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Postdoctoral researchers: roles, functions and career prospects

Gerlese S. Åkerlind*
The Australian National University, Canberra, Australia

Concerns with postdoctoral research training and employment outcomes are growing at an international level. Recent studies of postdoctoral and other contract researchers in various countries emphasize common issues associated with these appointments, including the absence of any systematic definition of postdoctoral research positions, lack of policy and data on postdoctoral researchers, and increasing dissatisfaction among postdoctoral researchers with the nature of their position and with their future employment prospects. These issues are explored further in the study reported here, through an interview-based investigation of the views of both postdoctoral researchers and postdoctoral supervisors with regard to the nature of postdoctoral research positions and the career development support provided within those positions. Key findings include substantial variation in the functions of postdoctoral researchers, and in the perceived purposes of such positions. Despite a widespread perception among both postdocs and their supervisors of limited employment opportunities in academia or research positions, there was a consistent focus among both parties on the postdoctoral period as providing preparation for such positions.

Introduction

The nature of postdoctoral training and employment prospects for research-only staff has been a focus of increasing concern over the past decade, internationally and in Australia, where the study reported here was conducted. Throughout the 1990s, attention has been paid to major issues relating to postdoctoral training and employment outcomes, including:

1. the casualization of many research positions;
2. reduced career and employment opportunities for postdoctoral researchers;
3. appropriate means for delineating the stages of research careers; and

* Centre for Educational Development and Academic Methods, The Australian National University, Canberra ACT 0200, Australia. Email: Gerlese.Akerlind@anu.edu.au

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4. the provision of skills training mechanisms and career development support for postdoctoral researchers.

A special issue of the journal, *Science* (vol. 285, no. 3, September 1999), which focused on postdoctoral research conditions and employment, reported a system under stress in the USA, Canada, Japan and Europe. This view is supported by a small number of significant projects investigating postdoctoral training and employment issues that have recently been conducted in the USA, Canada, the UK and Australia, as outlined below.

Developments in the USA

In 1994 the Association of American Universities (AAU) formed a Committee on Postdoctoral Education to address a number of concerns about the '*ad hoc* evolution of postdoctoral education' in the USA. The Committee conducted three informal surveys of selected major research universities 'to gain insight into campus policies and practices governing postdoctoral education and to sample the views of postdocs'. The Committee reported an overwhelming variation in how postdoctoral education was conceived and a system-wide policy vacuum. Specific concerns of the Committee (AAU Report, 1998) were:

1. the steady growth in the number of postdoctoral appointments nationally;
2. the increasing number of postdoctoral appointees in their second, third, and even fourth appointment;
3. the widely held perception that the postdoctoral appointment is being used as an employment holding pattern;
4. the apparent transition, at least in some disciplines, of the postdoctoral appointment from an elective activity to a required credential; and
5. the growing number of reports of dissatisfaction expressed by postdoctoral researchers.

These concerns were reiterated in 1999 in the special issue of *Science*. The postdoctoral system in the USA was portrayed as being under great stress, with nearly 40000 postdoctoral researchers, a majority of whom are 'in a kind of limbo between student and independent researcher, without the status that their peers in other professions enjoy', with little job security and often low pay:

> Many [of the postdocs] are frustrated and annoyed at being asked to support a system that seems increasingly unable to generate secure, well-paying jobs. They complain that employers and funders, typically universities and the Federal Government, don't understand the pressures they face or, worse, think that the status quo should be preserved. (*Science*, Special issue, 1999, p. 1513)

A major longitudinal study of postgraduate career destinations in the USA has also found that postdoctoral appointments can become 'holding bays' rather than stepping-stones to continuing appointments in research (Nerad & Cerny, 1999). It seems that

postdoctoral positions do not necessarily guarantee career advancement in the higher education sector.

Developments in Canada

In Canada, concerns about working conditions and career prospects for postdoctoral researchers are parallel to those in America. In 1998 an interdisciplinary, national study of postdoctoral fellows in Canada, and of Canadian fellows abroad was undertaken (Helbing *et al.*, 1998). The study surveyed the 1996 population in relation to basic demographics, job stress, job satisfaction and work environment, and explored the employment outlook for this population. The key areas of concern identified by the study were:

1. the low value placed on postdoctoral researchers by institutions;
2. a lack of sufficient benefits;
3. low pay;
4. increased time in postdoctoral positions; and
5. concerns about career advancement.

The most significant source of stress among the researchers was uncertainty about future employment. Moreover, 70% of respondents felt that they had not received sufficient counselling for career planning. The majority of postdoctoral researchers in the study selected an academic teaching/research position as their first choice for an employment goal.

Developments in the UK

A 1996 White Paper, entitled *Realising our potential: a strategy for science, engineering and technology*, emphasized the need for more effective career management for contract research staff (CRS), of which a large proportion are postdoctoral researchers. This was seen as requiring combined action from both institutions of higher education and research funding bodies. A Research Careers 'Concordat' was agreed between relevant bodies (CVCP, 1996), with the aim of providing a framework for the career management of CRS in universities and colleges in the UK. In 1997, the signatories to the Concordat set up a Research Careers Initiative (RCI) designed to provide, among other goals, regular evaluation and progress reports on implementation of the Concordat.

