

From apprentice to colleague: The metamorphosis of Early Career Researchers

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Abstract While the studies of Early Career Researchers (ECRs) have contributed politically important insights into factors hindering ECRs, they have not yet achieved a theoretical understanding of the causal mechanisms that are at work in the transition from dependent to independent research. This paper positions the early career phase in a theoretical framework that combines approaches from the sociology of science and organisational sociology and emphasises the transitional process. In this framework, the early career phase is considered as containing a status passage from the apprentice to the colleague state of their career in their scientific communities. In order to capture the mechanisms underlying this transition, it is important to analyse the interactions of these careers as they unfold over time. The usefulness of this approach is demonstrated with a pilot study of Australian ECRs. We show (a) that misalignments of the three careers stretch the transition phase; (b) that the two major factors affecting the transition are a successful PhD and a research-intensive phase prior to normal academic employment; and (c) that the most important condition hindering the transition is the lack of time for research. It can be concluded that as a result of a ‘market failure’ of the university system, the transition from dependent to independent research is currently being relocated to a phase between the PhD and the first academic position.

Keywords Career theory · Scientific careers · Early Career Researchers · Scientific communities

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Beyond compassion: The missing causes and effects of the Early Career Researcher problem

The growing literature on the problems of early career academics indicates that they constitute the most vulnerable group in the science system and are therefore the first to suffer from the stress that has befallen this system, i.e., from the emergence of ‘steady state science’ (Cozzens et al. 1990). Worrying reports about the early careers of those who stay in academia after obtaining their PhD have been accumulated in several countries, from a variety of perspectives, and with foci on different groups such as postdoctoral (full time) researchers and early career (research and teaching) academics. Apart from the fact that the national science systems ascribe different functions to postdoctoral research, the studies revealed two major problems:

- (1) The duration of postdoctoral research employment is increasing due to a lack of permanent academic positions.¹ This trend is regarded as particularly problematic in the USA, where the educational function is undermined by the transformation of postdoctoral employment into a ‘holding pattern’ (NRC 2005: 4). A similar trend of worsening career prospects for postdoctoral researchers has been found in other countries, e.g., Australia (Thompson et al. 2001; Åkerlind 2005) and the UK (Roberts 2002, Chap. 5).
- (2) According to funding statistics in the US and Australia, early career academics face below-average success rates, which is partly due to raising expectations on grant applications (NRC 2005: 102–103). An Australian study found that success in the competition for external grants depends not only on the systematic disadvantages concerning the track record, but also on the motivation of an ECR to do research and on working conditions such as time constraints resulting from teaching and administrative loads, access to internal grant schemes, and integration into research teams (Bazeley et al. 1996; Grbich 1998; Bazeley 1999, 2003).

While reporting grave problems of a specific career phase, both types of studies have in common that they report an unconnected link of an unknown causal chain. If the causes of the worsening research situation of early career academics are linked to funding and time constraints, they are not different from those of other academics, and it is difficult to see why the effects—worrying career prospects and below-average access to funding—should be important beyond general considerations of fairness. This cannot be all. And indeed there has been one tentative reading of the signs that sounds much more serious, namely the idea that the early career phase contains the transition from dependent to independent research. The above-mentioned finding that the postdoctoral period appears to turn into a ‘holding pattern’ of ‘normal’ employment for scientists who cannot find a permanent position indicates that the problems of the early career phase could be much more alarming. They point out that the ways in which future researchers are created are becoming warped, a process that may indeed have grave consequences for any national science system. For example, a study in the US suggested that the major purpose of the postdoctoral phase, namely providing Early Career Researchers (ECRs) with ‘skills and experiences that will help foster their transition to independence’, is in danger of being lost (NRC 2005: 4).

¹ See Zumeta (1985), Nerad and Cerny (1999), Stephan and Levin (2001: 682–683), and the reports of the Committee on Science, Engineering, and Public Policy (COSEUP 2000) and by the National Research Council (NRC 1998, 2005).

