HERB

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Postdoc – From Invisible Scholar to a Change Driver

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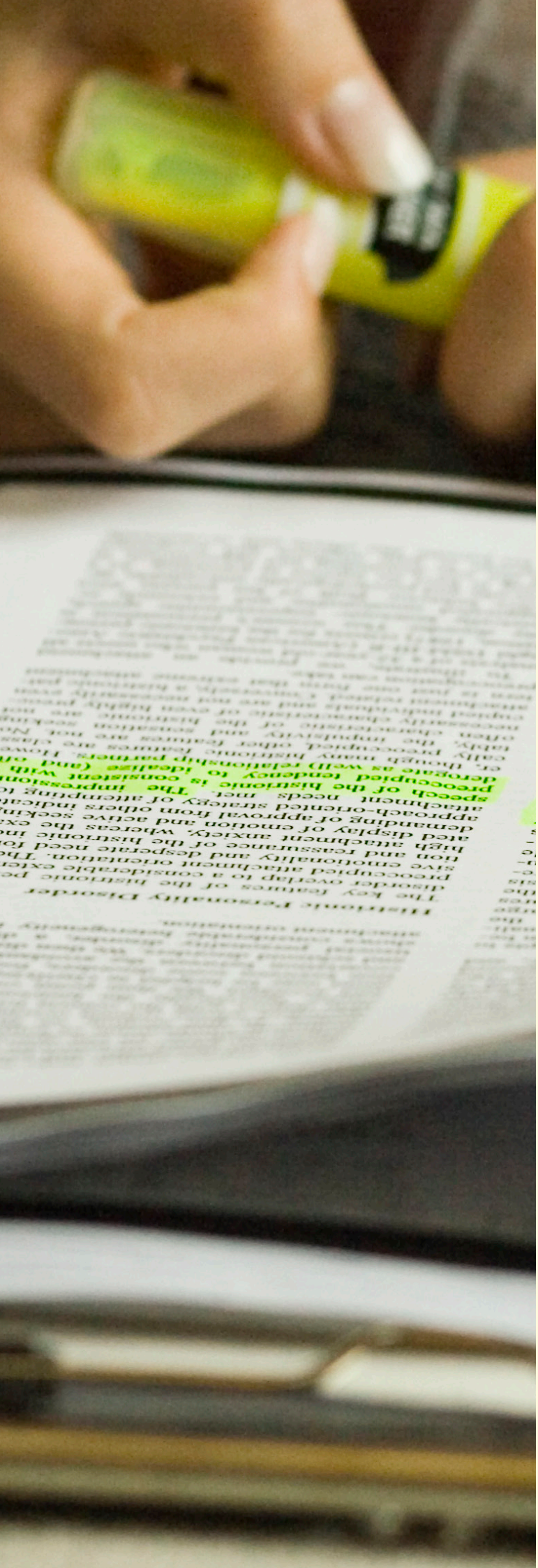

Dear colleagues,

The postdoc is an established stage of an academic career path to tenure in some countries, and a notion hiding positions with varying rights and obligations to boost scientific development in other countries without tenure-tracks. Generally, it is a term to denote a researcher with an academic degree in a temporary position that allows him or her to continue studying, acquire new skills and expertise, experience academic mobility, enrich his or her networks and take the next step on the career ladder. Even countries with an established tradition have numerous lacunae and problems with postdoctoral studies, such as overproduction, the unclear status of postdocs, overload with quite a modest salary, the dubious protection of their rights, and an unclear career outlook. In countries that are just starting this initiative, tangible goals, governmental roles and clear institutional mechanisms have not yet been outlined, which creates misunderstandings but also potential.

The current issue brings together essays, historical reviews, qualitative and quantitative research, and expert opinions from Russia, the CIS, the US, the EU and China to uncover global, national and institutional perspectives on postdoctoral programs. We discuss the rationale behind postdoctoral initiatives, their implementation, successes and failures, new challenges and future expectations inside or outside academia. The purpose of these efforts is to create a global picture of postdoctoral studies, for readers to think over their prospects for higher education institutions and national science in Russian and other developing countries.

Guest editors
Anna Pravdyuk
Denis Ananin
Natalia Nikiforova
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National Research University Higher School of Economics

National Research University Higher School of Economics is the largest center of socio-economic studies and one of the top-ranked higher education institutions in Eastern Europe. The University efficiently carries out fundamental and applied research projects in such fields as computer science, management, sociology, political science, philosophy, international relations, mathematics, Oriental studies, and journalism, which all come together on grounds of basic principles of modern economics.

HSE professors and researchers contribute to the elaboration of social and economic reforms in Russia as experts. The University transmits up-to-date economic knowledge to the government, business community and civil society through system analysis and complex interdisciplinary research.

Higher School of Economics incorporates 97 research centers and 32 international laboratories, which are involved in fundamental and applied research. Higher education studies are one of the University's key priorities. According to recent QS World University Ranking, HSE is now among the top 150 universities in the subject of "Education". This research field consolidates intellectual efforts of several research groups, whose work fully complies highest world standards. Experts in economics, sociology, psychology and management from Russia and other countries work together on comparative projects. The main research spheres include: analysis of global and Russian higher education system development, transformation of the academic profession, effective contract in higher education, developing educational standards and HEI evaluation models, etc.

Center for Institutional Studies

The Center for Institutional Studies is one of HSE's research centers. CInSt focuses on fundamental and applied interdisciplinary researches in the field of institutional analysis, economics and sociology of science and higher education. Researchers are working in the center strictly adhere to the world's top academic standards.

The Center for Institutional Studies is integrated into international higher education research networks. The center cooperates with foreign experts through joint comparative projects that cover the problems of higher education development and education policy. As part of our long-term cooperation with the Boston College Center for International Higher Education, CInSt has taken up the publication of the Russian version of the "International Higher Education" newsletter.

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What is a Postdoc? Drivers, Purposes, Experiences and Impacts

Lynn McAlpine

Professor Emerita: University of Oxford (United Kingdom) and McGill University (Canada)
lynn.mcalpine@ctl.ox.ac.uk
lynn.mcalpine@mcgill.ca

In this essay, I focus on PhD graduates who remain postdocs, researchers in academia – not the 40–50% of PhDs working outside academia. After characterizing the different types of postdocs, I explore the drivers behind the growth of the number of postdocs, particularly those on contract; then conflicting stakeholder purposes; followed by the challenges and benefits of the postdoc experience, ending with patterns of stakeholder impact. In doing so, I draw on my knowledge of the literature and 15 years of research into early career researchers. My hope is to paint a broad enough landscape of the postdoctoral regime and postdocs located within it, so readers can situate the other contributions in this special issue.

What is a postdoc?

In many countries, the notion of doing or having a postdoc, further training after a PhD, is becoming almost an obligatory fact-of-life for those who wish traditional teaching-research academic careers. However, not all postdocs are created equal as to the degree of independence or institutional career support. These differences in role have an impact, though previous studies have not consistently treated them distinctly. The few postdocs awarded a competitive personal fellowship can work where and with whom they wish for the extent of their fellowship, but career support may vary. Those accepted into a competitive fellowship program have somewhat less independence as to where and with whom they can work but are assured of institutional career support during the fellowship. However, the majority of postdocs are those working on contract to Principal Investigators (PIs) who have received funding for their research; in such cases there is much less independence or assured career support. While many of this third group are in the sciences, in the Global North particularly this trend of PI-funded research teams is expanding to the social sciences and, to a lesser extent, the humanities, though teams are smaller, and members may be allowed somewhat more freedom in their research.

Drivers

The principal driver for the dramatic increase in the number of postdocs is the physical and virtual mobility of assets that drive national knowledge economies and academic research globally. These assets include, for instance, cutting-edge disciplinary and multi-disciplinary knowledge, methods and methodologies, innovations, and patents. They also include mobile, highly skilled postdocs who carry these assets with them. In fact, postdocs are responsible for a disproportionate share of discoveries and innovations with their mobility moving knowledge across international scientific networks. In the broadest and most positive light, the impact of such mobility should filter out to the institutional host, the funding source, the knowledge economy, the discipline, ultimately benefiting society.

Purposes

However, there are multiple stakeholders in the postdoc regime: postdocs themselves, PIs, universities, national research funding councils, national priorities and policies, and international development agencies. Each of these stakeholders may have different purposes for postdocs and the purposes will vary by institutional and national priorities. For instance, most national policies encourage the cross-border mobility of assets to achieve national goals, such as being internationally competitive and aiming for robust socio-economic growth. The reasons for this, though, vary across countries. (National policies may also encourage within-country mobility, though this limits the mobility of knowledge in countries with small populations or few research institutions.)

As in cases like the US and the UK, demand cannot be met domestically, they have developed similar policies (e.g., access to visas) and funding strategies (funding councils and universities) that encourage inward-bound postdoc mobility and make them attractive destinations. (Funding councils and universities also have other goals, e.g., first, disciplinary breakthroughs, and second, teaching.) There is national variation in the structures supporting this purpose. For instance, while funding councils in both countries help support national goals, in the US, PI grants embed research training and are understood as promissory, so there is greater potential independence for the PI and contract postdocs as regards the research direction. In the UK, however, the focus in PI grants is finishing the contracted research, so postdocs work to complete promised outcomes to deadlines. In contrast, in less well-resourced countries, like those in Africa or eastern Europe, outward-bound mobility may be encouraged given insufficient or inadequate resources, with the aim that those leaving return with new assets. Here, funding may come from agencies in countries backing UN and other development goals, with access to host countries limited by visa and other eligibility restrictions.

Given ranking tables, universities seek to compete globally in research. To remain competitive, they need postdocs to support PIs in achieving their research goals. As a result, as long as visa requirements are met, many universities leave PIs to hire postdocs independently given the PI is seeking specialist knowledge and experience. In some cases, universities may consider postdocs 'in training' (and in some countries national policies may require this), in which case they will offer some career support – though PIs may not encourage postdocs to participate. These examples show

that stakeholder priorities may not align, and in fact, there may be tension with postdocs having to navigate competing purposes to achieve their own goals.

Choosing, living, and leaving the postdoc experience

Doing a postdoc involves choosing to seek a post, then living it, before considering where next.

Choosing the postdoc. The end of the PhD brings career uncertainty, both intellectual (the need to become recognized for a unique research profile) and occupational (the need for immediate financial security and, hopefully, at some point permanent academic employment). Both intellectual and occupational careers usually involve geographical and institutional mobility. Yet, deciding what and where is not straightforward with multiple factors in play. Among them are balancing where to move (funding opportunities, postdoc benefits, future assets) within one's larger life (family, values, personal goals). Thus, the decision involves comparing options related in the first instance to home and potential host country contexts (the latter limited by visa requirements, perhaps a different language and discriminatory practices). These concerns spill over into: 1) different university host contexts (reputation, access to resources, postdoc support); 2) PIs' reputations; 3) team environments as a publication context; and 4) social support. These collectively contribute to a positive through poor experience.

Even in considering these factors, the potential postdoc is dependent on and limited by what can be discovered and what is offered. In other words, the PI is, in effect, the frontline immigration officer, within the context of national and institutional requirements. Thus, PIs hire the most suitable postdocs to accomplish the projected work, including publications. In return, postdocs are required to meet the expectations of the job, with the assumption that through this exchange they gain assets – access to new expertise: expensive equipment, fieldwork sites or archives; team publications, and bigger and more productive networks – becoming more competitive for future posts.

Living the postdoc. Having accepted the postdoc and moved, the actual experience begins. Here a new set of issues emerges, including adjusting to new institutional, regional, and perhaps national, contexts. In the best of all worlds, there will be high levels of PI support and team collaboration, the research will be well aligned with the postdoc's interests, resulting in greater expertise and more publications, as well as more extensive networks of possible collaborators – all of which will advance the postdoc's intellectual career. Not all postdocs have such positive experiences. Many individuals report minimal PI support, competitive team environments, work that is not aligned with their own interests, discrimination, poor housing conditions, and for some absence from family, and visa issues and/or lack of language training if in a host country. All or any of these cause distractions, sometimes disruptions, to advancing their intellectual careers. Notably, postdocs are highly unlikely to take advantage of institutional support and resources. Reasons include lack of awareness; PIs not encouraging absence from work; or the support not being seen as useful.