Following the Concordat, the funding councils started distributing 'end of grant' questionnaires to staff who had been employed on research grants, and progress towards Concordat goals has been monitored in part through these surveys. In its March 2000 Report, the RCI summarized the results of three rounds of surveys administered between 1997 and 1999. The more favourable trends identified were:

1. a rise in the proportion of CRS receiving their university's policy statement on contract research staff, from 65% in 1997 to 72% in 1999;

2. a rise in the proportion of CRS receiving annual appraisals of their professional and personal development, from 43% in 1997 to 51% in 1999, and a decline from 12% to 7% in staff finding such appraisals *not* useful;
3. a rise from 21% to 30% of CRS receiving formal career advice from departmental colleagues;
4. an annual increase in the availability of training in transferable skills, such as communication skills, teaching, project management and information technology, as well as skills in areas specific to research work.

However, as some authors rightly contend, this level of change may be described as 'minimal' in impact (Bryson, 1999). In the 1999 'end of contract' survey, only 52% of CRS indicated that they had a definite position to go to after completing their contract. Bryson suggests that the low level of impact is because the Concordat does not include substantial sanctions for non-compliance.

Developments in Australia

In 1994, Australia's Department of Education, Training and Youth Affairs (DETYA) published the results of a study entitled, *The casualisation of research postgraduate employment* (Collins, 1994). This research showed that the proportion of contract employees in universities had increased from 28% in 1980–4 to 62% in 1991–3. Postdoctoral researchers were widely represented in the cohort, although other categories of contract employees were also included. There was a high level of dissatisfaction among the cohort with contract-based employment. Contract researchers expressed their concern about the stresses associated with the insecure nature of this work. They were also deeply concerned about what they perceived to be a rapidly contracting academic job market.

The challenges associated with career advancement for researchers were also highlighted by a 1996 study commissioned by the Australian Research Council (ARC), entitled, *Taking the lead: the ARC Fellowships Scheme in Australia* (Marceau & Preston, 1996). Disconcertingly, the study revealed that many research fellows were in their mid-to-late 30s and into their 40s, and few went on to join teaching and research institutions, government research organizations or industry. Similar to the 1994 DETYA study, two recurring themes emerged:

1. the insecurity associated with a research-only career; and
2. the scarcity of teaching/research positions to take up after research fellowships had been completed.

The ARC also commissioned a study entitled, *Waiting in the wings: a study of early career academic researchers in Australia* (Bazeley *et al.*, 1996), to investigate the challenges early career researchers face when pursuing academic careers. While this study explicitly excluded postdocs, defining them as pre-career researchers, the findings are of relevance. The study highlighted the shrinking academic job market and dissatisfaction among early career academics with the career structure in universities.

A government-funded Evaluations and Investigations Programme study, completed in 2000 (Thompson *et al.*, 2001), involved a nation-wide investigation of postdoctoral training and employment outcomes. It is from this study that the data reported in this paper are drawn.

Defining postdoctoral researchers

Research into the nature of postdoctoral positions is currently hampered by the lack of a consistent definition of postdoctoral researchers or agreement on the precise nature of the research population concerned. For instance, Marceau and Preston (1996) defined postdoctoral researchers as those in 'non-tenured research-only academic positions whose holders have a PhD or equivalent qualification'. Bazeley *et al.* (1996) defined 'early-career researchers' as those in the first five years of academic or research-related employment following completion of postgraduate (and postdoctoral) research training. So, postdocs in the traditional sense of the word were not even included in this study, being regarded as *pre-career* trainees. They were described as 'beginning researchers' who typically lacked training, experience and confidence in their work.

The study of Canadian postdoctoral fellows resulted in the creation of a Canadian National Postdoctoral Registry, defining postdoctoral researchers as 'those individuals holding a temporary, "soft money" research position after receiving a PhD, who are working toward establishing an independent research program'. The Registry includes researchers employed outside universities, in research institutes, industry and government laboratories.

The American Universities Committee on Postdoctoral Education identified the following characteristics as common to postdoctoral positions, namely that such positions:

1. require the recent award of a PhD or equivalent doctorate (e.g. ScD., MD);
2. be a temporary position;
3. substantially involve full-time research or scholarship;
4. adequately prepare someone for a full-time academic and/or research career;
5. *not* be a part of a clinical training program;
6. require the supervision of a senior scholar or a department/laboratory, etc.; and
7. provide the appointee with sufficient freedom and support to publish the results of his/her research or scholarship during the period of the appointment.

The absence of any systematic definition of postdoctoral researchers is also illustrated in the varying titles used for postdoctoral research positions, including research assistant/associate/scientist/fellow, postdoctoral assistant/associate/fellow and support staff. Furthermore, the same title may represent an academic appointment or a non-academic appointment in a university or elsewhere.

Summary of the context for this study

Until recently, investigation of the nature of postdoctoral research positions has attracted little research interest. The research that has been conducted is still of an

exploratory nature, and the findings are confused by a lack of clarity as to what constitutes a postdoctoral researcher and a postdoctoral research position. Nevertheless, a consistent theme that runs throughout existing studies is a concern for the reducing employment prospects of postdoctoral researchers, marked by a growth in the number of postdoctoral positions available; a reduction in the number of permanent academic positions available; an increase in the length of time individuals commonly spend as postdoctoral researchers; and increasing dissatisfaction among postdoctoral researchers with the nature of their position and with the career opportunities available to them.