The notion of a transition from dependent to independent research also indicates the reason why previous studies have been so sparse in their consideration of causes and effects of the situation they bemoan. Owing to their roots in organisational sociology and to their weak links to the sociology of science, traditional career studies are focused on positions in organisations and neglect the embeddedness of academic careers in the production of scientific knowledge. They are therefore not able to identify the consequences of changes in careers for the production of scientific knowledge. From the perspective of knowledge production, the early career phase of academics engaged in research covers a crucial transition, namely the transition from dependent to independent research. This transition takes place in the social context of scientific communities rather than the organisational context. It is strongly affected by the organisational context, but is equally strongly dependent on the evolution of an academic's research.

The aim of our article is to introduce two interrelated innovations to the discussion of ECRs, a category in which we include *all academics whose work tasks include a research role*. Firstly, we apply a complex perspective on academic careers, which combines an academics' history of knowledge production, their movement through social positions in scientific communities, and their movement through organisational positions. Secondly, we supplant the synchronous perspective applied in connection with large-scale quantitative surveys by a historical perspective that is able to include the prehistory and history of the transition period. These innovations are applied in a pilot study that demonstrates how misalignments of the three careers affect the transition period.

Approach

Theoretical background and variables

The focus on positions in organisations that characterises research on academic careers comes at the price of entirely neglecting scientific communities (e.g., Bowden 2000; Huisman et al. 2002; Robin and Cahuzac 2003; Gaughan and Robin 2004) or assigning them a secondary role—as 'context' of the organisational careers of academics (Duberley et al. 2006), as communities in which the identities of academics develop (Henkel 2004) or as a 'key driver' of the (organisational) careers of a few 'impassioned' scientists (Mallon et al. 2005). This is a high price indeed because scientific communities rather than the organisations that employ scientists are the primary social context of knowledge production. These knowledge-producing collectivities are usually dispersed across many organisations and countries. Their members advance a common body of knowledge by interpreting the existing knowledge, identifying gaps in that knowledge and defining tasks to fill these gaps for themselves, conducting these tasks, and offering the new knowledge they have produced to their community by publishing it. Thus, in the case of research work the scientific community is the source of tasks and standards of conduct as well as the target of contributions, i.e., it fulfils all the main functions of the work organisation except for providing salaries and resources for the work (Gläser 2001, 2006).

This insight is not new to higher education research, see e.g., Clark (1983: 28–34) on 'disciplines' as the 'primary mode' of work in higher education. It has not, however, been consequential in higher education research because the latter traditionally focuses on universities, i.e., on the formal organisations. The endogenous dynamics of the 'primary mode of work'—research—and its social context—scientific communities—are viewed

only through the organisational lens and thereby construed as a set of seemingly unconnected peculiarities of academics and their work.

The unique relationship between an employment organisation and the social collective that conducts the work ‘of this’ organisation is indeed responsible for many of the peculiar features of academic careers. To understand them we must understand scientific communities, which show many of the features of a profession but are significantly different from them in that scientific communities are their own ‘clients’, i.e., sources of tasks and recipients of results. This is why researchers are further decoupled from their employment organisation than ‘normal’ professions. However autonomous a profession might be (see e.g., Scott 1965 on ‘autonomous professional organisations’), the work conducted by professionals in an organisation is work *for* the organisations, for goals set *by* the organisation. This relationship can be applied to the teaching role of academics in universities but not to research.

