsibilities (2 items). Items for each construct were averaged together to form composite scores. Individual items are listed below.

How dissatisfied or satisfied are you with the extent to which your postdoc prepared you in the following areas?

(1) Very dissatisfied

(2) Dissatisfied

(3) Neither dissatisfied nor satisfied

(4) Satisfied

(5) Very Satisfied

Opportunities and resources provided during postdoc ($\alpha = .75$)

- Your research topic
- Opportunities to work with undergraduates
- Opportunities to present at conferences
- Opportunities to network
- Office space

Skills preparation ($\alpha = .92$)

- Specific technical knowledge
- Time management skills
- Research skills and experience
- Starting up a research program
- Developing research collaborations
- Maintaining collaborations
- Networking
- Job search strategies
- Negotiating job offers

Preparation for balancing work-life responsibilities (α = .93)

- Balancing work and family responsibilities
- Balancing work life and social life

Ratings of Postdoc Advisor

We assessed respondents' ratings of their postdoc advisor across two constructs: positive behaviors (4 items), and negative behaviors (2 items). Items for each multi-item construct were averaged together to form composite scores. Individual items are listed below.

Rate the degree to which your advisor did the following during this postdoc.

(1) Not at all (2) A little (3) Somewhat (4) Mostly (5) Totally

Engaged in positive behaviors ($\alpha = .88$)

- Was respectful
- Helped guide your research
- Took note of your strengths
- Helped you work on your weaknesses
- Promoted your work within the research community
- Informed you about career options outside of academia
- Encouraged you to teach

Engaged in negative behaviors ($\alpha = .61$)

- Micromanaged your work
- Asked you to do administrative work unrelated to your postdoc research

Independence during Postdoc

We assessed respondents' perception of independence during their postdoc with seven items. We averaged across items to form a composite score ($\alpha = .91$). Individual items are listed below.

How much control did you have with the following aspects of your postdoc?

- (1) No control (2) A little control (3) Some control (4) Mostly in control (5) Total control
 - Choosing your mentor
 - Choosing your research topic
 - Choosing your research methodologies
 - Choosing your teaching topics
 - Choosing what you wanted to present at conferences
 - Deciding on authorship when publishing
 - Deciding where to submit manuscripts for review

Supportiveness of Department

We assessed respondents' sense of supportiveness of their department during their postdoc with four items. We averaged across items to form a composite score ($\alpha = .93$). Individual items are listed below.

Think about the social environment in the department where you completed this postdoc. To what extend did you feel...

- (1) Not at all (2) A little (3) Somewhat (4) Mostly (5) Totally
 - Welcomed
 - Encouraged