These issues are explored further in the study reported here, through an interview-based investigation of the views of both postdoctoral researchers and postdoctoral research supervisors with regard to: the nature of postdoctoral research positions; and the career development support provided within those positions.

Study methodology

This study was conducted as part of a larger study of postdoctoral training and employment outcomes in Australia (Thompson *et al.*, 2001). The larger study involved a national survey of all identified postdoctoral researchers (PDRs) in every university in Australia. For the purposes of the study, a PDR was defined as: *a fixed term, research only Level A or B academic with PhD qualification* (Levels A and B represent career entry points into academia in Australia, based on a system-wide classification of academic positions from Levels A–E.) It should be noted that this definition excludes two categories of contract researchers which other studies may include—i.e. fixed-term researchers on academic appointments but without a PhD, and fixed-term researchers with a PhD but not classified as an academic appointment.

The questionnaire-based survey highlighted substantial variation among PDRs in their perceptions of the nature of their current position, plus substantial concerns about their future career prospects (see Table 1). The findings also confirmed that the large majority of PDRs aspire to an academic career (Table 2).

These findings form a background to the research reported here, which explored these issues in more detail using in-depth interviews with a sample of postdoctoral researchers selected from the larger survey, plus a sample of postdoctoral research supervisors. The results of these interviews are reported here. The interviews provided an opportunity to explore varying perspectives on the roles played by PDRs and the types of career support available to PDRs. Four key questions, in particular, were addressed through the interviews:

1. How are postdoctoral research positions conceived?
2. What are the career expectations of postdoctoral researchers?
3. What career and employment advice and support do they receive?
4. What training and skill development opportunities do they receive?

Table 1. Background information on PDRs in Australia (N = 1005–1010)

Field of research	% of total PDRs	Years since PhD (Mean)	PDR work supervised (vs working independently) (% respondents)	Number of PDR positions held (Mean)	Perception of L/T career prospects (1 = very poor; 5 = very good)
Math Sci	3.4	5.9	18.2	2.9	3.3
Phys Sci	6.7	6.1	24.6	3.0	3.0
Chem Sci	7.9	4.7	60.3	2.7	3.3
Earth Sci	5.6	5.5	18.0	2.8	3.0
Info/ComSci	2.2	4.9	31.8	2.6	3.9
Engin/Build	8.4	4.5	41.6	2.2	3.7
Biol Sci	25.4	5.5	31.1	2.7	3.2
Agric/Vet	6.7	5.6	26.6	2.5	3.3
Health Sci	20.4	6.0	30.6	2.8	3.2
Social Sci	7.8	3.9	24.2	2.4	3.7
Humanities	5.4	5.5	5.4	2.9	3.3
Total/average	100	5.4	30.7	2.7	3.3

Note:
Data compiled from Thompson *et al.* (2001), Tables 3.5, 3.7, 3.15 and 3.24.

The interviews were semi-structured, consisting of a series of core questions typically followed by additional questions seeking further information in response to interviewees' answers. In general, the interviews were of approximately 60 minute duration. The interviews were taped and transcribed verbatim, except in one instance where the interviewee preferred not to be taped. The transcripts were then content analysed for similarities and variation in response to the issues raised.

Table 2. Desired career destination

Ideal position	% respondents
Academic	73.3
teaching/research	(41.1)
research only (incl. PDR)	(32.2)
Government research agency or institute	7.7
Industry—research	7.9
Other	14.7
Undecided	6.4
Total	100

Note: Thompson *et al.* (2001), Table 3.20. For futher detail see p. 49.

The sample of postdoctoral researchers

A sample of 22 PDRs was interviewed, selected from those who completed a survey questionnaire. The interviews were conducted in late 1999 and early 2000. Interviewees were all selected from research-intensive universities in Australia. However, within these parameters interviewees were then selected as far as possible to represent the *variation* in the postdoctoral population found in the questionnaire data, with an emphasis on exploring the *range* of postdoctoral research experience. The PDRs interviewed varied along the dimensions outlined below.

Demographic variation within the sample

Institution
Located in five universities in four different states of Australia.
Gender
Male (12); female (10).
Age
25–29 (3); 30–34 (6); 35–39 (7); 40–44 (1); 45–49 (3); 50–54 (1); 55–60 (1).
Citizenship
Australian (15); other (7).
Research field
Mathematics (1); physics (2); chemistry (2); earth sciences (2); engineering (3); biological sciences (2); agriculture (3); health sciences (4); social sciences (1); humanities (2).
University where PhD awarded
Same university as postdoc position (6); other Australian university (7); overseas university (9).
Year in which PhD awarded
1999–2000 (5); 1996–8 (8); 1990–5 (4); 1985–9 (4); 1977 (1).
Term of appointment
12 months (3); 2 years (4); 3 years (8); 4 years (3); 5 years (2); no response (2).