Building on insights from the Chicago School of Sociology (Barley 1989), on research on professional careers (Dalton et al. 1977; Zabusky and Barley 1997), and on recent extensions of career theory (Parker and Arthur 2000) we propose to regard the academic career as consisting of three interrelated but largely independent careers (see Gläser 2001):

- (1) All researchers create a ‘research trail’ (Chubin and Connolly 1982), which consists of the research processes they are involved in during their career. Since most of these processes partly build on previous research, they form a diachronic structure that gradually extends the researcher’s knowledge base. The iterative construction of a research trail by proceeding from one project to the next is the *cognitive career* of a researcher. An important peculiarity of the production of scientific knowledge is that the content of an individual’s research has a career of its own, which is characterised by continuity, growth, and interactions with the social careers in the contexts of the scientific community and of organisations.
- (2) The participation of academics in the knowledge production of their scientific communities can be regarded as a sequence of role bundles that are very similar to jobs even though no contracts between a community and its members exist. Thus, academics who are engaged in research go through a *community career* in their scientific community. Adopting the proposal of a four-stage model of a professional career by Dalton et al. (1977) we distinguish four stages of an academic’s career in their scientific community:
 - an *apprentice* learns to conduct research while working under the direction of others;
 - a *colleague* conducts independent research and contributes the results to their community’s knowledge;
 - a *master is a colleague* who additionally acts as a mentor for apprentices; and
 - a member of the *elite* additionally shapes the direction of the knowledge production of their community (see for this stage Mulky 1976; Laudel 2005).
- (3) The material basis for research (salaries for researchers and resources for conducting research) is provided by research organisations (research institutes, universities, firms, etc.). By moving between jobs offered by these organisations researchers go through an organisational career whose stages are linked to specific performance expectations and research opportunities. The main purpose of organisations is to equip parts of scientific communities with the resources they need for conducting research (salaries for academics, infrastructure and resources for research). Task definition, conduct of work, and integration of results take place in scientific

communities. Organisations therefore merely ‘host’ scientists who in turn ‘rent’ places in organisations to contribute to the knowledge of their community (Sørensen 1992: 94–96; Clark 1983: 28–34; see also Mallon et al. 2005: 402, who wrongly limit this feature to the career of the ‘impassioned scientist’).

The three careers are linked in a complex pattern of interactions. The cognitive career depends on the community career because knowledge acquisition as well as opportunities to conduct research, to collaborate, and to communicate partly depend on the status acquired in the community. It also depends on the organisational career because organisations provide local work environments consisting of material resources, locally stored knowledge, research support, and colleagues (Gläser 2006: 85–87). Interorganisational mobility, which is an important feature of many academic careers, moves academics between these local working environments, thereby giving them the opportunity to absorb local knowledge and ‘using’ them to transmit knowledge between local work environments. The community career must provide the reputation that is necessary to be hired by organisations, and the organisational career must provide the opportunities to pursue the community career.

While empirical research has not shown a clear link between the ECR phase and a specific *organisational* position, our theoretical considerations suggest that there is a distinct status passage in the *scientific community* that occurs in the ECR phase, namely the passage from apprentice to colleague and the corresponding transition from dependent to independent research. The mode of knowledge production in a scientific community requires that the members of the community define their tasks and the ways in which they are conducted autonomously. This means that a colleague—a ‘full member’ of a community—is able:

- To assess the relevance, validity and reliability of the community’s body of knowledge and of the contributions offered by fellow members in their publications;
- To acquire valid and reliable knowledge that is deemed relevant for their work;
- To identify gaps in that knowledge and to formulate research questions concerning these gaps;
- To assess their capabilities and opportunities to answer these research questions;
- To conduct the work necessary for answering the research questions, which may include collaborating with other researchers; and
- To publish the results in a way they can be adopted by their scientific community.

The transition to a colleague who meets these role expectations is a significant qualitative change because it implies a step into a role-set whose foremost attribute is autonomy. This is an enormous challenge because the new colleague’s knowledge base is still comparatively small, and they may never have formulated a research question on their own.