Leaving the postdoc. Again, occupational career uncertainty emerges alongside intellectual uncertainty. Where to next that will advance career prospects for those still wishing to remain in academia? Each institutional move can have a short-term negative effect on research output. But, not moving also has a negative effect on career prospects. Postdocs are institutionally and internationally very mobile, relocating to posts they hope will advance their careers. Choosing where to go within broader life goals begins again, so the same issues arise as in choosing the previous postdoc, but hopefully with more assets. This journey of continuing career uncertainty requires resilience and managing possible tensions between intellectual and occupational careers and life goals. But for how long?

Impacts

The increase in the number of postdocs originates in the desire of countries to drive national knowledge economies and research-related organizations to compete globally. In the long term, postdoctoral work achieves a number of different organizational goals: universities can report patents, publications, social impact, etc.; funding councils – intellectual breakthroughs and researchers trained; and development agencies – projects completed. But, the structure to make these happen, the postdoc contract, is transitory. PIs are constantly seeking and training new postdocs and postdocs continue to seek intellectual and occupational certainty through repeated mobility. As a result, while home countries may wish to retain postdocs, the more skilled that postdocs become, the more they can negotiate placements globally. In the same vein, while international postdocs may be attractive to the national research enterprise, visa restrictions may be at odds with this goal and limit a postdoc's ability to remain when the contract finishes. However, postdocs will not necessarily return home to advance research. In fact, the rate of return can be quite low depending on the postdoc's country of origin and the host country. Whether postdocs are presently in their home or host countries, the decision as to 'where next' will be made in relation to which national and institutional contexts postdocs perceive to offer better intellectual and occupational career opportunities alongside individual (and family) quality of life. The 'moral of the story' is that postdocs must become shrewd early on about how to negotiate the postdoc regime to achieve their own goals.

Research Community Support as a Core Resource for a Positive Postdoc Experience

Kirsi Pyhältö

Professor: Center for University Teaching and Learning, University of Helsinki (Finland)
kirsi.pyhalto@helsinki.fi

Introduction

New PhD graduates are a highly selected group of individuals, the majority of them aiming at an academic career. Yet, few will eventually earn posts within academia: for instance, only a quarter of recent PhD graduates in Germany have academic careers [1]. Those who do stay, need to overcome a variety of challenges, including high competition and pressure to publish in highly ranked journals, a prolonged postdoc phase, and lack of funding. The challenges turn easily into stressors, eventually leading to career abandonment if the postdoc does not have access to sufficient resources to overcome these challenges or lacks the skills to identify and utilize the resources available. Research has identified research community support as one of the core resources for postdocs [2]. Integration into the research community has also been shown to contribute, for example, to postdoc employment [3], entertaining adaptive writing perceptions such as perceiving writing as knowledge constrcution [4], reduced levels of burnout and increased levels of research engagement [1]. This article explores the anatomy of research community support and how it contributes to the postdoc experience, and in doing so, synthesizes the evidence that may help universities and doctoral programs to build a more robust support system for postdocs.

Research Community Support

The research community is a complex nested entity comprising of several stakeholder such as peers, supervisor(s) and PhD students, and more or less formal communities and networks ranging from a research group to the faculty all the way to research funding agencies [5]. It constitutes the primary working environment for postdocs, and therefore, the support it provides is a central determinant of the postdoc experience and career trajectory [2]. There is, for instance, evidence that having extensive research networks increased the odds of immediate employment after earning a PhD, and a variety of choices in terms of employment [3, 6]. Research community support has also been associated with increased productivity in terms of the number of articles published [4] and overall satisfaction with the postdoc experience [6], while the lack of such support has shown to increase the risk of exhaustion and cynicism, and increase career turnover [2]. Research community support refers to the resources both perceived to be available, and those used by postdocs [5]. Research community support comprises of informational, emotional and instrumental support [2]. Informational support refers to knowledge, such as advice, feedback, affirmation, suggestions, and problem solving, which enables a postdoc to cope with problems and, at its best, the co-creation of new knowledge. Emotional support is characterized by empathy, trust, listening, caring and belonging to a research community network. Instrumental support such as time, labor or funding from different sources or facilities directly helps postdocs to manage their work. Receiving informational and emotional support from peers and more senior colleagues is related to experiencing increased levels of research engagement and motivation among postdocs [2]. Different forms of support might be available from different sources. A peer might be the primary source of emotional support, while a representative of a funding agency is a potential source of instrumental support. Having different kinds of support from several sources is a necessary, but not sufficient, condition for high-quality research community support. To be effective, the support should fit the support needs of the postdoc. Yet, there seems to be a mismatch, particularly in terms of emotional and instrumental support, between the needs of postdocs and the support provided by their research community: the community tends to provide primarily informational support while researchers need more emotional and instrumental support [7]. Finally, the support dynamics, whether the support is given, reciprocal or received, also count. In order to build and engage meaningfully in their research communities requires that the postdoc has learned who to ask for support and learned to provide a range of support for others, depending on the situation, participants and the task at hand. However, there is tentative evidence that postdocs are less skillful in giving support to others and engaging in reciprocal support activities than receiving support.

How to Utilize Research Community Support

A basic precondition for building an optimal working environment for postdocs is understanding the support ecosystem of the research community(s). This includes intentionally orchestrating and drawing on the variety of support sources embedded in the community and in research networks in order to enhance postdoc development and careers. This includes identifying what source is the most suitable for the task at hand and the aim. It is important to acknowledge the type(s) of support needed in order to overcome the particular problem faced by a postdoc. Sometimes, the support is dependent on the right combination of the source and the form. This means that the postdoc may be able to take better advantage of support provided by a certain source. Yet, from the perspective of developing a well-functioning support system, it is important to also consider that preferred support sources, for instance a certain professor, are not over exploited as support

sources or overwhelmed. In term of support dynamics, both offering and asking for support are skills that can and need to be learned. To sum up, investing in developing a research community support system in universities offers potentially high returns in terms of postdoc learning and research productivity, and hence eventually benefiting the future of the scholarly community itself and science for and within society. Realizing this potential, however, requires a joint effort from the members of the national and global research community, including the postdocs themselves.

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The Postdoc: Lessons Learned and Global Implications from a US Perspective

Karri A. Holley

Professor: University of Alabama (USA)
kaholley@ua.edu

In many countries, such as the US, postdocs have been a prominent part of the higher education landscape for decades. In US universities, postdocs serve as a key position in research laboratories and other knowledge-producing units. While the position was long seen as a path towards a permanent faculty position, challenges facing higher education today have made that route uncertain. These challenges exist across multiple national higher education contexts, with the result that postdocs around the world face uncertain futures. The role of the postdoc in US higher education faces increasing uncertainty along three dimensions: funding, professional status, and career trajectory.

Funding

In the US, the postdoctoral role became increasingly prominent during the years following the Second World War. These years showed tremendous financial investments in higher education by the federal government and increased interest in STEM-related knowledge production. One result was that the postdoctoral position was normalized during a time of robust budgets for colleges and universities. Subsequent decades have seen those budgets decline, leaving postdoctoral positions often dependent on external grant funding or internal allocations.

The long-term viability of the role is further complicated by what some observers describe as its precarious standing between graduate student and academic staff or faculty. While the latter is commonly seen as a full-time employee of the institution, the former is not, which leaves lingering questions. The postdoctoral position is not only uniquely situated between graduate programs and faculty roles, but there is also a growing number of faculty employed in contract, adjunct, or non-tenure earning positions. These faculty are typically paid less than their tenure-earning counterparts. The distinction of holding a PhD or related research doctorate is not the primary factor for determining financial compensation for postdocs, but rather pay in relation to graduate students, tenured faculty, and non-tenured faculty.

Professional Status

The status of postdocs within the higher education system is not only reflected in salary and financial support, but also in terms of autonomy, independence, and institutional support. A postdoc is commonly defined as an individ-

ual who has completed a PhD (or related research doctorate) and is engaged in a temporary and/or standardized role that includes mentoring and advanced training. The notion of an apprenticeship is applicable here, although this term has most commonly been applied to the doctoral student experience.

The National Postdoctoral Association (NPA) is the sole organization in the US focused on understanding and improving the postdoctoral experience. Among other issues, the NPA has advocated for funding opportunities and institutional status that supports the postdoctoral position as an early career researcher. This approach calls for collaborative work (rather than strictly a mentored relationship) between postdoctoral researchers and faculty. Permitting the participation of postdocs in institutional-supported benefit programs, such as retirement plans, acknowledges the role as an essential component of an individual's career trajectory and the scientific enterprise as opposed to a "holding pattern" position between the doctoral program and a faculty career.

Career Trajectory

Perhaps the most challenging aspect of the postdoctoral position relates to career trajectory. One reason is that the supply of doctoral students, graduates, and postdocs is greater than the number of permanent academic positions available. Given the many obstacles facing higher education in 2020, including a global health pandemic and declining financial support, the number of academic positions is not expected to grow in the immediate future. A combination of these two realities requires attention to professional development and career planning for postdocs.

Efforts have been underway from the NPA, federal funding agencies, and academic institutions to address the career challenges of postdocs. Doing so requires robust data gathered by standardizing the job title for researchers working in postdoctoral positions across institutions. Another effort has limited the number of years an individual can stay in a postdoctoral role. Researchers would not be allowed to stay in a position indefinitely or hold multiple positions; this encourages individuals to take a next step for career development and possibly open a position for a new doctoral graduate.

In addition to a focus on time limits, a focus on developing postdoctoral skills for a range of careers beyond academia has been prioritized. Recognizing that postdocs are increasingly likely to work outside higher education requires attention to skills focused on communication, collaboration, networking, and innovation.

Implications and Conclusion

This essay is written about postdoctoral researchers within the US system of higher education and from a US perspective. Important lessons for other countries, especially those who are just beginning to implement the postdoctoral role in their higher education systems, are evident. First, the postdoctoral role should be clearly and consistently defined in accordance with institutional types. These definitions should consider not only such issues as the length of appointment and salary, but also work expectations, supervisory norms, and professional outcomes. A larger perspective might also consider the implications of the postdoctoral position for a country's economic future. How might the postdoctoral experience help advance human resource development in ways that provide individual and national benefits? Second, institutional leaders should consider the relationship between graduate education and postdoctoral structures, including which academic disciplines might be prioritized and how postdoctoral positions might be better integrated with the stages of doctoral education.

While national systems employ postdocs in different ways and some have a longer history of the role than others, the trends and key issues identified here can be seen globally. One common element is that postdocs are ill-positioned between doctoral education and the faculty/academic staff ranks; when perceived as neither student nor faculty, these individuals can be overlooked by academic institutions and miss out on key benefits, support systems, and developmental opportunities. A comprehensive understanding of postdoctoral education requires understanding the tensions inherent to doctoral education (oversupply, lack of quality and rigor, little support for effective supervision, etc.) and faculty work (lack of stable employment constructs, decreased autonomy, etc.). Collectively, outcomes for postdocs cannot solely be explained by individual talents, skills, commitments, and achievements. All of these factors are important, but how postdocs are positioned within and supported by the academic system influence these outcomes. Issues related to funding, professional status, and career trajectory (within and outside academia) will continue to shape postdoctoral outcomes.

Some Observations on the Postdoctoral Experience at University College Dublin (UCD, Ireland)

Conor Galvin

Director, PhD Programme; University Lecturer & Researcher: UCD College of Social Sciences & Law (Dublin, Ireland)

conor.galvin@ucd.ie

"You are all very welcome to UCD…"

In her welcoming note which introduces the Handbook given to all newly appointed postdocs and fellows at University College Dublin, Prof Orla Feeney, UCD Vice-President for Research, Innovation and Impact, wishes them every success and writes that she hopes they take full advantage of the 'supports and services the UCD research

community has worked together to devise' for postdocs for their 'personal and career development'. This handbook also contains similar welcoming notes from the UCD Research Careers Team and, among others, the Dean of Graduate Studies, UCD Human Resources, and the UCD Teaching & Learning Unit.

This is significant for two reasons: first, it shows the importance UCD attaches to making sure newly appointed / incoming postdocs have a sense that they are now part of our larger university community, that they know they are not alone and they are valued; and second, it indicates clearly that within the university there is always someone a postdoc can turn to for advice and support. The handbook – and the Postdoctoral Orientation Event at which it is distributed and discussed – signposts a range of units and individuals UCD who are ready to help any UCD postdoc with key areas of their development, particularly around settling in, accessing continuing professional education, the roles and expectations of postdocs, and planning for their futures.