The sample of postdoctoral supervisors

The sample of supervisors interviewed was also selected to enable exploration of the *range* of views of postdoctoral research. As there was no preceding survey of supervisors, and thus no collection of demographic information about supervisors, they were selected by asking those PDRs interviewed to suggest names of supervisors in their area. As a consequence, approximately half of the supervisors who were interviewed were currently supervising one or more of the PDRs interviewed. It is in the nature of postdoctoral research positions that several of the PDRs who were interviewed were also acting as supervisors of less experienced PDRs, and one was also interviewed on this basis.

While no supervisor who was approached declined to participate, some were not available during the suggested dates for interview, and others did not reply to the

email invitation to participate. Of those approached, five supervisors did not respond and four agreed to the interview but were not available at a suitable time. In total, 10 supervisors were interviewed, varying along the dimensions outlined below.

Demographic variation within the sample

Institution
Interviewees were selected from the same five universities as the PDRs.
Gender
Male (7); female (3).
Research field
Physics (1); chemistry (1); earth sciences (1); engineering (2); agriculture (2); health sciences (2); humanities (1).
Level of appointment
Professor (5, including 3 departmental heads); Associate Professor (3); other (2).
Experience as a supervisor
From 1 PDR over 1 year to 30 PDRs over 20 years.

Interview outcomes

PDRs' views of postdoctoral research positions

The PDRs interviewed showed both variation and consistency in describing their respective positions, that is variation within a limited range. The interviewees experienced their current position in three main ways with respect to career and employment:

1. As a stepping-stone or interim position towards a permanent or 'real' position;
2. As *being* their career, with ongoing contract research positions the nature of their career;
3. As an opportunity to engage in research, with career implications of lesser significance to them.

Each of these perspectives is described further below. However, it should be noted that a number of interviewees did not identify with the term, 'postdoc' or 'postdoctoral researcher'. Although they were classified as postdoctoral researchers based on the specified criteria, they distinguished between the position they occupied and what they saw as the traditional trainee-type postdoc position. In addition, even though all were on an academic appointment, they commonly did not speak of themselves as academics. 'Academics' were more commonly seen as people in combined teaching and research positions. The descriptions below are based on interviewees' views of their current position, irrespective of the title they personally used to describe it.

Postdoctoral research positions as a stepping stone. Interviewees who regarded their position as being an interim one, sitting between their PhD and a tenured post,

referred to their postdoc as a time of growth, development and learning. This represents the traditional view of the postdoctoral period as a time for broadening the skills developed during doctoral study and developing greater independence as a researcher:

> I guess I see it as a kind of [pause] almost but not quite as a real job! [Laughter] It is like a postgrad sort of thing. I see it as being an apprenticeship to an academic career, more than anything else. But it is also a real job; you get paid. So, I see it mainly as preparation for a research career. I guess, ideally, a postdoc is a time in which I get to spend all my time on research, and try to get some papers out and make contacts, learn more of the ropes, but also contribute to the university. (Male PDR in Engineering)

Viewing their position as a career stepping-stone was the most common description given among the PDRs interviewed, and was represented in all of the disciplinary areas included in the sample, except the Humanities (though this may be a consequence of the small sample size, as only one postdoc from the Humanities was included).

Most of these PDRs felt confident of getting another postdoc position after their current one, if necessary. However, few felt confident of making the shift to a tenured academic or other permanent position. Their major concern, career-wise, was that after the third postdoc it would become difficult to get further PDR positions, so the shift to a permanent position needed to have occurred before then. Additional career fears included concerns about being in an unproductive postdoctoral position, either now or in the future, where there were few opportunities to publish. This could occur for reasons largely outside their control, including the nature of the research project, whether they were working in a position of isolation or not, discord within the research group, lack of supervisor support, inappropriate supervisor expectations, etc.

Some of these PDRs, in their second or later appointment, felt that they had already gained as much research independence and breadth of skills as could be expected during the postdoc period and so they no longer felt engaged in further development, but were simply marking time—a category of PDRs that was also identified by supervisors.

Postdoctoral research positions as a career in their own right. Interviewees who saw ongoing contract research positions as the nature of their career were all engaged in either medical or agricultural research, with research funding available through a dedicated National Health and Medical Research Council (NHMRC) or government and industrial funding sources. These fields do provide opportunities for obtaining salary funding through ongoing research grants in a way not possible in other fields, at least in Australia. This places this limited group of PDRs in a very different context to others. Their view that there is the possibility of getting ongoing contract research positions for the rest of their working lives, even if there is no guarantee of doing so, contrasts with the view of many of the PDRs interviewed from other fields that ongoing contract research positions simply are *not* available:

> I guess in medical research, you do a PhD and then you do a postdoc position, and usually do a series of them … I know people of 55–60 who are still in postdoc research positions

> … So, I am now on a two-year appointment and applying obviously for other five-year ones. But many of us, especially the 40–50-year-old age group, are permanently postdocs as far as I am concerned. (Male PDR in Medicine)

Unlike other PDRs, who commonly associated a new postdoctoral position with a change in location, these postdocs seemed to expect that, as long as they could keep getting grants, they could stay in their current institutional or geographical location. So, in this regard, they experienced a greater sense of stability than many other postdocs, despite the shared insecurity about ongoing funding or employment. Not surprisingly, a primary aspect of their work as a PDR was to write applications for grants to continue funding their research.