To understand the transition from apprentice to colleague we need to analyse the interaction of all three careers of the ECR (see Fig. 1 for the main variables). The community career in the transitional phase is shaped by the ‘colleague’ role expectations. The ECR is expected to have produced a contribution to the community’s knowledge at the colleague level (with her PhD thesis), albeit with support from a mentor. After their PhD ECRs are expected to produce contributions of the same type on their own, thereby developing their individual research trails characterised by continuity, increasing breadth, and growing collaborations that are characteristic for their field. Owing to our interest in the transition period we need information about reasons for the continuation of research on the PhD topic and for the emergence of new topics that either supplement or supplant the PhD topic. The extent to which these role expectations are met is expressed by the research

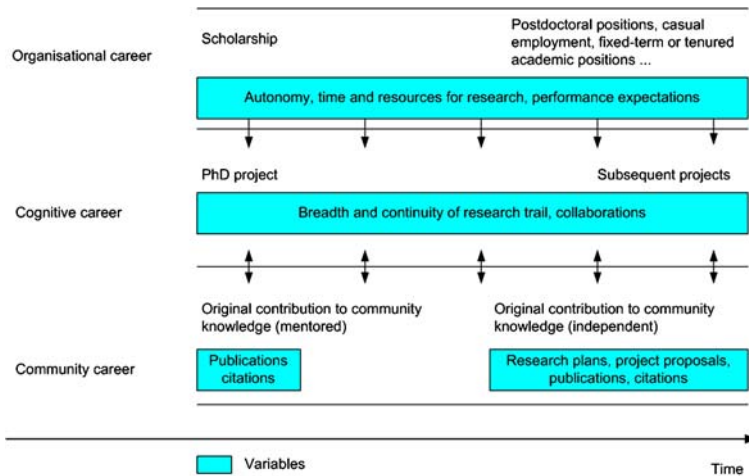


Fig. 1 Variables describing the transition phase in the three careers

output (publications and their reception by the community) of the PhD project and subsequent research, and by the research plans and project proposals after the PhD project.

The organisational career of an ECR creates the institutional and material conditions for research. The opportunity to become an independent researcher primarily depends on the opportunity to make autonomous decisions on research, the time the ECR can spend on research, the resources provided by the organisation and the performance expectations concerning research. The individual employment patterns may also include periods in which no research can be conducted (unemployment, childcare, or other interruptions of the career).

The progress of an ECR's three careers is influenced by other factors that must be considered in the investigation but are not contained in the diagram. A *researcher's traits* include their research capability, their research goals and their interests in pursuing a research career. Other influences encompass *field-specific characteristics*. These characteristics influence the resource demand of a researcher, the usual time-span for conducting a project in a certain field which in turn is determined by the research objects and methods ('Eigentime'), the need for collaborators and so forth. Another variable shaping the careers of ECRs describes whether they have *collaborators*. Finally, in this career stage, academics at the master stage of their career who act as *mentors* might play an important role for the transition.

Case selection

In order to identify causal mechanisms, variations of causes and effects need to be observed. This means that we must compare ECRs with different career patterns (sequences of jobs), from different scientific communities (fields) and in different organisations in order to ascertain the role of the different variables in shaping their careers. The study presented here uses data collected in an ongoing investigation of the impact of evaluation based funding on Australian university research (Gläser and Laudel 2007).

The 'Catch 22' of investigating the transition phase is that we must already know the data in order to decide who to investigate. Political measures aimed at the promotion of ECRs circumvent the problem by defining a period of time after the PhD in which

academics count as ECRs. The time spans vary between 5 years for grants of the Australian Research Council (ARC 2007), 6 years for the US Sloan Research fellowships (Alfred P. Sloan Foundation 2007) and 7 years for the 2008 British Research Assessment Exercise (RAE 2005). Bazeley tried to take into account the employment situation, assuming that a researcher's early career can be hindered by casual or non-research related jobs.

An Early Career Researcher is one who is currently within their first 5 years of academic or other research-related employment allowing uninterrupted, stable research development following completion of their postgraduate research training. (Bazeley 2003: 274)

This definition resembles the science policy measures in that it arbitrarily sets a time-span of 5 years. It also rests on the assumption that 'academic or other research-related employment' allows 'uninterrupted, stable research development'. We will demonstrate that this assumption is too optimistic.