Postdocs as valued members of the university

UCD is one of Europe's leading research-intensive universities and has the longest tradition and the most highly structured arrangements in Ireland for formal, postdoctoral training and support. Since 2006, UCD has developed a researcher career structure for academic researchers with a strong emphasis on more open and transparent recruitment and progression. This is a wholly-UCD initiative, modelled on ideas that emerged from the European Commission's early work on proposals for the Education Research Area, circa 2005. In 2012, UCD was awarded the EU HR Excellence in Research designation by the European Commission under the Human Resources Strategy for Researchers (HRS4R) process. We were the first in Ireland to receive this designation. This recognised UCD as a provider of a high-quality working environment for researchers. In particular, it recognised UCD's commitment to implement the principles of The European Charter for Researchers and The EU Code of Conduct for the Recruitment of Researchers. What the university does in terms of post-doc training and support is firmly based on this view of research and researchers.

Postdocs at UCD; some facts & figures

At any point in time there are approximately 350 postdocs at UCD on what the university terms general Postdoc1 or Postdoc2 research contracts – which last up to four years but are at different appointment scales – and approximately another 80 on postdoctoral fellowships associated with particular shorter-term university projects and initiatives – these typically run for one or two years. Postdocs, therefore, are an important section of the UCD university community. UCD postdocs come from all over the world. They tend to be young, ambitious, and have recently completed highly successful doctoral work at a university of repute. Many are Irish with prestigious Irish Research Council awards; others are European or from further afield and arrive through EC Marie Skłodowska-Curie Actions or similar international award schemes. The elite UCD Ad Astra Fellows Scheme – with its global focus – also offers a route to postdoctoral work at the university.

Contract-holding postdocs contribute mainly to natural and life science research across the various colleges and centres working in this area (approximately 65%) – typically science, medicine, bio-tech, and so on. However, a sizable minority are associated with humanities and social sciences schools and centres including our law and business schools. Some of this last group are on teaching contracts. However, regardless of which part of the university they work in, each post-doc is offered a substantial package of support; part collective, part personalised – so that it is meaningful. The design, updating, and provision of this support is therefore a significant challenge for those involved, but it defines the unique and progressive experience that postdocs can expect at UCD. A steady turnover, with about 20% of the postdoc cohort arriving or leaving in any given semester, adds further to this challenge. Nevertheless, UCD has achieved national and international recognition for the quality and efficacy of its postdoctoral training and support. The Irish Universities Association (IUA) has recently announced that it proposes to recommend the introduction of a national scheme for postdoctoral training and support modelled on the UCD provision and practice.

UCD postdoc Training & Support

So what does the UCD postdoctoral provision look like? According to Naoimh O'Connor, Postdoctoral Research Careers Manager at UCD, the university addresses postdocs' needs under two main headings; research capacity building and personal readiness for future opportunity. This dual focus influences what the university provides.

On arrival at UCD, each postdoc is allocated a personal online space where they build a Personal Development Plan (PDP) that records and stores evidence of activities relating to progress in their career strategy and priorities as well as the transferable skills they already have, and areas to build on/develop for the future. Individual mentoring in line with this PDP and participation in a carefully calibrated series of training events and workshops then takes place.

The broad direction of UCD postdoctoral support and development emphasises the importance of working to this PDP. It addresses: making the best use of the high-quality mentoring that UCD provides for early stage researchers, learning about writing research plans & bids, taking opportunities to do some guided teaching, and preparing for academic job interviews – all against the background of the funding landscape in Ireland and the EU for early career researchers. Additionally – since it is viewed as increasingly important for both academic and cross-sector work – contributions across disciplines concerning outreach, impact and community engagement are included in the postdoc training programme. In short, the nature

of the career and professional support offered to postdocs is rooted in a view that they are early-career professional researchers and deserve to be treated as such.

Individual mentoring: The Postdoctoral Research Careers Manager at UCD works with the Principal Investigators (PIs) of the new postdocs to help identify two different mentors to help the postdocs with development. This is a voluntary role, taken on at the request of UCD and the PIs involved. The first is usually an established senior academic, ideally one who knows the local environment well but also has experience in working in other institutions internationally. The second is usually someone closer to the postdoc's career stage (maybe 3-4 years ahead) with whom they can share experiences and identify successful strategies to advance their PDP while avoiding problems and pitfalls that could obstruct the postdoc's progress during their time at UCD. The value of this has been shown time and again over the years and it is a highly prized aspect of a UCD Postdoctoral appointment. Interestingly, control of this mentoring activity rests with the postdoc, not the mentor. In this way, it is the postdoc who takes the lead and so comes out the other side 'more qualified, more supported and more confident' in the words of Dr Eoin Cummins, an experienced mentor in UCD School of Medicine and a Recipient of the Science Foundation Ireland Career Development Award.

Postdoctoral learning events and workshops take place typically once or twice a month. These are jointly organised by UCD Human Resources and UCD Research, Innovation and Impact and cover four broad areas: Research & Research Management; Teaching, Learning & Mentoring; Personal & Professional Excellence; and Innovation & Entrepreneurship. (See Table, below.) The series features multiple contributions from senior academics and from recent postdocs who have moved into lecturing positions across the University. These include inputs on commercialising research and the people at UCD to contact about this. Additionally – as it is becoming more important for both academic and cross-sector work after completing a postdoc – the series also has contributions across disciplines about outreach, impact and community engagement.

Research & Research Management	Teaching, Learning & Mentoring	Personal & Professional Excellence	Innovation & Entrepreneurship
• Report Writing for Researchers • Lean Six Sigma • Managing Research Projects • Grant Writing • Measuring Your Research Impact • Building Research Leaders	• Design and Management of Instruction • Design of Teaching Materials • Presentation, Communication and Facilitation • Assessment of Learning	• Presenting Your Research Effectively • Communicating the Impact of Your Research • Well-Balanced Working • Time Management for the Busy Researcher	• Innovation in Research – how it can support your career progression in academia and industry • Commercialisation Bootcamp – how to commercialise your technology / research outcomes

Further individual training for specific purposes is sometimes requested by postdocs. In such cases, they are linked into the extensive set of training days, events and courses organised by UCD Human Resources and UCD Teaching & Learning (our principal in-house staff development providers) or in very specific instances funded to attend advanced training events nationally or internationally through a variety of UCD schemes and bursaries.

Concluding comments

The central concern of the UCD Postdoctoral Training & Support programme is to include our postdocs in the mission of UCD as it exercises its great strength and diversity of disciplines to contribute to the flourishing of Ireland through the study of people, society, business, economy, culture, languages and the creative arts, as well as through research and innovation. We seek to do this in ways that foster in UCD postdocs a culture of enjoyment and pride in one's work, through offering opportunities, new responsibilities and new challenges – so fostering a growing sense of themselves as researchers and members of the university. Through high-quality individual mentoring and collective training events and workshops, UCD postdocs are introduced to key concepts and values underpinning excellence in third-level teaching, research, and learning. The structure of our programme offers opportunities for each individual to engage in core aspects of academic practice and to build a professional portfolio through participation in relevant funding, training and employability events. Many UCD postdocs go on to take up faculty or career researcher appointments here or in other universities across Ireland, Europe, and the world. Others leave after their postdocs to continue their careers as professional researchers in state or independent research centres and institutes, again either in Ireland or across the world. In this way, UCD contributes to the status and capability of academia and to the state of research at the national level and beyond. We believe our unique and internationally well-regarded postdoctoral training and support programme is a significant part of how we aspire to that mission.

Like any university system, of course, the UCD Postdoctoral Support programme is not perfect. The most constant challenges faced by the programme relate to the structural aspects of postdoctoral appointments. Many operate under considerable stress – at certain stages of their appointment, lab or project-time is absolutely paramount for the postdoc and training and workshops may need to take a backseat because they simply cannot find the time to participate. Additionally, PIs can sometimes roster postdoc commitments in ways that clash with the support programme times and activities – mostly inadvertently, but occasionally in a deliberate way – if project timelines are tight and/or funding is finishing. In such cases, the Postdoc Career Manager and UCD Human Resources do what they can to help the postdoc find cover and release, but the final word rests with the PI.

Another issue that has to be constantly monitored is that newly appointed postdocs – particularly those on shorter fellowship-type schemes that are not handled centrally by the university – may not see the value of the programme or, in some cases, may not even know that the UCD Postdoctoral Support programme is open to them.

It is a constant feature in the lives of the UCD Postdoctoral Career Manager and her programme colleagues to publicise the programme and its offerings internally through UCD communications channels and to be constantly watching for new postdoctoral arrivals or appointments that might miss the invitation. There is always room for improvement!

A Brief Historical Analysis of the Postdoctoral System in Mainland China

Jin Jin

PhD student: Faculty of Education, The University of Hong Kong

Hugo Horta

Assistant Professor: Faculty of Education, The University of Hong Kong
hugo.horta@ist.utl.pt

The establishment

Compared to postdoctoral systems in most developed countries, China's postdoctoral system is relatively new and has developed within a socialist market economy. The postdoctoral system in China was government-led as part of the rebuilding process after the cultural revolution left the academic system a shambles, and the opening-up reforms started in the late 1970s which led the country to become integrated in global economic, political, scientific, and cultural spheres. For the Chinese government in the 1970s, increasing qualifications, to serve societal and economic development demands, was a top priority for the national development strategy. A series of developmental public policies driven by human capital thinking influenced mostly, but not only, science, technology, engineering and mathematical (STEM) fields. Among these were the reinstatement of the National College Entrance Examination, building-up the academic degree system, creating funded programs for studying abroad, and fostering reverse-brain drain policies.

The China United States Physics Examination and Application (CUSPEA), initiated by Professor Zhengdao Li, a Chinese American Nobel Laureate in Physics was one of the most influential programs under the development public policies initiated by the government. CUSPEA selected excellent Chinese students and scholars to study in prestigious US universities on scholarship from US universities. In 1979 and 1980, the first two cohorts of 915 students were sent to the US under the CUSPEA program, mainly to study subjects in STEM fields, perceived as a priority for the Chinese modernization process. Professor Li was aware of the necessity of making arrangements for returning PhD graduates and proposed, along with 89 Chinese academy members, that a postdoctoral fellowship should be set up. Even though the idea of a postdoc was a new concept for the Chinese leaders in the 1980s, the detailed and concrete plan, regarding how to set up postdoctoral research centers and how the goals, organization, and funding should be structured, was considered convincing and workable. In 1985, the state council of China approved the 'Report on setting up trial postdoc research centers', initiating the Chinese postdoctoral system more than 100 years after the US had its first postdoc. The salary for postdocs increased from 8,000 RMB per year when it was created to 12,000 RMB in 1985 (the average salary in China in 1985 was around 1,000 RMB) [1, 2]. Allocated by the Ministry of Finance, the initial postdoctoral funding required no less than 75% of the funding to be spent on research and the rest on living expenses.

A system under constant reformulation

The role the Chinese government played in the development of the postdoctoral system is a key feature distinguishing the Chinese postdoctoral system from other systems in many developed countries. Unlike the latter which were developed partly for universities' own research needs in a mix of bottom-up and top-down processes, the establishment and evolution of the Chinese postdoctoral system was managed in a planned top-down manner. The Chinese government defined the role of postdocs, made the postdoctoral development plan in accordance with the national talent development strategy, and took responsibility for the organization and implementation of the postdoctoral system nationally. Initially, universities and research institutions were to be the main organizations hosting post-

docs. A recruitment quota for postdocs was assigned by the government for host organizations, and the funding attached to each quota relied predominantly on a financial allocation by the central government and supplemented by funds from other sources.

Even though the establishment of the Chinese postdoctoral system was late, it experienced continuous growth and quickly scaled up to become the second largest in the world. However, the low salary for postdocs internationally combined with a highly centralized, planned system were not effective in attracting the most promising talent. To better serve the needs of the country's economic, societal and technological requirements, the Chinese government made successive and significant adjustments to its postdoctoral system trying to make it more flexible, decentralized, and broader, influencing the definition of postdocs, the system structure, recruitment and funding. At the initial stage (1985-1987), the number of institutions that could host postdocs was small, and the majority of postdocs were recruited in science and a small number in engineering. A two-level management model, the central government and host institutions, was adopted. In the following ten years, the number of postdocs and host organizations dramatically increased and companies could recruit postdocs as well. By then postdocs covered most disciplines and economic sectors. The three-level management system, adding a provincial/municipal layer, was introduced and host organizations recruiting postdocs started using diversified schemes to financially support postdocs (before it was fully centralized). Since 1998, it has become explicit that postdocs should be recruited via diversified schemes and managed differently by the hosting organizations. The National 12th Five-year Plan (2011-2015) further recommended that newly established postdoctoral programs in universities should lean toward basic disciplines, emerging disciplines, cross-disciplines and key national development disciplines.