In terms of career concerns, these PDRs tended to go through a regular cycle of concerns. Many had considered alternatives to postdoctoral research positions, especially when they had a failure in getting a grant for which they had applied. However, interest in alternative employment tended to diminish when new grants came through and rise again at the end of a grant or when there was failure to receive a grant. At this stage of their career, most of them felt well able to find alternative employment, but stayed in contract research positions because they valued the research. The biggest concern for this group was *not* that there were no alternative career paths, but that into their 40s they would become too old to make the shift, should a shift become desirable. If this coincided with failures in grant funding, their employment opportunities would be dire.

Postdoctoral research positions as a research opportunity. Among those interviewed, PDRs who viewed their positions primarily as an opportunity to engage in full-time research were all in funded research fellowship positions of some sort, in contrast to less prestigious grant-funded or institution-funded positions. Disciplinary areas represented in this group included Earth Sciences, Humanities and Social Sciences.

Despite the relatively prestigious nature of their appointments, these PDRs expressed uniformly strong pessimism about the chances of finding another position after their current one. They had chosen to take up their fellowships because of their commitment to research, not because they thought the fellowship would provide any career benefits:

> It means a chance to focus on some of my own research. And it means a job, because I'm not likely to have a career after it … I don't see what comes next. Theoretically, they [PDR positions] are for you to lead into academia or an academic appointment somewhere, but I don't see how at this point. (Female PDR in Social Sciences)

Sadly, given their pessimism about obtaining future research positions, these postdocs typically had difficulty identifying any other employment options that they would find acceptable.

Postdoctoral research positions: roles and functions

Running somewhat independently across the three ways of experiencing PDR positions described above, interviewees reported a range of roles and day-to-day duties.

At a broad level, the range of activities that most interviewees described as the basis of their PDR position can be summarized, in order of decreasing independence and responsibility, as:

1. conducting a research project independently, from the design to the write-up stage;
2. being a project or lab manager, where funding was obtained by someone else and the research goals determined by the project, but within that the PDR had complete independence and flexibility in decisions about research directions and the carrying out of the research; and
3. being a 'pair of hands' in the lab, where the supervisor and the project determined the nature of the research that was done—the role of the postdoc was simply to conduct the required experiments and analyses.

A sense of complete independence as a researcher was associated with PDRs appointed on funded fellowships or who had obtained their own research grant funding. This was possible across all disciplinary areas. Situations of lesser independence were associated with appointments funded by government or industry grants, typically representing lab-based disciplinary areas where the postdoc had been employed following funding approval and, thus, had not been involved with the original research design.

Two other types of PDR positions were also mentioned, though far less frequently. These positions were uniformly internally funded by the institution or department concerned, in contrast to the externally funded positions described above. Once again, they represent a broad spectrum of research independence, involving:

1. a dedicated opportunity to further develop the postdoc's PhD, by writing it up as a book, conducting additional analyses, etc.; and
2. acting as their supervisor's aide, a fragmented role where the postdoc did whatever their supervisor requested, including conference organization, website design, student supervision, etc., and their work was not tied to any particular project.

The sheer variation in roles and expertise encompassesd by the term, postdoc, was frequently commented on by PDRs and supervisors alike:

> Again, a postdoc position is a very broad term. It is quite a structure of classification in the university system. But I always wonder what a postdoc is, and how do you tell that someone is a postdoc? Because a postdoc is someone who has finished their doctorate and then worked in that area. So, when do you become not a postdoc? (Male PDR and supervisor in Agriculture)

Career development strategies: how PDRs further their careers

Not surprisingly, PDRs' sense of how to go about developing their career was variable. Some expressed confusion and uncertainty about it; others felt they had a clear idea of what to do but that there was no guarantee that their efforts would be

successful. For instance, the most common way mentioned of furthering one's career was to maintain a high publication rate and to publish in high-quality journals—a view echoed by supervisors. Yet, achieving this was *not* generally seen as ensuring career success. Some of the PDRs interviewed could list precisely the number of publications required to be in the running for either another PDR position or a more permanent position, but did not see this publication rate as any guarantee of finding a future position—again, a view echoed by supervisors.

Networking was mentioned by some as of potential value, both for getting future grants and for moving into another position. In addition, luck was seen as playing a major role in career and employment opportunities, for instance, whether an area of research was popular or not—something that could vary within short time scales of 2-5 years. The nature of the project, the supervisor, and the research group that PDRs were part of were also seen as key factors *not* always under their control:

> I took a two-year postdoc in London … When the job came up it was almost an ideal position for someone with my background and someone with my interests. The institute that it was at had quite a good reputation in the field … But I got over there and it turned out that I was the only person in the group, essentially. My boss was head of the clinical department. His input into the research was minimal. It was a case that he would notionally supervise research from afar … So, I thought I was well situated for a good postdoc period, and it was a disappointment … It was a learning experience, but if it doesn't come out on your CV in the form of publications, it has not been a successful period. (Male PDR in Medicine)

One of the interview questions asked postdocs about their expectations prior to moving into their current position and whether those expectations had been met. The only examples given of expectations *not* being met related to such unexpected difficulties, including a lack of awareness of the expectations that supervisors have of their postdocs, tense relationships between members of a research group and poor relations between different research groups. These were all seen as impacting on networking opportunities, among other impacts. The PDRs who mentioned these factors said that they had learned through experience to pay much more attention to these issues when choosing postdoctoral positions, rather than simply concentrating on the research reputation and productivity of the research group and supervisor that they were joining.