Since it is impossible to identify the status passages of a researcher prior to the data collection, the case selection must resort to imprecise indicators such as the time when the PhD was granted. Thus, we selected from our material all interviews with academics who had finished their PhD within the previous 8 years, thereby casting a wider net than previous studies. A total of 16 interviews with so-defined ECRs from six Australian universities and six fields in the sciences, social sciences and humanities were included (Table 1).

Data collection

Studying the causal mechanisms that shape careers requires analysing the interactions of a researcher's three careers over time. There seems to be no alternative to biographical interviews as the main method for collecting data in such a diachronic approach. Only by using biographical interviews we can capture the dynamics of the cognitive, community and organisational careers of the researcher in their unique combination.

Since our study is a secondary analysis we had no choice but to draw on data from the semi-structured interviews conducted in the main study. Therefore some of the information (particularly on the PhD phase) remains patchy. However, parts of the interviews had a biographical focus. We asked the interviewees how their research had developed since their PhD and about changes in their research since they joined their current university at the time of the interview. We also inquired about the history of specific projects. The following parts of the interviews are relevant for the study of ECRs:

Table 1 Distribution of the 16 ECRs across fields

Field	Number of ECRs
Physics	2
Mathematics	1
Biochemistry	3
Geology	3
Political Sciences	4
History	3
Total	16

- research topics conducted since the interviewee joined the university and their epistemic characteristics, reasons for selecting and abandoning certain topics, collaborations;
- previous positions and the opportunities for research they provided;
- funding needs and funding obtained for the more recent project(s); and
- current position and conditions of work such as time for research, teaching loads, and the degree of autonomy.

Interviews were prepared by collecting information from the internet (on research topics, grants, collaborators, and publications), and by bibliometric analyses of the research trails of interviewees. For each interviewee, publication information was downloaded from the ISI Science Citation Index, Social Science Citation Index, and Arts and Humanities Citation Index of Thomson Scientific’s Web of Science. Detailed bibliometric analyses of the publications were conducted in order to identify topical changes, trends in publication behaviour, and the researcher’s international visibility. We constructed individual publication and citation profiles. A major instrument that was used was the interviewee’s ‘bibliometric research trail’. Self-citations and bibliographic coupling of the interviewee’s publications were used to construct a network of interlinked publications (Fig. 2). In fields with insufficient ISI coverage (political science, history, and partly geology), we retrieved publication lists from the internet and constructed the network on the basis of similarities in the title keywords. The so-constructed ‘bibliometric research trail’ was presented to the interviewees and discussed with them in the interview. The ISI databases were searched for citations to the publications. In the case of political scientists and historians, where the ISI databases are of limited use, we also considered publication types (journal articles, books,

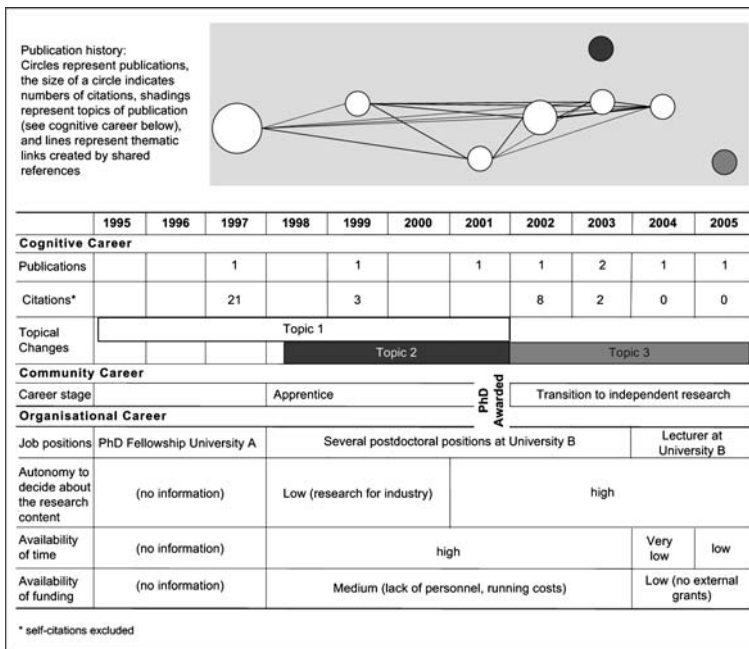


Fig. 2 Career profile of a researcher and main influencing conditions (example)

and book chapters versus conference papers and unpublished reports). Additionally we searched for national and international reviews of books.