To attract academic talent to the postdoctoral system, the Chinese government kept increasing the state financial allocation to postdocs but realized that this centralized financial support could not meet the development requirements of universities and postdocs. The central government was also carrying out reforms to decentralize the management authority to provinces and municipalities with the intention of mobilizing regional resources and forming diversified funding mechanisms. This allowed universities, which were developing their research capabilities at a rapid pace and required increasing numbers of highly qualified human resources to receive support from both central, provincial, and local government.

A system striving for improvement but facing many challenges

The Chinese government also established the postdoctoral system partly to break up the constraints on organizational affiliation, salary, housing, among others, which were common to academic careers. The government did this by providing better benefits and guarantees for postdocs, partaking in the welfare benefits that 'lecturers' received, even though they were not considered to be formal academic staff. Considering the limited quotas for postdocs which continued to be centrally controlled, the government allowed for postdoctoral programs to be created in enterprises, while allowing universities to recruit postdocs through self-financing. This forced universities to compete for postdocs among themselves and with companies.

In the past three decades, postdoctoral research funding and salaries have been growing and different tiers of funding from various funding bodies have been made available for postdocs to apply to. The central government's financial allocation is the main source for the China Postdoctoral Science Foundation (CPSF), which only funds postdocs, but provinces, cities and institutions are encouraged to provide additional subsidies. The General Office of the State Council (Central government) made provisions in the report "Opinions on Reforming and Improving the Postdoctoral System" with specific guidelines concerning the amount of postdoctoral funding (a combination of salary and research funding) and its use. The postdoctoral stipend funding rules changed and expenses for living costs can take now up to 80% of the funding (it was no more than 25% when the postdoctoral system was created), while the rest can be used to cover international academic conferences and academic exchange activity costs. In addition to this stipend, provinces, municipalities and universities introduced policies and raised postdocs' salaries to a competitive level to be able to attract the best talent.

However, even if the financial conditions to support postdocs have been improving, they are still perceived as insufficient. Although both government funding and institutional funding are increasing in total, considering the even faster increasing postdoc recruitment scale, the coverage of funding per postdoc is diminishing. Moreover, the different types of funding are not mutually exclusive, meaning that there is the possibility that one postdoc obtains all types of funding while others may only get one or no funding at all. It is important to note that one may become a postdoc in China without receiving any funding. The multiple funding system also leads to controversy over the ownership of research findings. Those who receive CPSF funding are required to acknowledge it when they publish outcomes of CPSF-supported research projects. However, since postdocs can receive different types of funding from different funding sources, they are also required by other funding sources to acknowledge them. This would not be a problem if they could annotate multiple funding sources, but they cannot as their research findings would not be officially recognized. Therefore, which funding body should be acknowledged becomes a dilemma. Besides these challenges and the unbalanced distribution of funding across individuals, there is also the unequal distribution per university and province. There are more research programs, stipends and funding available for postdocs working with well-known academics in prestigious universities and in big cities. Postdocs

working in remote western provinces for example, have limited research funding, while in many places, salaries are almost double for postdocs with overseas research and study experience.

Another challenge is the international attraction of the Chinese postdoctoral system. China started to recruit international postdocs in 1988. The recruitment scale kept expanding but it still lacks postdocs from developed countries. The number of international postdocs, increased from 4 in 1988 to 1,350 in 2018, but from 1988 to 2018, the total number of international postdocs was only 5,677 out of a total of over 200,000 [2, 3]. Most international postdocs are from neighboring countries with close economic exchanges with China. Taking 2016 as an example, postdocs are from more than 70 jurisdictions and represent 4% of all postdocs in China. The distribution shows that 69.3% are from Asian countries, largely from India (279) and Pakistan (115). 14.% are from European countries, largely from the UK (14), France (11), Italy (11), Ukraine (10) and Russia (7) [4].

Summary

The postdoctoral system in China is young, has grown quickly, is still unbalanced and faces challenges. In its 35-year development, it has constantly adapted to a fast-changing higher education and scientific system and this required increasing decentralization, flexibility and adaptability. Its development is, in many ways, different from those in developed countries. China has the second largest postdoctoral population in the world. Increasingly, postdocs have been playing crucial role the Chinese research system. On average, each postdoc is involved in 2–3 research projects and publishes 3–4 academic publications in national and international journals during their postdoctoral period. Structural reforms, new funding, various schemes and programs keep being launched but how effective these are in helping China recruit talent and to what extent these meet the development needs of postdocs remains open to debate. In the foreseeable future, it is likely that the number of Chinese postdocs will continue to increase, and the issues about the sufficient conditions for their work continue, but other questions also arise, pertaining to, as in other countries, postdoc employability. Very few studies take the perspective of postdocs to better understand their perceptions concerning their identity, working status and career prospects. More studies focusing on this perspective need to be developed to better understand the role, agency, and contribution of postdocs to the Chinese and global academic and scholarly communities.

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Providing the Research System with Sufficient Competent Early-career Researchers: the System of Postdoctoral Programs in China

Chuanyi Wang

Associate Professor: Tsinghua University, (Beijing, China)
wcy1985@tsinghua.edu.cn

Lili Yang

PhD researcher: Department of Education, Centre for Global Higher Education, University of Oxford (United Kingdom)
lili.yang@education.ox.ac.uk

Postdoctoral research training has become an essential component of building an academic career. It provides researchers with a transitional period between their dissertation and securing a faculty position at universities or research institutions. A primary aim of postdoctoral training is to support researchers in achieving research competence sufficient for their future career development. Therefore supports, including collegial, financial and institutional, are key to successful training.

China has witnessed rapid growth in the number of postdocs since the 1990s – the number grew from 340 in 1990 to 25,514 in 2019 [1]. Unlike in many countries where universities are primarily in charge of postdoctoral research training, the Chinese government, in cooperation with universities, research institutes, enterprises, and public institutions, has established a system of postdoctoral programs to support the increasing number of postdocs. The system played and is still playing a crucial role in China's modernization efforts by providing highly skilled talents to all walks of life. In Chinese academia, the system is also an important bridge between doctoral graduates and employers who are in need of researchers. This article unpacks how these postdoctoral programs were institution-

alized and how they function today. As all postdoctoral programs in China require approval from the government, here we mainly consider the system of postdoctoral programs at a national level.

The institutionalization of the postdoctoral program in China

The system of postdoctoral programs in China, including the China Postdoctoral Science Foundation (boshihou kexue jijin), was established in 1985. In 1985 and 1986, the system recruited around 250 postdocs. This system laid the basic foundation for China's postdoctoral programs and is still in use today.

A management organization was formed: The Coordination Committee for the Management of the Postdoctoral Mobile Station (boshihou keyan liudongzhan guanli xietiao weiyuanhui) [2]. This Committee is responsible for approving and evaluating postdoctoral programs, approving candidates, allocating funding for the Postdoctoral Science Foundation, and managing daily affairs. In general, postdocs would work at a postdoctoral mobile station (see the next section) for two years, after which they are required to leave the station, perhaps to work in a different station. The total duration of work at postdoctoral mobile stations for each researcher should not exceed four years. All postdocs are treated as formal registered staff, paid at the lowest pay scale for lecturers or assistant researchers, and enjoy various benefits such as subsidies for living difficulties, bonuses, and public medical care.

The two types of the postdoctoral program

There are two types of postdoctoral programs in China, which are respectively based on the postdoctoral mobile station (boshihou liudongzhan) or the postdoctoral workstation (boshihou gongzuozhan). In 2017, there were 3,009 postdoctoral mobile stations and 3,329 postdoctoral workstations.

Postdoctoral mobile stations are established in higher education institutions. They are responsible for recruiting researchers dedicated to basic and applied research. These postdoctoral programs must be based on the institution's or department's discipline. The institution/department must be eligible to recruit and cultivate doctoral students, have a strong research capacity and a good academic record, and be undertaking major national research projects. To be able to set up a postdoctoral mobile station, the institution/department needs to submit an application to the National Postdoctoral Management Committee, covering the number of faculty who are eligible to supervise doctoral students [3], the number of national key research projects, and details of the available conditions and financial support for postdoctoral researchers. Preference is given to those in key national disciplines or with key national laboratories.

Postdoctoral workstations are established in enterprises or public institutions engaged in research and technological development. They are responsible for recruiting researchers dedicated to applied research or experimental development. Only institutions with high-level research teams, in good operating conditions, and specializing in research and technological development, are eligible to recruit postdocs. These institutions often need postdocs for their own R&D, or for consulting public policy making (in the case of public institutions).

Every three years, the National Postdoctoral Management Committee evaluates all existing postdoctoral programs. The evaluation content covers the basic conditions of the program, the recruitment of postdocs (the number of postdocs holding an overseas doctoral degree is particularly important), the research projects undertaken by postdoctoral researchers, academic output, and the academic career of previous postdoctoral researchers. Notably, the evaluation of postdoctoral mobile stations is more focused on the academic contribution made by their postdocs, and the number of the postdocs who later develop into high-impact researchers, whereas the evaluation of postdoctoral workstations stress their contributions to social and economic development and awards received from the government.

The quality assurance of postdoctoral training

The quality assurance of postdoctoral training can be classified into two categories. The first is the assessment conducted during the contract, which may lead to dismissal before the end of the contract. Such dismissal can be caused by any of 1) a failure in regular evaluation, 2) academic misconduct, 3) receiving administrative sanctions that are more severe than a warning, 4) absence from work for no reason for more than 15 days in a row or more than 30 days within a year, 5) having difficulty in continuing research due to health issues, and 6) overstaying in another country for more than 30 days.

The second is the assessment conducted when the contracts are about to end. At this point, the institution in which the postdoctoral mobile station/workstation is established can put forward opinions and suggestions regarding the academic rank and title of the postdoc (see also below), based on his/her academic performance, academic capacity, and academic output over the course of the contract. The postdoc is asked to submit a report which goes through peer review and defense meetings.

For the final assessment, universities have developed various strategies. For example, there is one type that assesses postdocs' academic outputs by benchmarking against a minimum standard. If they meet the standard, then postdocs can end their contracts successfully. In some universities, the minimum level may include having published at least five articles in designated journals (which are often SCI/SSCI/AHCI/CSSCI/CSCD-indexed) and having successfully applied for research funding from the national or provincial government. There is also another type that particularly relies on the evaluation and judgment made by postdocs' mentors. This type often has a standard that is easy to meet. The decision of whether a postdoc may end

the contract successfully is made by the postdoc's mentor at the institution or a steering committee appointed by the institution.

Notably, there is a wide range of reasons for terminating the contract early, either by the institution or the postdoc, such as moving to a new job or not adapting well to the working environment. In other words, not ending the contract successfully does not always mean the postdoc fails to meet the standard. Further, postdoctoral work is intrinsically temporary, so changing job can be common. Thus early contract termination does not necessarily have a negative impact on postdocs' academic careers.

Implications for China's research system

There are six main implications for Chinese postdoctoral programs. First, it provides important support for doctoral graduates to grow into mature researchers/scholars. For example, postdocs may receive funding ranged between 50,000 and 230,000 RMB (around 7,000 to 32,000 USD) from the China Postdoctoral Science Foundation to initiate their own research, mentorship from well-established scholars right after receiving their doctoral degrees, and opportunities to build academic networks. Second, it expands the academic labor pool for higher education institutions. There were 340 postdoctoral researchers recruited in 1990, 2,651 in 2000, 10,559 in 2020, and 25,514 in 2019. Third, it builds bridges between academia and industry. The establishment of the postdoctoral workstation, in particular, has promoted applied research and experimental development. However, the problem of "empty nests" emerged – some postdoctoral workstations may fail to recruit any postdocs for a few years. Fourth, it alleviates the pressure on the employment of doctoral graduates, especially at a time when the academic labor market is becoming saturated, and economic and social demand is decreasing. Postdoctoral positions become an important way to attract and employ doctoral graduates. Fifth, it helps those postdocs with overseas doctoral degrees to adapt to China's domestic academic environment. Sixth, it reduces the uncertainty of academic careers. Many higher education institutions have implemented a particular type of postdoctoral program whose researchers are regarded as reserve faculty — Reserve faculty Postdoctoral Programs (Shizi boshihou).