Far and away the most common career aspiration of the PDRs interviewed was to continue a research career or to move into an academic teaching and research position. However, the latter position was consistently seen as representing a move away from research, given that such positions, within Australia at least, notionally involve only 30% research. It is interesting to note that these positions were routinely described by PDRs as 'teaching positions' rather than as research positions or teaching and research positions. Related to this, a number of postdocs referred to the potential value of teaching experience for academic positions, though most still saw publications as the primary criterion.

Other career possibilities were mentioned, but far less frequently and mostly within the context of 'if all other options fail'. These included moving into industry or public

service positions, becoming a research manager or administrator, high school teaching, starting a small business, or a complete career change requiring further study and training. However, the PDRs interviewed consistently regarded themselves as *not* being very popular choices for these alternative careers. Few ideas were presented as to how to make themselves more desirable to potential employers, but developing management skills was one regularly presented possibility. However, one fear for these PDRs was that being employed, even for a short time, in any position other than a 100% research one (including academic teaching and research positions) would make returning to a research-only career impossible.

Supervisors' views of postdoctoral research positions

Supervisors talked about the nature of postdoctoral research positions and the role played by postdoctoral researchers from a dual perspective, that of their department (or lab group) and that of the PDRs themselves.

The PDR perspective. In terms of the PDRs themselves, the supervisors interviewed described the nature of postdoctoral research positions in two primary ways:

1. as a unique research opportunity—either as a time to concentrate on researching and writing in a way not possible at later stages of a career and/or as a time to follow research leads in a very open way, with fewer constraints than is possible later in their career; and
2. as an opportunity to develop, post-PhD—as a time when budding academics or researchers set up their bona fides, develop research independence, create a name for themselves, develop the ability to gain research grants in their own right and show whether they have the ability to move into a research or academic career.

These two views were related to a similar variation in whether supervisors saw the postdoctoral period as either the best time of a researcher's life or as an especially stressful and uncertain time. For instance, a few supervisors emphasized that one reason that people should not hold more than one or two PDR positions is because the level of research productivity and publication required of postdocs looking for a permanent position is not sustainable long term. The following two comments illustrate the variation in views:

> Well, it [a postdoc] is a luxurious, beautiful entity, where one is able to, by and large, focus on a specific research project. So that most of your field of view is occupied by the single task of performing research in a specified area … So, I say that it is luxurious in the sense that it is able to focus primarily on a single objective, and that is a rare thing for most people in their working lives, not to be pulled in multiple directions. (Male supervisor in Engineering)

> It actually is that really impressive corridor when you set up your bona fides and you show your stuff … They need a stick [as well as a carrot] to say, it doesn't come easy, you are

> allowed to be in the lab at 7.30 in the morning, and you are allowed to struggle there at 7.30 at night. It is quite acceptable … postdocs trade-off a lot. They are trading off money and position and contract and all sorts of things to show what they are capable of doing. (Female supervisor in Medicine)

As with the PDRs themselves, some of the supervisors interviewed distinguished between different types of postdoctoral positions, from "glorified technicians" who acted as the research hands of their supervisors to more independent PDRs who were seen as engaged in a collegial process of intellectual sharing. Some supervisors also emphasized that, irrespective of the title of someone's position, they could no longer truly be called a postdoc after a certain number of years in the position (described as somewhere between 2 and 5 years). After this time, even if the postdoc was not able to make the transition to a permanent position, these supervisors regarded them more as a research worker than a research trainee. Obviously, this perspective was very much tied to a view of 'true' postdoctoral positions as primarily developmental positions.

Asked about the optimal length of time to spend as a postdoc, most supervisors referred to a 3–5-year period involving one or two PDR positions.

> I mean, people generally, if they have done one postdoc or possibly two, they are generally looking at getting a permanent academic position between the ages of, say, 30 and 35. Mid-thirties is common. Once people start to go beyond 40, and they have maybe done three or four or five or more postdocs, potential employers might start to look at them and ask: Why haven't they had a position so far? Is there something wrong with this person? Or maybe they just don't have the quality, and they have managed to be hired, but they are not up to being a permanent member of academic staff. (Male supervisor in Physics)

In addition, as with the PDRs themselves, some supervisors talked about the disadvantages of holding two 2–3-year positions versus one 4–5-year position, due to the loss of time involved in setting up a new research project and the consequent reduced period of output and publication. There are also productivity losses associated with relocating, where this is required, and with having to search for new positions within a shorter time-frame.