Data analysis

The interviews were tape-recorded, fully transcribed and analysed using a method of qualitative content analysis (Gläser and Laudel 2006). Information about the variables described above were extracted from the interviews. We reconstructed the cognitive, community and organisational careers of each researcher from the interview and bibliometric data, and identified major changes in the variables. This led to a schematic history of the three careers that combined information about the cognitive career (topical continuity and breadth), the community career (publications and authorship patterns, citations), and the organisational career (autonomy, time for research, resources).

Figure 2 shows an example of the career profile and the condition profile. By arranging all this information on one time-scale, interactions between the three careers and the conditions of action are revealed. For example, the academic whose career is depicted in Fig. 2 shows desynchronised community and organisational careers. The ‘postdoctoral phase’ began 3 years before the PhD was awarded.

The analysis of transitions from dependent to independent research requires identifying the point at which this transition has been completed. This is the most difficult decision of all. The NRC study on ‘new investigators’ in the life sciences has characterised the ‘independent investigator’ as one ‘who enjoys independence of thought—the freedom to define the problem of interest and/or the approaches to solve the problem’ (NRC 2005: 26). This characterisation defines independence in organisational terms because it reduces the problem to the autonomy granted by the environment and neglects the investigator’s *abilities* to define problems and approaches. This ability is an aspect of the cognitive career, and the status acquired with it belongs to the researcher’s community career. We therefore used the following indicators in deciding whether somebody has achieved the state of an independent researcher:

- Selection of research topics: How did the research questions after the PhD emerge? Does the ECR pursue long-term research interests? Is the topic self-selected or was it suggested by colleagues/collaborators?
- Publishing of the research following the PhD: Was it published at all? Where was it published? Does the ECR publish independently, i.e., without the former supervisor?
- Perception by the Scientific Community: How is the research perceived by the national and international scientific community?
- Competitive research funding: Funding agencies often have high expectations about the research concept outlined in the funding proposal; hence a successful grant application can be considered an indicator for achieving the ‘colleague’ stage.

These indicators were interpreted on the basis of background knowledge about field-specific characteristics such as the ‘Eigentime’ of projects, publication and citation cultures, resource requirements of typical research processes in the field; and the competitiveness of university grants and external grants. This information was obtained in the context of the larger study in interviews with approximately 20 academics from each field and managers from the six universities.

Results

Community careers: Apprentice or colleague, or neither?

The tables in the appendix contain a summary of key information from our 16 cases. Our definition of ECRs as academics whose work roles include research implicitly suggests that all ECRs move from the apprentice to the colleague stage. After all, this is the organisational expectation tied to the standard academic ‘teaching and research’ employment relation. It is also difficult to imagine the alternative case of life-long apprenticeship. Contrary to this expectation, our data suggest that apprentices fade out of their scientific community by either abandoning research or conducting dependent research, i.e., supporting the research of others who are visible as colleagues.²

All ECRs in our sample have in common that they went through a PhD phase, i.e., a phase of guided research in which a mentor is involved in the definition of the problem, in the selection of methods and objects, and in the formulation of the results. Thus, while a successful PhD project is commonly expected to lead to a contribution equivalent to that of an independent scientist, this contribution is not produced independently. Except for the rare but possible cases where mentors don’t influence the work of their PhD students, the PhD is clearly part of the apprenticeship.

Twelve ECRs in our sample published the results of their PhD project. Most of them received the recognition that is common in the field (in only two cases the publications went largely unnoticed). Four ECRs had not managed to publish their PhD results four to 7 years after the PhD had been awarded.