In summary, the system of postdoctoral programs has provided an important impetus for China's cultivation of scientists, engineers, and academics. Doctoral graduates are provided with abundant opportunities to work at postdoctoral mobile stations for basic research and applied research, or at postdoctoral workstations for applied research and experimental development, in accordance with their own interests and career plans. In this early career period, postdocs are able to receive support that is designed for them, without competing with senior researchers. For China's higher education system in general, the system of postdoctoral programs has increased competition among doctoral graduates, while also improving the competence of institutions' future faculty members.

References and notes:

[1] The source of the data presented in this article: the official website of the Chinese System of Postdoctoral Programs, http://www.chinapostdoctor.org.cn/content/details55_660.html (access date: 9 July 2020).

[2] This Commission was later renamed as the National Postdoctoral Management Committee.

[3] The faculty's eligibility to supervise doctoral students is often approved by the university.

The Emergence of Postdoctoral Studies in Kazakhstan

Aliya Kuzhabekova

Associate Professor: Graduate School of Education, Nazarbayev University (Nur-Sultan, Kazakhstan)
aliya.kuzhabekova@nu.edu.kz

Postdoctoral education is a very recent development in Kazakhstan. Its emergence has been determined more by external influences and institutional isomorphism [1] than by a domestic realization of the importance of adding an extra stage in the training of researchers. Two separate processes have contributed to the emergence of postdoctoral studies in Kazakhstan: the creation of Nazarbayev University (NU) combined with a growing supply of returning scholars with international PhDs, and an innovation enhancing initiative implemented with assistance from the World Bank.

Postdoctoral studies at NU

NU was established by the government of Kazakhstan in 2010 to become "the country's flagship academic institution with aspirations to become a global-level research university" [2]. NU operates more as a Western university than a post-Soviet institution. Unlike other universities in Kazakhstan, which are centrally controlled by the Ministry of Education and Science (MOES), it has complete autonomy and an independent governance structure. It operates as a consortium of 7 schools established in partnership with top international research universities, such as the University of Pennsylvania, Cambridge University, and the National University of Singapore. NU is predominantly run by generously paid international faculty and enrolls into its English-language programs 4,663 students competitively selected from the most talented youth in Kazakhstan.

During its first years, NU focused on undergraduate and Master's programs. By 2017, the university had developed standard processes in undergraduate and initial graduate education, and started to introduce doctoral programs and focused more efforts on pursuing an aggressive research

agenda to fulfill the vision of becoming a flagship research university. Since then, faculty members have been increasingly successful in attracting Kazakhstani and international research grants and in starting international research collaborations. As the research activity of the university has been intensifying, the international partners and the internationally trained faculty of the institution have started to contemplate the establishment of Western-style postdoctoral positions.

The initial reason for the introduction of postdoctoral positions was the lack of access to junior researchers, who could support projects in sciences and engineering, where such researchers were viewed as essential for running laboratory experiments. Until recently NU schools specializing in engineering and sciences trained only a limited number of graduate students. Research faculty at the schools relied mostly on returning scholars with international PhDs, who they hired on part-time contracts as research assistants using money from their research grants. The inability to offer attractive employment conditions, given that domestic funding schemes had restrictions on the duration of contracts and on salaries, created high turnover within the teams. The creation of postdoctoral positions with different contractual and salary arrangements was pushed mainly as a solution to this problem.

Another factor contributing to the emergence of postdoctoral positions was the increasing resistance of schools to hire returning scholars into full-time faculty positions despite the government's and the scholars' expectations that the university would utilize their expertise. As the university's international faculty and administrative body increased, these scholars, especially the ones educated via the government sponsored "Bolashak" scholarship, have been increasingly perceived as being less prepared for faculty positions than their foreign peers due to the lack of publications and postdoctoral experience abroad. Pushed by the government to hire local faculty, the schools have started to view postdoctoral positions as a mechanism to continue the training of returnees and the university's own doctoral graduates, to prepare them for the transition to faculty positions.

Currently, postdocs comprise only 6% of the research and teaching staff of NU. All the postdocs, with the exception of one individual in civil engineering from Korea, are locals. The policies for the hiring, payment, supervision, and evaluation of postdocs are still being developed. While there are already university-wide regulatory documents, each school has been experimenting with its own approaches and the final shape that postdoctoral studies will take at the institution is yet to be seen.

World Bank's "Fostering Productive Innovation Project" and postdoctoral initiatives at other universities

The emergence of postdoctoral studies at other universities was a consequence of the World Bank's productivity enhancement project and the growing influence of NU as a model for reforms.

In 2015, Kazakhstan received an USD88 million loan from the World Bank to help the country reform its national innovation system and enhance the country's productivity [3]. A significant amount of that money was intended for the support of research activity and for the professional development of junior and established scholars. In 2018, the Committee on Science of MOES launched a special grant program intended for the training of postdocs to be funded from the loan [4]. This funding mechanism created incentives for universities to open postdoctoral positions for training junior researchers independently or in collaboration with international partners. By the time the call for proposals was announced within this funding scheme, the administration of some top research universities had been already exploring the feasibility of introducing postdoctoral positions following the example of NU and their own international partners. However, universities had faced financial and legal constraints. The new grant offered the funding, the legal mechanism, and the criteria for the development of programs, which the universities could use as a basis.

To the best of our knowledge, only the Kazakh National University has so far launched a postdoctoral program and developed internal regulations describing the mechanisms for selecting, funding, and advising postdocs – and what is expected of them [5] (KazNU, 2018). In addition, a group of authors from the Medical University of Astana and the Republican Center for Health Development have developed methodological recommendations for postdoctoral programs in medical universities [6] (Koikov et al., 2019). Based on the competition for grants to establish postdoctoral programs conducted in 2019, at least 7 more institutions have successfully received funding for developing postdoctoral programs [4].

The impact of postdoctoral studies on national research

Despite the early stages of postdoctoral programs, they have already demonstrated a positive effect on the development of research at NU and, probably, in the country as a whole. First, postdocs have become essential for the productivity of research teams at NU. They are now actively applying for research funding, assisting the faculty in managing research projects, running experiments, and preparing manuscripts. Second, the postdoctoral positions have become a good way to keep graduates of foreign universities in research, who have been notorious for their high turnover in Kazakhstan as most graduates of domestic PhD programs leave for industry or other sectors after graduation. The postdoctoral positions at NU are paid above the market average, come with subsidized housing, access to relatively good research funding and modern equipment, as well as being supervised by active scholars trained in other countries. These positions keep the graduates in academia during their most productive years and give hope that these individuals will continue with research in the future as more opportunities arise.

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Russian Postdocs as a New Tool for Academic Development: an HSE University Perspective

Yulia Falkovich

Director: Scholarly Integration Center, coordinator: Russian postdoctoral Program Fellowship, HSE University (Moscow, Russia)
yfalkovich@hse.ru

Niyaz Gabdrakhmanov

Research Fellow: Institute of Education, Laboratory for University Development, HSE University (Moscow, Russia)
ngabdrahmanov@hse.ru

Anna Pravdyuk

Manager: Scholarly Integration Center, HSE University (Moscow, Russia)
apravdyuk@hse.ru

The Postdoctoral Program Landscape in Russia

The system of postdoctoral fellowships in Russia is relatively new; the first postdoctoral programs appeared in 2013. Their development was accelerated by the "5-100" Russian Academic Excellence Project initiated by Russian Ministry of Education and Science. Postdoctoral initiatives started to be implemented in more than 10 Russian universities including Lomonosov Moscow State University and Saint Petersburg State University.

Most programs were designed to follow the western model of postdoctoral fellowships. Originally, the aim of such programs was to attract scholars with high scientific potential and a variety of research backgrounds to carry out independent research and extend the pool of university research projects. Universities generally expect external candidates with a PhD (or its Russian equivalent, stepen' kandidata nauk/Candidate of Sciences), publications in high-ranking international academic journals and international experience. These researchers are aged between 26 and 39 and have advanced knowledge of English.

Conducting research is the primary task of postdocs. They can also be involved in joint research work with students and fellow scientists, and in giving open lectures and holding seminars. As a rule, the call for applications is open for foreign and Russian researchers. However, Russian universities focus their efforts on attracting international colleagues to a greater extent [1].

The positioning of postdoctoral programs in Russia is still under development and reflection. For instance, Russian universities sometimes compare it with the well-known system of Doctorantura, an education program for holders of a Candidate of Sciences degree who are aiming to become a Doctor of Sciences. As, for example, National Research Tomsk State University claims that "The Institute of Postdoctoral Studies at TSU replaced Doctorantura, familiar to all of us" [2], National Research Tomsk Polytechnic University calls its postdoctoral program "Postdoc of TPU, an analogue of Doctorantura" [3]. The second aim of Russian universities is to use their postdoctoral programs as a tool for international recruitment, examples of such universities include Ural Federal University, Novosibirsk State University, and Far Eastern Federal University. Russian universities currently regard postdoctoral programs as a development tool for their staff.

Russian Postdoctoral Fellowship Program at HSE University

Generally, all postdoctoral programs, not only in Russia, aim to attract international researchers rather than domestic ones. Even if they are not citizens of foreign countries, they are expected to have a PhD from a university abroad. HSE University was the first Russian university that launched a postdoctoral program to attract national researchers. HSE University executives developed two different programs, for international postdocs and for national postdocs. The criteria for participation and pro-

gram conditions are different. The International Postdoc Fellowship Initiative was launched in 2014. This is a 3-year program for those who have PhDs from a foreign university. The Russian Postdoc Fellowship Program, launched in September 2018, is 1-year program for Russian scholars who have never worked at, or obtained a PhD from, HSE University. It is possible to extend the term for 1 more year. Here, we would like to focus on the Russian Postdoc Fellowship Program as it is a unique attempt to develop the national research system and address the challenge of inbreeding at Russian universities.

Although the program is new and it is too early to describe concrete results, we show the initial impact of the program from the perspectives of HSE University executives and Russian postdocs.

University Executive Perspective

The Russian postdoctoral fellowship program is part of the HSE University mission to promote the development of Russian academia and research. First, the program serves as a platform to develop national intellectual exchange and university collaboration. Exchange can be very fruitful, taking into account the fact that Russia is a very large country with more than 700 universities and over 400 research institutions. They differ widely in terms of the approaches they use and the level of teaching and research. The aims of such collaboration can be a short term, the professional development of a postdoc and increasing the effectiveness of an HSE research project; or medium term, research collaboration with departments of partner universities. The program both helps strengthen the existing collaborations of HSE University and find new partners. Secondly, the program furthers the renewal of academia, bringing dynamism to a community which tends toward being staff-locked and stagnant. It is difficult to get an inflow of new ideas or to master new research approaches if there are no people with different mentalities, knowledge, skills, values, experience or contacts, who can join the research team. Thirdly, as HSE University is a leading national university in the field of mathematics and computer science, social sciences and humanities, the program further strengthens the staff of Russian educational and research organizations with the help of program alumni.

In general, there are three groups of participants. Representatives of the first, largest, group come from universities all over Russia where the research infrastructure is less developed. Members of the second group are scholars from metropolitan universities. Their aim is either to continue research in their field in a new environment or to change their research dramatically. For scholars in the third group, the Postdoctoral Program is a chance to return to academia. They are PhDs who have worked in industry but who are willing to work as researchers.

The Russian Postdoctoral Fellowship Program is a university level program. The university provides funding for the candidates who are selected, on a competitive basis, by the HSE Postdoc Committee. Their guaranteed monthly salary is determined by program conditions. The department that was awarded an opportunity to get a postdoc is encouraged to co-finance. The postdoc also has the opportunity to join projects carried out at other HSE labs or departments. The university provides annual travel grants and the possibility of internships in addition to those that are available from the departments. Postdocs are encouraged to take part in adaptation programs and special postdoc events as well as all the social and sport facilities.

The program seems to be a win-win situation. The HSE departments where postdocs work get a motivated colleague who does not have a teaching load and who is willing to concentrate on research. Such collaboration results in the increase of the department research output; the development of interdisciplinary research projects at department and university levels; and the renewal of the university research staff. The university academic community starts to become more open-minded and flexible to the integration of new research practices and ideas.