The departmental perspective. At the departmental level, the supervisors interviewed described PDRs as playing a number of roles. Supervisors from all disciplinary areas described postdocs as 'enriching the intellectual life of their department'. In addition, for those working in laboratory-based groups, PDRs were seen as literally essential to the survival of the lab group, and thus the research, in a number of overlapping ways:

1. through providing access to the wide range of expertise needed to conduct scientific research;
2. by acting as day-to-day managers of the research lab;
3. by providing day-to-day and technical skills-based supervision of research; and
4. by conducting the coal-face research of using technical apparatus and gathering measurements, etc.

Employable skills of PDRs

Asked to describe the most employable skills or attributes that a PDR could have or develop, most supervisors emphasizd the importance of the number and quality of publications that they produced. Some were able to quantify just how many publications were required for a tenured academic appointment in their field—e.g. three publications (that is, first-author publications in international journals) from the PDR's PhD research and two publications for each year of their time as a PDR. For the PDR to turn their PhD into a book was mentioned in other disciplines. However, one supervisor emphasized that the type of research project that the postdoc was working on would have a big impact on their ability to produce publications at the rate required. For instance, industry-funded projects could be confidential, and thus not publishable, or the project more orientated to applied outcomes than research outcomes.

Giving presentations at conferences, especially international conferences, was also mentioned several times, and one supervisor summarized all of this as 'developing a profile' and demonstrating independence as a researcher. Other skills that were considered important for future employment included teaching experience, technical skills and experience with different scientific instruments, although these were mentioned far less frequently. However, as indicated earlier, the publications, presentations and skills that were mentioned by supervisors were *not* seen as providing any sort of guarantee of employability, in other words, they were seen as a necessary but not sufficient condition for academic employment.

Although not explicitly asked to focus on academic or research careers when discussing employable skills for postdocs, it was clear that this was the immediate focus of most supervisors. However, a number also acknowledged alternative career possibilities for PDRs, though the context in which they did so varied—some saw non-research or non-academic employment as a sign of failure, some as a sign of the times and some as a legitimate career choice. None the less, no particular employable skills or attributes were emphasized by the supervisors for non-academic or non-research careers, except for one supervisor who mentioned that, for industry, the production of services rather than publications would be valued as an outcome of applied projects.

Employment and career support for PDRs

Having described the main employable skills and attributes of postdocs, supervisors were then asked how they supported their PDRs in developing or acquiring these skills and attributes, plus any other forms of employment or career support that they provided. The range of support mentioned included:

1. direct support for finding another position—e.g. by bringing new positions or grants to PDRs' attention, or by mentioning PDRs to people with jobs available;
2. providing opportunities to develop additional skills, such as undergraduate teaching, supervision of research students, grant writing, and attendance at skill development courses and academic conferences;

3. enhancing PDRs' research productivity and profile—e.g. by encouraging them to speak at conferences and putting them as first author on publications; and
4. general advice, support and networking.

Many of these career support activities occurred in an *ad hoc* way. Indeed, a couple of supervisors emphasized the individual nature of the support required, depending on the individuals concerned. In all but a few cases, the lack of any form of structured career support was apparent:

> I think that supervisors tend to have too much power and too much control … It depends very much on the supervisor how much freedom the supervisor gives in running a lab and whether the supervisor treats the postdoc as an equal colleague as opposed to just a slave … the majority of postdocs, they are tied to a particular grant and project and that is their job. However, I always tell them that as far as I am concerned—and this is never documented anywhere for obvious reasons—that only takes up 80% of their time. As far as I'm concerned, I give them 20% freedom to do anything that they like. But that is me. It doesn't mean that that is normal practice. (Male supervisor in Engineering)

The *ad hoc* nature of many of the support activities mentioned by supervisors meant that it was entirely up to each individual supervisor as to whether they provided such support. In fact, a number of the activities mentioned by supervisors were also explicitly mentioned by some of the PDRs interviewed as areas where they would have liked support, but had *not* received it, or areas where they felt their supervisor had actually blocked their career advancement. For instance, one interviewee referred to his supervisor's refusal to allow any work time to be devoted to grant writing as being an active career impediment; another referred to the postdoc period as a time of *de*skilling, due to the limited range of activities that she could engage in and the consequent dating of her previous experience.

Other factors that prevented interviewees from taking advantage of some of these opportunities included uncertainty about the responsibilities of supervisors with respect to PDRs. This lack of clarity inhibited some postdocs from approaching their supervisors for discussions of either career or research issues. A number added that as PhD students they had felt less inhibited than as PDRs because the role and responsibilities of supervisors had been clearer. In addition, a sense of isolation, reported by many of those interviewed, often impeded opportunities for career discussions with colleagues other than their supervisor. Interviewees frequently mentioned a lack of opportunities to mix with others in their department or area, even when they belonged to a lab group—at least, where the lab group was small or marked by personality difficulties. Identifying other PDRs for peer support was mentioned as a particular difficulty, as they were rarely identifiable from staff lists:

> I have tried to find out where they [fellow PDRs in the university] are and who they are. I can't! I used the University database. I used the phone book. I checked the grants given out by DETYA. (Male PDR in Geology)

A number of the PDRs indicated that their career was already too far in train for career advice to be of much value at this point. The time when they would most have

appreciated career guidance was towards the end of their PhD rather than at the post-doc stage—an opinion also expressed by some supervisors.