While the occurrence of an apprenticeship can be established beyond doubt in all sixteen cases, the completion of the status passage to the colleague stage is much more difficult to establish. According to the criteria described in the previous section, seven of the 16 academics conducted independent research at the time of the interview. These researchers pursued long-term research interests or had self-selected topics after the PhD, had independently established research plans and had won external competitive grants. The following quote clearly indicates a smooth transition by framing all research following the PhD project (and possibly even the PhD project itself) as independent.

The DNA work I’d already started with different collaborators [at my previous university] and that had resulted in a publication before I even came here. But I saw there was considerable scope for continuing it. And the other aspect to it, the work on the development of [insects] under different temperature regimes I had done some work on in my PhD but again wanted to expand so the genesis of the project was in my earlier work [at my previous university] and I suppose the ideas had arisen then from recognition of what was required to really make full use of the [insects] in an [application] context. So the whole reason the Linkage project was able to be successful was that I was able to put a suitable argument forward to the Linkage partners that by carrying out this research we would be able to improve the application of the [insects] in [the application contexts].

(Biologist, Lecturer)

Except for one, they had all published results of research conducted after the PhD. Some of these publications were already cited by the national or international community. One historian was categorised as having achieved colleague status without having published

² See Gläser et al. (2004) on the emergence and importance of ‘helper’ roles in a research organisation.

results from her research following the PhD. The publication delay was ascribed to a combination of the field-specific longer duration of research and publication processes (she was writing a book) and the time pressure (see below).

We categorised six ECRs as not (yet) conducting independent research. Three of them had neither published the results of their PhD project nor anything from subsequent research, while the others had occasional publications in local journals or conference papers. A marked difference to the group categorised as independent researchers is the interest in research expressed in the interviews. Four academics expressed an interest in research but provided eclectic lists of topics and were unable to describe an underlying consistent interest that made them work on these topics.

This is difficult trying to ask me what I do. You're right. I'm trying to cover a number of areas. More specifically it's actually been a factor of taking much longer than I should have with my PhD and having to do lots of different part time jobs.

(Political scientist, Lecturer)

The two other interviewees in this group expressed little interest in research, which suggests that they are aiming for an academic career that either only consists of teaching or includes a 'helper' role, as the following quote indicates.

And if I'm left to my own devices I won't do that. I will do everything else, and then research. As I say, it's the last thing. So, having someone to work with is fantastic, because you do it for the other person as opposed to for yourself.

(Historian, Lecturer)

None of the six academics had external competitive funding (two had won a competitive faculty grant each).

The remaining three researchers could not be unambiguously categorised because of insufficient information about their research.³ None of them had published results of postdoctoral research. While none of them has held external grants, they all had secured internal competitive funding. Three of them were members of research groups which played an important role in formulating their ECRs' new topics.

Cognitive careers

In the context of the cognitive career, 'success' of an apprenticeship means that the topic of the PhD kicks off a research program by enabling the emergence of new projects from the solutions found in the PhD project. This is very common in the sciences because of the high level of specialisation. It also facilitates the transition to independent research because radical changes would require an extended learning period to acquire knowledge about a new area immediately after the PhD, and would slow down the transition.

While a continuation of the topic of the PhD would be beneficial to the ECR and appears to be the easiest way to achieve independence, it must be enabled by both the topic of the PhD (not all research topics can 'grow' this way) and by the work environment of the ECR (not all environments tolerate all topics). All of the independent ECRs build upon their PhD by further pursuing this topic and simultaneously broadening their research. They included new questions, new objects or methods, and in some cases also added new

³ The lack of data is due to the character of the study as a secondary analysis. If we had 'operationalised' our criteria *ex ante* and focused part of the interviews on them, a categorisation would have been possible.

topics to that of the PhD (see for example the biologist quoted above). One political scientist even supplemented her PhD line of research by three new topics which were either remotely or not at all connected to the PhD topic.