HSE Russian Postdoc Perspective

Approaching the end of the first 2-year cycle of the Russian Postdoctoral Fellowship Program, we conducted an investigation on the impact of the program from the program participants' perspective. The aim was to identify their initial motives and whether the program met their expectations, what impact the program has had on their future career and the reaction of their academic community, including their previous employers and colleagues, to their participation in the program. There are 45 HSE Russian postdocs, 70% took part in the survey.

Almost 100% of the respondents claimed that the participation in the program met their expectations. First, they managed to reach the academic goals they associated with immersion in a well-organized scientific environment. Secondly, 61% of participants appreciated the fact that they are now more in demand in the academic market, although, half of the respondents are still searching for jobs, since almost half (42.9%) have not yet received job offers.

Over the two years of the program, most participants developed an idea of an effectively managed, vibrant academic environment. This means the program alumni have high expectations for their next job, and this minimizes the possibility of their returning to their former employer. From the point of view of enhancing academic mobility, it may contribute to the renewal of the academic staff at universities and research organizations.

The postdoctoral position is a relatively new phenomenon for Russian universities and a program requirement is to change the primary place of employment. Termination of the employment contract has become a difficult decision for both program participants and their previous employers. Half of the employers accepted the decision of their colleagues to become an HSE postdoc and they are glad to work with the colleagues after they come back again. Other employers did not want their colleagues leave their jobs for a different research experience and they are not ready to continue their joint projects.

Despite existing institutional barriers and psychological difficulties, an important program outcome is the fact that most participants were not disappointed with their decision. If it were possible to make the same choice again, they would as the program helped them to develop professionally.

All Russian HSE postdoc alumni are planning to continue their academic careers. While working for two years at HSE University, postdocs had an opportunity to see the organizational of this university from the inside. It concerns not only scholarly communication and academic routine but also the social and management infrastructure of the HSE University community It helped them reach a new level of understanding of high academic standards that may significantly reduce the likelihood of returning to previous jobs. Almost 60% of program participants claimed that they would like to find a position that fits their new understanding.

Conclusion

The postdoctoral program in Russia is a new form of interaction between universities and research organizations in the free market of academic labor. It can be an effective means to address the challenge of inbreeding and stimulate rapid intellectual exchange, which can lead to fruitful research cooperation.

The experience of Russian universities shows that a unified model of postdoctoral programs is not suitable for Russia because of the country's size and specific regional characteristics. Each university uses the postdoc to address their own challenges depending on the budget, management capacities and how ready the university environment is for change. The case of HSE University shows that postdoctoral programs can be used as a means of international recruitment, a platform to nurture advanced researchers (Russian Doctors of Science) and it is possible to adjust the program to the mission and long-term goals of a university's development.

The future of postdoctoral programs may be influenced by the current situation with the COVID-19. It may change the formats of such programs to a "digital postdoc" or online research collaboration.

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An Unrealized Postdoctoral Program: the Experience of St. Petersburg Polytechnic University

Victoria Lobatyuk

Associate Professor: Department of Social Sciences, Peter the Great St. Petersburg Polytechnic University (St. Petersburg, Russia)
lobatyuk_vv@spbstu.ru

A focus on youth

In 2012–2015, a number of youth initiatives and projects related to the social activities of the Council of Young Scientists and Specialists were developed at St. Petersburg Polytechnic University (SPbPU), including the creation of a youth talent pool for researchers and teachers, the development of a post-doctoral program, and the contest "assistant vice-rector".

One of the main tasks of the Council was to promote professional development, the accumulation of experience and creative growth, and to realize the scientific potential of young people. Graduate students or university employees from 22 to 35 years old could provide proposals to improve and develop the scientific activities of the university by supporting young scientists. The authors of the best projects implemented their ideas, occupying the position of "assistant vice-rector" for scientific work during the year. The project to create a centralized system for recruiting postdocs at SPbPU appeared in 2013 precisely thanks to the initiatives of the "assistant vice-rector". The concept of a postdoc support program was initially experimental in nature. The leadership supported this initiative and program began to develop.

Implementing the postdoctoral project

The main goals of creating post-doctoral studies include developing the quality of research and teaching staff and establishing a balance between the professional and age composition of the staff. At the beginning of the project, based on open source materials, an analysis of postdoctoral systems in Russian and foreign universities and of the mechanisms for the external recruitment of young scientists was carried out. Similarities and differences in these systems were determined and best practices were identified. The most effective systems which were possible to transfer to SPbPU, include the postdoctoral system introduced at St. Petersburg State University, which was implemented as a grant competition for research conducted under the guidance of leading university scientists.

In 2014, draft regulations for postdoctoral studies were developed. The recruitment of postdocs to SPbPU was

to be carried out in two stages. At the first stage, applications were received from the leaders of scientific teams with a description of the study and the requirements for the postdoc. These applications were considered by the tender committee once a quarter, and a list of successful applications was drawn up. At the second stage, there was a competitive selection of candidates for postdocs. Young scientists (up to 40 years old) with experience working in leading Russian and foreign universities, who had defended their dissertation or received a PhD no earlier than five years before the announcement of the competition, and who were not working at SPbPU, could apply.

The competition organization required applications from project managers for inviting postdocs, which were considered by the competition committee, and the winners of the competitive selection were to be offered employment for the position of researcher on the basis of a fixed-term contract for a project of up to three years. These positions differed from traditional researchers, since they had strict KPIs and high applicant requirements, exceeding the average indicators for departments. The potential postdocs were evaluated by quantitative indicators: publications indexed in international citation databases, articles in journals with an impact factor of more than 1, participation in international conferences, receiving grants, forming their own research group with the involvement of students and graduate students. These requirements were indicative and could be strengthened by the leaders of scientific teams. Every six months, a certification procedure was undertaken. Financing came from the funds of the Program "5-100", while the salary of the postdoc required 50% co-financing from the unit inviting him or her.

In parallel with the development of the draft regulations on postdoctoral positions, other organizational processes took place: an analysis of the faculty showed that there was a shortage of young scientists and teachers with experience in research and education at leading Russian universities and research organizations. In this regard, the pilot recruitment of 20 specialists was carried out. These employees were not selected centrally, but through the heads of institutes and laboratories; they did not always fully meet the criteria, except for work experience at a leading university. This pilot recruitment scheme helped to identify interest in these positions both among applicants and among heads of departments. All resumes received at the university for the postdoctoral position were checked.

Why not?

Currently, there are no postdocs at SPbPU, the program was closed after a year, having remained a pilot project. The financing of the project was discontinued in 2015 for several reasons. There was no response from heads of departments: the centralized system for inviting postdocs was perceived as an additional burden, its implementation would have been carried out with great resistance. Such a recruitment system seemed cumbersome and not justified from a bureaucratic point of view. Leaders who had successful recruitment experience before the project did not want to complicate their usual processes, including working with established contacts, and those who were not interested in postdocs continued to ignore the possibility of externally recruiting young scientists. The program did not provide incentives for scientific leaders, i.e., it was assumed that the opportunity to receive co-financing from the university to attract an additional highly qualified specialist to the research project was sufficient motivation. Only a few leading scientists took it that way, most future scientific leaders were perplexed as to why there were no financial incentives or other support.

Exactly the same situation arose in another program aimed at supporting young scientists "Youth deputies for research and teaching staff". Here, incentives were received by the deputies, not the leaders. At first, this seems to make sense, as the work of the young scientist was evaluated and it was he or she who was required to fulfill the criteria. However, the incentive system did not take into account the additional work required of the leader, which was necessary when integrating and training a temporary employee. During the development of the project, its main experts were members of the scientific and technical council and HR, which meant the opinion of ordinary scientific leaders was lost. This was the main drawback of the program, leaving it only at the pilot stage.

The corporate culture of SPbPU is characterized by inbreeding, this preserves the centuries-old traditions, but also leads to a closed system.

Competition played a negative role in similar programs. There was the project for deputy faculty, which was to attract not only graduates and employees of the university, but also specialists from Russian and foreign universities. However, only young teachers and researchers who studied or worked at SPbPU became deputies. External candidates often failed to qualify.

Let us return to the fact that the implementation of the project under consideration was carried out as part of the "assistant vice-rector" competition and had a clear deadline – one year. Within one year, it was not possible to justify the need for recruiting postdocs in the proposed format. That is, we can assume that the cause of the problems lies also in the status of its initiators. We conclude that the introduction of such initiatives was not always justified in closed universities, which have a large number of scientific areas and schools with their own ways of recruiting young specialists. It is important to examine such programs before their implementation, bringing all the stakeholders together.

Notes:

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Postdocs in Russia: Possible Steps

Svetlana Tvorogova

Independent researcher
svetlana.tvorogova@gmail.com

The current scheme

In European and North American universities, the postdoc format is used as a bridge between graduate school and a permanent position. Typical tasks for postdocs, in addition to publications, include obtaining funding for new research projects and organizing scientific events. Many authors consider changes in the structure of university research and the disappearance of the category of middle-level researchers as a source of tension in modern academia: there are professors in tenured positions and scientists on temporary contracts unsure of their future. Such a system is beneficial for universities: they have no obligations to young employees, but they can employ motivated researchers who are eager to show what they are capable of.

A postdoc contract is temporary because of funding considerations. Positions are often paid from research grants; a prospective postdoc must look for projects that have received funding. Or a postdoc can win a scholarship for the implementation of his or her own research project within 1–3 years of work, having previously reached an agreement with the host institution. In both cases, when the funding ends, the position closes.

Postdocs in Russia

Until recently, the reality described above was completely different from the Russian situation, where employment stability gave universities loyal employees, and teachers and researchers found stability, which is so often lacking in modern life. For more than a decade, Russia has been looking for ways to make the work of universities more effective and flexible. Strengthening research mobility and creating long-term internships or postdoctoral positions could be of great help. Reproducing the foreign systems in full is not recommended, but some of their elements, adapted to Russian realities, may be useful.

Who is interested in enhancing the mobility of young researchers? Two types of universities can be distinguished: 1) metropolitan universities and universities from traditional academic centers, and 2) regional universities that are actively developing their international reputation and therefore looking for talented personnel. Among the scholars, especially young ones, there are those ready for a move and the associated risks. It is important for universities to get active researchers, and it is important for researchers to have their work recognized. Universities are looking for quality scholars and their research, while the scholars need professional development and career advancement.

Terminology

Further in the text, the term "long-term internship" is used in the sense of the English term "fellowship" (financial support for continuing professional development) or the German "Stipendium" (financial support for the young scientists, artists, etc.). A long-term internship allows them to focus on moving from organization A to organization B for the sake of gaining new professional opportunities, and it fits into the traditional interpretation of internships in Russia as an enrichment of their professional experience.

Regional universities as new attractors

The main center of attraction for scientists in Russia are the capitals and leading university centers. These are appealing because it is clear what to expect. However, long distances and high costs of living are obvious drawbacks, stopping many.

Universities across the country are striving to develop their academic positions and are looking for ways to become more attractive to active researchers. Encouraging movement within the country can change the existing hierarchy of regions. A long-term internship allows a scholar to find a university, a team, a city; and a university can better present itself as a dynamic research center.

While a university benefits by attracting the new staff from the other academic centers (new ideas, new connections, the possibility of new projects), the scholars often have to face various constraints, which ideally have to be compensated. One of the implied incentives is gaining experience in a more prestigious university. For the less-known universities this option is less evident, but they could offer special working conditions (e.g. less teaching and / or less bureacracy) together with a perspective of a permanent position for the productive researchers.

Possible solution: "From Kaliningrad to the Kuril Islands"

Directing the flow of researchers towards non-capital universities is a non-trivial task: effective incentives are needed, but the returns can be significant. A possible option is the creation of a national or inter-university exchange program. PhD holders who have already shown their academic potential can apply for participation. During such a long-term internship, a scholar receives favorable conditions for academic work: a high level of academic freedom, a minimal (or zero) teaching load, and selective reporting. Expected results can be adjusted for the specific goals of a particular university, but in any case require publications and academic interactions through the organisation of seminars and conferences.

Starting from scratch in a new place is challenging, thus it is important to support those who dared. Conducting regular training can help in solving the assigned tasks: honing the skills of publishing, grant applications, or organizing events. Such training can be carried out on-site or remotely, but it is important to use it as a tool for building connections and support between program participants, who are all in a similar situation.