With respect to skill development opportunities, in particular, freedom to take advantage of such opportunities depended primarily on receiving support from PDRs' supervisors. Required support was in two forms: support for the *time* taken to spend on such activities (that is, time taken away from the research project *per se*), and *financial* support for fee-based events, such as externally provided workshops, conferences and courses. While PDRs on funded research fellowships or those acting as independent project managers for their supervisors did *not* feel obliged to seek permission to either engage in or pay for such developmental activities, they still faced the issue of deciding whether they could afford the time away from their designated research project.

Discussion

The results of this study highlight key structural and cultural issues limiting potential employment outcomes for postdoctoral researchers:

1. Substantial and often unacknowledged variation in the nature of a postdoctoral position, including the lack of formal distinction between early-career postdocs and long-term research workers;
2. Training and career support that is unstructured and *ad hoc* in nature;
3. Career support orientated primarily towards academic and research-only careers;
4. The representation of alternative careers as a career failure; and
5. The key transition in perceived employability after 5–6 years as a PDR.

The absence of any clear consensus as to what constitutes the nature and functions of a PDR was apparent in the interviews. While supervisors typically described PDR positions in ideal terms, as an opportunity to focus on research in a way not possible later in one's career, or to develop one's research skills and profile post-PhD, PDRs themselves described duties and positions which varied substantially in nature. The implications of such variability for PDR training and career support are aggravated by the lack of formal acknowledgement of the situation, although some supervisors acknowledged a reality in variation with the ideal they had described.

In addition, the interviews highlighted a widespread lack of systematic institutional policies and structures for postdoctoral training or career support. Most of the skill development and career support opportunities and assistance described were *ad hoc* in nature, and what did occur relied mostly on the initiatives of PDRs themselves and/or concerned supervisors, as individuals. Furthermore, even where a PDR attempted to be proactive in progressing their own skill development and career preparation, their ability to put initiatives into action was often dependent upon the support or agreement of the individual supervisor concerned.

Another concern was the almost uniform focus in the interviews on preparation for an academic or a research-only career, despite perceptions of limited employment opportunities in these areas. While some supervisors and PDRs did mention

alternative options to an academic or research career, they did not necessarily perceive PDRs as popular choices for such positions, nor did they have a clear sense of how the transition from a PDR position to such careers is made. The simple reality is that most supervisors of PDRs, being in academic or research-only positions themselves, are inevitably poorly equipped to provide career support which goes outside such positions.

Even more significant than this *lack of* information and support for career options other than academic or research-only ones is the ingrained *bias against* alternative career options in an environment of reducing academic employment opportunities for PDRs. There is a widespread perception among both PDRs and supervisors of such career outcomes as representing a career failure. This is an almost inevitable consequence of the structural and cultural constraints that frame postdoctoral research. PDRs have spent many years working in an academic or research-only setting, first as doctoral students and then as postdoctoral researchers, supervised and mentored by people who have themselves chosen an academic or research-only career, and surrounded by like-minded peers. It seems unavoidable that, in this setting, the great majority of PDRs would come to identify professionally with an academic or research-only career, and see any deviation from this as a career disappointment (Antony, 2002). As long as postdocs are trained by academic researchers in an academic research setting, it seems inevitable that they will continue to aspire to academic and research-only careers.

The structural problems described so far act to interfere with the progression of PDR training and employment outcomes at a national and international level. Appropriate policies and procedures are difficult to implement without an explicit acknowledgement of the varying nature of PDR positions. One thing that is clear is that the substantial variation in PDR positions means that uniform policies would not be appropriate. Different types of PDRs need to be distinguished and treated differently. This is especially true at the level of PDRs in their first 5 to 6 years of appointment versus longer-term PDRs.

There also needs to be active encouragement and support for career alternatives to academic and research-only careers. However, not in a simplistic way. For instance, a frequently suggested remedy to the situation is the simple introduction of broader training and skill-development opportunities for postdocs, in order to broaden their marketability. I would still support this suggestion, because it would be of value to the minority of postdocs interested in non-academic and non-research careers. However, for the majority, such opportunities might help with employment, but are unlikely to assist with a sense of career success or satisfaction. Indeed, most PDRs are unlikely to be even interested in taking advantage of such options, should they be available, unless they have already reached a state of pessimism about their future career. This is all in addition to the conflict faced by postdocs over time taken away from their current research work to engage in skill development, because successful completion of their project and publication of research outcomes is still perceived as the most significant factor in achieving career success.

Consequently, I conclude that one of the most viable options for ameliorating the situation for PDRs lies in the *pre*-postdoc stage, that is when potential PDRs are still

doctoral students, or even earlier. A number of those interviewed as part of this study suggested that they would have appreciated career advice as a PhD student more than as a postdoc. I can only concur. The presentation of broadening skill-development opportunities, information about the proportions of PhDs and postdocs following various career avenues, and attempts to reduce the socializing effect of being immersed in an academic research setting would all be better introduced earlier than later. Indeed, the PhD stage is likely to already be too late for many. This raises the option of compulsory career counselling prior to admission to doctoral candidature, an option that seems well worth exploring given the entrenched nature of the career forces operating on PhDs and postdocs.

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