# The cost of a postdoctoral experience and its impact on STEM diversity

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ISEH Headquarters June 8, 2017

Academic diversity in the biological sciences isn't what it should be.  At the most basic level, representation by underrepresented groups in the top research universities in the United States is less than 5%1.  Despite gains in enrollment of underrepresented students in the biological sciences at the undergraduate and doctoral levels, these gains do not extend to the tenure-track realm, where representation has changed very little over the past three decades.

At another level, because of the ferocious degree of competition in science today - for publication in high impact journals, for limited grant funds, for fewer tenure-track positions -- one might argue that academic diversity is slowly been shaped by a "1%" mindset.  Perhaps more than ever before, the institution you come from-- even the lab you come from-- influences where you will publish, whether you will attain funding, and ultimately whether you will succeed. My purpose here is not to grumble; I'm sure there are many arguments that can be made on either side of this opinion. However, here I argue that the nature of the postdoctoral experience further links the attainment of a tenure track position with the availability of financial resources needed to endure that experience, and therefore that academic success does not depend on talent alone, but also on economic resources. I think undoubtedly one of the most unfortunate consequences of this is that it continues to negatively impact faculty diversity.

I will use myself as an example:  I barely survived my six-year postdoc. My starting salary was under 40K.  When I finished, after almost 15 years of postgraduate education and experience, I was making 52K.  I lived in one of the most expensive regions in the country.  I had two young children, and I lived nowhere near family. I'm not ashamed to admit that I was broke, and I was ready for a real income.  But my paper was under revision!  In order to be successful, I knew I had to hang in there to see my paper published in a high impact journal and await the score on my resubmitted K award application (a process which took almost two years).

Unfortunately, my struggle is not unique, *but I was very privileged to have had family assistance and support that allowed me to continue pursuit of my goal.* My mom loaned me money on occasion, and would come up to help my partner watch our young kids when I traveled to meetings. This support was not only financial; both my mom and my partner understood that this (long, unpredictable) period of training and low wages would ultimately lead to greater success and stability, and encouraged me (and allowed me) to persist despite my financial situation.  Without their support, I am confident that I would not have made it to a tenure-track position. Nonetheless, I applied for numerous industry jobs in the last months of my postdoc, as my family wouldn't have survived another year on my salary.

For many postdocs, this long, unpredictable, and financially difficult pathway to academia just doesn't add up. Individuals coming from disadvantaged backgrounds, that don't have economic resources or family support to persist in an underpaid position with an undefined tenure, are at a true disadvantage in the slow race for a tenure-track position.  It can be difficult, or even embarrassing, to explain to your family that you can barely pay your rent when you have an advanced degree, particularly if you are among the first in your family to attend college.  I believe that several factors that currently define the postdoctoral experience, at least in the United States, contribute to implicit bias that undermines the representation of under-represented scientists at top research institutions and is reflected in the leak of those scientists from the academic pipeline.

**Tenure-track success means a longer postdoctoral fellowship.** While the average postdoc in the sciences is still roughly 5 years, one might argue that the average postdoc for those that reach the tenure track is longer.  Little data exist for this kind of metric, but the best estimate is that there is at least a 1-2 year gap between the postdoc length for industry or other jobs and postdoc length for a tenure-track position.  Why would that be the case? As the merit list for a tenure-track job grows longer, so does the tenure of your postdoctoral fellowship.  Publication in a high impact journal typically requires an immense amount of work; as an example, the average number of figure panels and authors in papers published in Nature and Cell has risen 2-4 fold in the last 30 years2.  Furthermore, multiple submission and revision cycles can take years before acceptance.  Applying (and often re-applying) for independent funding tells a similar story -- awaiting reviews and grant cycles can take a couple years.  Together with graduate education, these numbers mean that it can take over 12 years before you attain a "real" job in academia.

**The cost of a successful postdoc experience makes it difficult to sustain.** Many postdocs experience financial difficulties that only worsen over time. Relatively low salaries that, until recently, have remained essentially stagnant3, often aren't enough to support individuals, much less families. Many of the top research institutions -- the institutions that churn out the most prospective tenure-track applicants -- are also in the most expensive cities -- Boston, New York, San Francisco, London. In these cities, housing costs alone often gobble up the vast majority of a postdoc salary. Most often, moving near family does not factor into choice of a postdoctoral lab, so help nearby is not an option. If you are a postdoc with a family, forget it -- exorbitant childcare costs, at least in the US, can gobble up the rest of your salary. Moving costs alone can put you thousands of dollars in debt. Attrition under these circumstances is almost undeniable -- it can become a choice between career and survival.

**The "1%" and implicit bias**

Underlying several of the aspects I've mentioned above is the less obvious but pervasive influence of what I previously referred to as a "1%" mindset. In the search for qualified tenure track applicants, many institutions employ explicit bias by filtering through applications for candidates that come from top research institutions, prominent labs, with publications in high impact journals. And to some degree, this make sense -- these applicants are typically bound to be competitively trained, hardworking, and highly competent. But these standards are also implicitly biased against applicants from less prominent institutions with publications in less prominent journals *that are no less competent*. For many of the reasons described above, these applicants may be at smaller institutions in less expensive cities, because it allows them to continue their scholarly pursuit in ways that are affordable. They may publish their work in less prominent journals to demonstrate productivity in a reasonable amount of time, or simply because being at a less prominent institution makes it more difficult to publish in a high impact journal. The 1% bias thereby weaves its influences into the many factors that influence tenure-track desirability, and implicitly biases the tenure-track process towards applicants that can manage to sustain life as postdoc at all costs in order to achieve success.

There is no easy fix to this problem. The University of California, along with several other institutions, recently adopted a much higher pay rate for postdocs. Perhaps leveling the economic playing field will help equilibrate the experience for underprivileged scientists. Furthermore, by acknowledging and openly addressing how the cost of the postdoctoral experience implicitly excludes underrepresented scientists, perhaps we can shake off some of our own implicit bias and challenge those around us to consider how these factors shape our scientific community.

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3. https://report.nih.gov/NIHDatabook/

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