Ideally, financing such a program should be designed for the long term – this will provide predictable conditions for participants, other researchers and universities and, will allow a couple of trial years to ensure it works successfully. One possible form is a renewable national program, which is regularly (for example, every three years) evaluated and adjusted if necessary. In addition to the federal government, which is interested in enhancing the economic and innovative activity of the regions, potential sponsors may be regional enterprises seeking to attract highly qualified staff to their regions. Finally, universities themselves are also able to coordinate their efforts and build a mutually beneficial system of staff exchange.

Limitations and opportunities

The relative isolation of some universities and the lack of a national database about initiatives in other regions may interfere with the effective operation of such a program. Contacts remain at the level of individual connections, which is good for disseminating success stories, demonstrating new role models, but does not significantly expand the audience on existing initiatives and projects. This restriction is especially sensitive for less well-known, but no less interesting universities, for which the creation and development of such a database is important.

Different academic disciplines have different requirements for such long-term internships. For a number of resource-intensive technical and natural-scientific disciplines, internships within the country will be technically impossible – the necessary equipment or a specific research expertise might be available in a single location. In order not to exclude such disciplines from participation in the program, it is advisable to consider alternatives, for example, interdisciplinary internships.

Most of the internship programs often suffer from the limited further use of the experience and connections they helped to gain. Suppose that a graduate of the program enters a university where the academic environment is still poorly formed – there may be a high degree of disunity, little research, and even less discussion. Such a situation is not uncommon and in order to improve it, support for the network interaction of graduates, resources for short-term internships, invitations to colleagues from other universities, etc. should be provided.

* * *

In Russia, there is demand for the increased mobility of scholars, and the need for researchers is especially great outside the metropolitan regions. Structural solutions that support the professional development of researchers would increase the quality of academic work and strengthen the innovative potential of the economy.

Postdoc Experiences of Belarusian Scholars Abroad: Switching from Academic to Non-academic Employment

Svetlana Poleschuk

PhD researcher: Department of Political and Social Sciences, European University Institute (Florence, Italy)
svetapol@gmail.com

This article gives a brief overview of the experiences of Belarusian postdocs abroad and discusses how postdoctoral programs affected their careers and what happened to those who switched to non-academic employment. Postdoctoral education in Belarus does not exist. As soon as a PhD is obtained, scholars are expected to move up the career ladder to an assistant professor (docent) or to a senior research fellow and then to an associate professor. Even though it is also possible to get a DSc, national statistics show that only about 5% of academic professionals in Belarus do so. In Belarus, graduates of full-time, state-subsidized programs of public education institutions are subject to obligatory job placement. On completing their undergraduate requirements, students receive their degrees together with a job assigned for them for the following two years. Those who enter graduate school are assigned a place of work afterwards. There are many exemptions to the law, and variability on the departmental and individual level, however the obligatory job placement imposes serious restrictions on career development. A postdoc was the next logical career step for scholars who got a PhD degree abroad and who want to make an academic career. Those who completed their doctorate in Belarus are also attracted by postdoctoral programs. While for some scholars, a postdoc was a chance for emigration, others wanted to return after getting experience abroad because they had clear career prospects at home (for example, if they were part of a successful local research group). To enter postdoctoral programs, applicants usually relied on their supervisors' contacts and chose those universities and research centers where collaboration had already been established.

Despite the fact that postdoctoral programs should give a boost to careers, give new opportunities, and lead to a permanent contract, interview data showed that a postdoctoral position could end a career. Since getting a permanent position was difficult, the interviewees usually just moved from one postdoc to another. Unsuccessful postdoctoral research could jeopardize career plans. The account of Raina (biologist, female, participant #58) illustrates this point. She won a Marie Sklodowska-Curie Postdoctoral Research Fellowship but when she did not succeed in her research, she decided to give up her career in academia and switch to industry:

> *I was hoping the project would be a breakthrough and then I would have a very cool CV and I would make my next career move. Having a Marie Curie [scholarship] in my CV, I'd look good. But the project was not a huge success for a number of reasons. And therefore there was no project, there were no articles, and thus, at the moment, my Marie Curie does not add anything to my life. There are no articles, which means somehow it didn't work out.*

Switching to industry was a common option for natural sciences. Getting a job in a company which develops high-tech products, scholars moved from fundamental to applied science, remaining in the same disciplinary field. The interviewees' experiences showed that such a transition did not mean a complete stop for scholarly work or a devaluation of the academic qualifications they had received. Some companies offered research-specific positions and remained in close contact with the university environment. In this case, the interviewees argued they did not see the difference between university work and industry. In general, the interviewees continued to use their professional knowledge and even had to update it. Zianon (physicist, male, participant #63) described his work in a Canadian company after three postdoctoral positions:

> *This work is not related to research at all, you don't need to research anything here, but to come up with a product. This very product has to do with a lot of calculations and theoretical knowledge. It was not about grinding on some machine. This is a field of knowledge related to the way financial markets operate. It is connected with detailed calculations. In general, I had to work on my mathematics a bit, go back to the books again, read and learn something. In this regard, the intellectual content has not lost its importance.*

Yet fundamental research differs from applied research in private companies. While the former is long-term and related to the interests of an individual scholar or a group, the latter is carried out within tighter time limits and with a focus on specific practical goals. Some interviewees perceived this as a drawback, while others were glad that they started to do "real" research that was useful for society. Vital (engineer, male, participant #56), having finished his postdoctoral program, took a non-academic career track in industrial research. He was inspired by the impact his work started to make:

> *There is a difference between the fact that your article or presentation at the conference is seen by 100 people or maybe 100 people are going read it, and then maybe 50 people will refer to it and the fact of you knowing that what you have done has an impact on several million people.*

Along with its commercially oriented goals and tight deadlines, research work in private companies has some other constraints. Scientists do not have ownership of the products of their labor, as this remains the property of the company. That is why publication activity and conference attendance was limited and needed to be approved by the management. Some interviewees said they continued to attend conferences as often as they did in academia, though instead of presenting a research paper they needed to network and promote the company's products. As regards workload, even though many believed that industrial jobs had more regulated working hours and generally much lighter workload than academic jobs, this was not always the case.

However, all these shortcomings were outweighed by the key advantages industrial jobs could offer: permanent employment and good salaries. To gain these advantages was the main reason why the interviewees left academia. Having received a PhD and successfully won one, two, or three postdocs, being at the peak of their productivity, the interviewees realized that they still were not able to get permanent employment at a university, that the future that awaited them was a constant search for grants and moving from one country to another. Stasia (biologist, female, participant #60) was sure that she made the right choice in leaving academia:

> *I do not want to compete for a research position, I do not want to depend on the contract. I did this. It was very stressful. When you don't know what will happen to your work in two years, the question arises whether it makes sense to invest in it emotionally, morally, physically. When you don't know if the project will be extended or whether you will have to switch to a completely different position. […] I am not ready to spend the next 10 years of my life on this. I want a family, I want to have the opportunity to relax and work for pleasure, and not because the deadlines are looming. And this is what is going to happen when I do science [in academia].*

To sum up, in hard sciences and particularly in natural sciences, the interviewees' career trajectories were characterized by movement from one position to another: the completion of a PhD, successive enrollment in postdoctoral programs, understanding that obtaining a professorship was unrealistic and then a switch from academia to industry. Looking at the careers of those who did a postdoc (either after a PhD or the Belarussian equivalent), we cannot say that postdoctoral programs led to career advancement. On contrary, a postdoctoral position could motivate scholars to leave academia, not only because getting a stable contract at a university was difficult but also because working as a postdoc did not always mean it ended successfully. For soft sciences, career progression after a PhD was not so straightforward. The interviewees did not enroll in postdoctoral programs immediately after their PhD or did not enroll at all, they got involved in various activities like

teaching, side jobs, project participation, grant applications, workshops and conferences organization, and article and book preparation. Only 2 interviewees, carving out an academic career outside Belarus, received a permanent contract. To remain in academia, they agreed on temporary contracts and unstable income, exactly what hard science scholars wanted to avoid by moving to industry.

Notes:

This article presents some findings emerged from my thesis Academic Careers in a Rapidly Changing World: Biographies of Academics Who Stayed or Left Belarus After 1991 which explored the experiences of a single cohort of scholars who started their higher education in Belarus at the beginning of the 1990s and were at their mid-careers at the time of the interview. Using semi-structured qualitative interviews with 67 participants from different disciplines, gender and mobility groups, I explored both the chronology and personal interpretations of transition experiences in the domains of education, employment, and family.

A Non-academic Career for Russian Postdocs in the Context of the National Project "Science"

Anastasia Chasovnikova

Head: Department of Educational Projects, The Center for Strategic Research "North-West" Foundation (Russia)
chasovnikova@csr-nw.ru

The national project "Science" [1] defines the key goals and priorities of the Russian scientific sector. One of these goals is to increase R&D funds from all sources (including the commercial sector). Government spending in this area has largely plateaued, a fact which will be exacerbated by the economic crisis that is following the COVID-19 pandemic. The most promising source of resources is therefore the commercial sector. According to UNESCO, in the most technologically and scientifically developed countries the share of the commercial sector in scientific expenditure is at least 70%. In Russia, this figure is 60%, including the contributions of state-owned corporations and the "voluntary-compulsory" system for generating funds for R&D. Although many businesses are now in difficult situations, after overcoming the crisis they will seek high-tech solutions to expand their markets and quickly recoup lost profits; the scientific sector must be ready to provide such solutions.

One way to ensure increased funding for R&D from the real sector is to increase the number of informal contacts between representatives of science and business. This is evidenced by numerous studies [2, 3]. The quality of interaction between business and academia is largely achieved through the knowledge of each other's activities.

A temporarily change of career path in favor of another sector can create such contacts. This implies the temporary transition of a corporate researcher to an academic institution and vice versa (intersectoral mobility). Scientists who have made such a transition are able to build strong ties between the corporate world and academia, having an understanding of the views and approaches of both groups. Intersectoral mobility enhances trust between organizations, creates a mutual understanding of their challenges and prospects. This allows the academic and real sectors to achieve common goals.

In most countries, various forms of institutionalized intersectoral mobility are practiced: internships, industrial doctoral programs, dual career programs, intersectoral summer schools, etc., and are an essential budget item. In Sweden, the budget of three such programs is more than 65 million SEK (equal to 63,5 million Euros). The Cordis EU project "Intersectoral mobility of researchers in South-Eastern Europe" program had a budget of over 750,000 Euros and included 8 countries.

These programs have shown significant financial effects and improved scientific productivity in the number of publications and citations. From 2003-2008, the number of joint publications of the academic and real sectors grew by 14% (for comparison, in the US the growth over the same period was 4.6%). The Wageningen Institute found that articles written in collaboration with the commercial sector have a higher average citation rate than purely academic articles. A quick analysis of the publications of leading Russian universities in the Scopus database (for example, Tomsk State University, St. Petersburg Polytechnic University, and Moscow Institute of Physics and Technology) confirms this conclusion. Despite the successful EU experience, in Russia there are no institutionalized forms of interregional academic mobility, let alone exchange programs with organizations from the real economy.

Given the national project "Science", it seems appropriate to launch such programs, at least as pilots. For many researchers, changing the sector of work is a psychologically difficult step that can have significant consequences. Mobility programs can reduce this tension and expand career opportunities. Such an expansion is likely to have a positive impact on the demographic indicators of Russian science. The possibility of using advanced equipment and removing bureaucratic barriers characteristic of academia, are important motives for young researchers to stay in science (45% of the CSR North-West survey participants said

low infrastructure security as the most important reason why scientists leave science, 69% said bureaucracy is one of the main problems they face in their scientific work. The sample size was 4,643 people).

As noted, many formats have been devised for intersectoral academic mobility. The right format for pilot intersectoral mobility programs requires further research. The features of the Russian academic system, where a change in trajectory can be perceived as "disloyalty" to science in general and to the supervisor of studies in particular, and of the corporate sector, which usually has negative experiences with academia, need to be taken into account. However, the advantages of the program will not depend on whether researchers return to academia.

Considering that those most mobile and open to a change of activities are young PhDs, who have recently graduated and who are looking for their next career step (postdocs, in the global scientific system), it seems advisable to focus such programs on this particular group of researchers. The very concept of a postdoc implies work mobility and the choice of alternative career paths. Postdoctoral studies are considered a way to expand scientific and personal contacts, and to get experience working in a different environment and with different methods. There are obvious advantages to adding new contacts, methods and experience from the commercial sector. Such experience will also contribute to the self-determination of researchers.

The formation of intersectoral mobility programs in Russia will face a number of obstacles. Today, not many solvent companies from the real sector have R&D centers in Russia where researchers can come to work from academia. Such programs will face administrative barriers. In addition, according to the CSR North-West survey, the business skills of Russian young scientists are critically low (68% of the surveyed respondents reported a lack or a low level of skills in collaborating with industry). The value of such programs for the commercial sector will be determined by the quality of human capital. Therefore, training for mobility program candidates in primarily skills such as project management, product development, and presentations will be required.

One policy option could be intersectoral mobility in the form of, for example, temporary internships (or staff exchanges) between the academic and corporate sectors, targeting postdocs. The positive effects of the program will make it possible to contribute to improving the quality and increasing the volume of applied scientific research and to the realization of KPIs of the national project "Science", increasing the extrabudgetary funds of research organizations in the areas of technology development and scientific and technical services. Such a program will have an indirect positive effect on other important parameters of "Science", for example, increasing the number of patent applications and articles published in leading international journals. Enhancing career opportunities could also lead to an increase in the share of young researchers.

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Postdoctoral Apprenticeship Research: Past, Present and Future

Denis Ananin

Research Fellow: Center for Institutional Studies, HSE University (Moscow, Russia)
dananin@hse.ru

Anna Pravdyuk

Manager: Center for Scholarly Integration, HSE University (Moscow, Russia)
apravdyuk@hse.ru

The impact of postdoctoral research and the effects of postdoctoral fellowships from all over the world has increased the interest of leading universities, research institutions and the business sector in the recruitment of postdocs. The opening of new positions and the implementation of new training programs makes postdocs an important, but very particular group of scholars in the scientific community; a group who face many challenges and uncertainties. The temporal nature of postdoctoral positions transforms this category of academic researchers into scientific ambassadors and creative, independent, mobile, and engaged insiders of the global research landscape. The title of the most famous book about postdocs is "The postdoc landscape: The invisible scholar" (2018) edited by Jaeger and Dinin, however one can assert that due to the increasing attention to PhD graduate research, postdocs have definitely become visible and become one of the top topics on the research agenda. Many researchers have contributed to the overview of different aspects of the postdoctoral phenomenon in terms of policy, the labor market, the academic landscape and the economy.

Features, including position specificity, career prospects, research productivity, collaboration development, non-academic options, and the commercialization of research, have been investigated by contemporary scholars. In this reading list, we offer some of the most cited, well-known,

and newest articles representing the latest surveys of postdoctoral issues. Earlier scientific works focus on the study of postdocs' backgrounds, their expectations and career prospects regarding different research fields and gender. The actual research of postdocs has moved from general to specific issues: postdoctoral research productivity, the commercialization of postdoctoral programs and postdoc technology transfer into the non-academic sector. Commercialization goals predetermine the necessity for the multiplicity of postdoctoral programs (startup postdoc program), the internationality of postdocs (scientific networks) and the improvement of postdoc support (supervision, mentoring etc.).

This reading list is a useful tool for the administrative development of postdoctoral programs at universities, and other research and non-academic institutions.

The papers listed below include unique autobiographical stories of postdocs published in Science and Nature. These authors, except for the paper by Nerad and Cerny, share their viewpoints and professional insights into different postdoc issues. Based on personal experience, the scholars represent the postdoc not only as an abstract subject, but also as a real living actor in academic society. Reported successes and failures of postdocs can help young researchers better plan their career and managers raise the efficacy of postdoctoral programs.

Shin, J. C., Jung, H., & Lee, S. J. (2020). Professional socialization of postdoctoral training among academics in South Korea. International Journal of Chinese Education, 8(2), 209–234. DOI: 10.1163/22125868-12340113

The postdoc as a short-term position envisions special conditions for the socialization of postdocs compared to long-term positions. Shin, Jung and Lee investigate postdoc professional identity. Using representative data from the Academic Profession in the Knowledge Society survey, the researchers conclude that "postdoctoral experiences are associated with research performance […] and their sense of belonging to their academic discipline; however, postdoctoral training is not associated with their sense of belonging to their affiliated institution".

Hayter, C. S., & Parker, M. A. (2019). Factors that influence the transition of university postdocs to non-academic scientific careers: An exploratory study. Research Policy, 48(3), 556–570. DOI: 10.1016/j.respol.2018.09.009

This survey explores postdoc options in the academic and non-academic labor markets. Universities are not the only employers of postdocs. Statistically the expectations of postdocs do not correspond to the number of vacant university positions. Postdoctoral fellowships should also prepare young researchers for non-academic jobs, giving them new knowledge and relevant entrepreneurial skills. The authors of the paper discover different individual, organizational, and policy factors influencing postdocs' decisions to pursue a non-academic career. The results provide a foundation for future research and policy action to enable this kind of transition.

Burston, M. A. (2019). The complexities of academic productivity: A case analysis of postdoctoral research productivity in Australian universities. Journal of further and Higher Education (in print). DOI: 10.1080/0309877X.2019.1612157

This survey about postdoctoral research productivity was initiated against the background of governmental criticism of Australian universities for their low proficiency. Commercialization and productivity are central topics in Australian higher education policy for funding distribution. The researchers concluded that the underperformance of the sub-sector was not caused by the commercialization value of the research output. The critique was based on the methodological problem in measuring the commercialization value of research outcomes. The survey provides methodology for the investigation of postdoctoral epistemic production which can be transferred to other national economies.

de Haan, U., Shwartz, S. C., & Gómez-Baquero, F. (2019). A startup postdoc program as a channel for university technology transfer: The case of the Runway Startup Postdoc Program at the Jacobs Technion–Cornell Institute at Cornell Tech. Journal of Technology Transfer (in print). DOI: 10.1007/s10961-019-09764-7

A team of scholars from Cornell Tech (NYC) introduces the innovative Runway Startup Postdoc Program, which focuses on a new postdoc track with academic and non-academic (entrepreneurial) parts. Established in 2014, the program is represented as an "effective channel for technology transfer" and a successful career option for postdocs. Differentiated from incubator and accelerator programs, postdocs get access to entrepreneurship training and university resources for research. Acquiring experience in startups, postdocs become "effective agents in commercializing their research".

Wong, V. S. C. (2019). Lessons from a postdoc gone wrong. Science, 363(6424), 314. DOI: 10.1126/science.363.6424.314

This paper is the personal story of a postdoc at Weill Cornell Medicine (NYC). Victor Wong summarizes his experience of postdoctoral training at the Canadian Institute of Health Research. The scholar compared postdocs with "guinea pigs" because every postdoctoral training is a unique case. At some point, a postdoc faces the most es-

sential question of whether to stay or to go. To make the right decision, Victor provides some tips and insights for the effective organization of the postdoctoral journey.

Woolston, C. (2019). Why a postdoc might not advance your career. Nature, 565(7737), 125–126. DOI: 10.1038/d41586-018-07652-y

Woolston highlights the relevance of postdoctoral training for the non-academic labor market. Based on two studies, he assumes that postdoctoral programs are focused on the development of skills for academic positions, but the majority of postdocs land outside the higher education sector. A potential employer illustrates that problem, saying postdocs "have all the academic science skills you don't need, and none of the organizational skills that you do". To avoid such a mismatch, the researchers suggest "teach[ing] postdocs entrepreneurial skills", so that postdocs become competitive for non-academic jobs.

van der Weijden, I., Teelken, C., de Boer, M., & Drost, M. (2016). Career satisfaction of postdoctoral researchers in relation to their expectations for the future. Higher Education, 72(1), 25–40. DOI: 10.1007/s10734-015-9936-0

This comparative study of two Dutch universities discusses the position of postdocs as it relates to their future careers. Given that the postdoc population is growing and that most postdocs are determined to remain in academia despite their restricted prospects, only few of them are preparing for a career outside academia. The authors highlight the importance of making postdocs more visible within their organizations, and the openness of career paths for postdocs outside academia. The authors claim that most important conclusion for the reader is that the duration of postdoc employment "approaching the length of the PhD trajectory (=48 months)" negatively affects postdocs' career satisfaction and prospects.

Powell, K. (2015). The future of the postdoc. Nature, 520(7546), 144–147. DOI: 10.1038/520144a

This article demonstrates the crisis in the postdoctoral system and possible ways to overcome it. Considering the important role of postdocs in driving scientific research and their low salaries, the author and her interviewees highlight a number of measures that are taken or might be taken in order to resolve this issue. One possible solution is to better reward postdocs. Another possible measure is to make postdoc positions fixed term. The size of scientific labs might also be reduced, and the position of a postdoc could be made harder to obtain. The article offers a number of tools for the administrative development of postdoctoral programs and demonstrates a personal story of how one life was affected by a constant change of position.

Scaffidi, A. K., & Berman, J. E. (2011). A positive postdoctoral experience is related to quality supervision and career mentoring, collaborations, networking and a nurturing research environment. Higher Education, 62(6), 685–698. DOI: 10.1007/s10734-011-9407-1

The authors observe whether such aspects as quality supervision and career mentoring, collaborations, networking, and the research environment influence the experiences and productivity of early career postdocs. They show an association between supervisor-postdoc relations and postdocs' future career development. This work raises awareness of the crucial contributions made by postdocs to the research output and the university environment.

Su, X. (2011). Postdoctoral training, departmental prestige and scientists' research productivity. Journal of Technology Transfer, 36(3), 275–291. DOI: 10.1007/s10961-009-9133-3

This research, based on a sample of US academic CVs from scientists and engineers, assesses the effect that postdoctoral training and departmental prestige have on postdoc research productivity. It is implied that the postdoc stage "boosts" one's research productivity during the first three years after receiving a doctoral degree, and then "fades quickly". However, "only scientists placed in highly prestigious departments demonstrate a consistently higher productivity level than their peers in other departments". The author concludes that the postdoc training experience combined with follow-up work in a prestigious department "are conducive to the presence of the accumulative advantage effect".

Åkerlind, G. S. (2005). Postdoctoral researchers: Roles, functions and career prospects. Higher Education Research and Development, 24(1), 21–40. DOI: 10.1080/0729436052000318550

This paper considers such issues as the employment prospects and career opportunities of postdocs, and the nature and duration of this position. The authors surveyed and interviewed postdocs and their supervisors; one of the findings was that postdocs view their position "as a career stepping-stone". Åkerlind distinguishes five types of postdocs, from those conducting independent research to those doing whatever is requested by the supervisor, including conference organization and website editing. Although the supervisors described postdocs as "enriching the intellectual life of their department", the lack of systematic postdoctoral career support and the bias against alternatives to academic career options remain a problem in postdoctoral professional development.

Melin, G. (2004). Postdoc abroad: Inherited scientific contacts or establishment of new networks? Research Evaluation, 13(2), 95–102. https://proxylibrary.hse.ru:2120/10.3152/147154404781776455

Studying a sample of Swedish junior researchers who had spent their postdocs abroad, the author focuses on the nature, meaning, and features of this period. Melin concludes that while choosing postdocs, researchers rely on established contacts, and existing scientific networks are developed in the process. However, these researchers still do not manage "to reach beyond the Western academic hemisphere during their postdoc periods" to explore new scientific environments.

Singer, M. (2004). The evolution of postdocs. Science, 306(5694), 232. DOI: 10.1126/science.1104916

Although the "postdoc problem" triggered some discussion and invoked measures such as the improvement of stipends and benefits, other issues remain unresolved, namely the lack of data about postdocs and using a number of peer-reviewed publications and strong track records, especially in building independent careers. However, some steps can already be taken, for instance, written appointment letters for postdocs, regular conversations between postdocs and PIs.

Nerad, M., & Cerny, J. (1999). Postdoctoral patterns, career advancement, and problems. Science, 285(5433), 1533–1535. DOI: 10.1126/science.285.5433.1533

This is the one of the first substantial surveys dedicated to the investigation of postdocs' career paths. The authors analyzed the results of the PhDs—Ten Years Later survey conducted among biochemical PhDs (86% of the interviewees) and mathematical PhDs (31%) who held postdoc positions. They found that the functions and meanings of the postdoctoral phase depend on the academic field and the researchers' gender. The results of the research might be helpful not only for those working in these fields, but also for administrative staff managing postdoctoral programs at universities as it is an example of a detailed analysis of various aspects of the postdoc position. It is concluded that university administrators should monitor the duration of the postdoctoral phase. The authors recommend the designation of a central authority for postdoc affairs.

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Contact info: E-mail: herb.hse@gmail.com
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