I applied for the fellowship so that I could explicitly add another research interest to my portfolio because I was applying for jobs in Australian politics and I was not getting short listed because, even though I had Australian politics in my thesis work and my gender politics work, nobody on the selection panels was recognising gender politics as mainstream.

(Political scientist, Lecturer)

The PhD topic was also continued by academics who had not achieved the colleague status. In their case, the continuation was clearly the result of ‘not knowing what else to do’, as in the following case of a mathematician.

[...] after I finished my PhD study I got this job ... and for most of the time I just continue my PhD studies in the research area, in the old area. Of course I tried to expand my research into other areas because sometimes you come to different countries you come to a different area and you should adjust your research to what is required in that country or in that area.

(Mathematician, Lecturer)

None of these ‘expansions’ have been successful in that they led to publications.

Four of the ECRs changed their research significantly after their PhD. Among those are the two ECRs who expressed little interest in research and ceased to conduct any in spite of their universities’ expectations. The two others were forced to leave the area in which they had accumulated expertise during their PhD phase and to enter a new field. A geologist had to adapt to the research direction of his department. He has not (yet) achieved independence. The biochemist’s careers are depicted earlier in Fig. 2. He had to radically change his topic because he couldn’t find a job in the area of his PhD. This forced him to conduct contract research for industry and hence to adapt to their interests. Owing to these changes and to his later integration into a research group that appears to set the research goals for him, he could not be unambiguously assigned the ‘colleague’ status.

Organisational careers

The organisational careers of ECRs are compared with regard to the sequences of positions and the autonomy, time for research, and resources they provide. At the time of the interviews, 15 of the ECRs held full-time teaching and research positions at their universities (one as senior lecturer, all others as lecturers). One was a postdoctoral research fellow.⁴ The number of positions held since the beginning of the PhD phase varied from two to five.

⁴ This composition cannot be taken as representative of ECRs because the selection of interviewees in the main project focused on staff in teaching and research positions. Since more than one fourth of the academic staff at Australian universities is in research-only positions (AVCC 2006), a bigger share of ECRs than represented in our sample can be expected to be in postdoctoral or other research-only positions.

The PhD phases themselves often deviated from a standard duration of 3–4 years. Eight of our ECRs had significantly longer PhD phases (from 6 up to 13 years). This was only rarely related to the cognitive aspect of the apprenticeship as described in the following quote:

In fact, my PhD took 6 years which, by Australian standards, is appallingly long and that's because I spent a lot of time, sweat, blood and tears on something that went nowhere and nothing has ever happened with it since. But, on the other hand, I learned a lot, and one of the most important lessons I learned is—I can now smell when a project is not going to work and I can walk away early. That may be the toughest thing for an experimentalist to learn because there's no course on that.

(Physicist, Senior Lecturer)

The characteristic pattern in our data is that PhD students do not manage to complete their PhD during their scholarship, or don't have a scholarship at all, and therefore need to take on positions (often as casual teachers or Associate Lecturers) to support themselves.

Well I actually obtained the associate lectureship in 19... Well it was a series of contracts actually, the first one started in 1994 and yet I'd already started my PhD by then, I think I started the PhD in 1991. And so for most of the duration of my PhD I was employed as an associate lecturer doing a lot of teaching and as a result for some years of my PhD I got virtually no research done at all because the teaching load was so heavy.

(Biologist, Lecturer)

Two respondents took also positions entirely unrelated to research. Even where academic or otherwise research-related positions were taken, the time constraints resulting from the new tasks expanded the final phase of the PhD by several years. However, extended PhD phases cannot simply be equated to longer apprenticeships. Some comments in the interviews appeared to indicate that an extended PhD phase can contain elements of the transition phase. Since our interviews did not cover the PhD phase, the possible occurrence of transitions already within that phase can only be hypothesised.

All independent ECRs except for one political scientist went through a research intensive phase before taking up their standard academic employment. In addition to five ECRs who held postdoctoral positions we found that one bioscientist took a half-time lecturer position after the PhD and thus had enough time for research. Only the seventh independent ECR, a political scientist, took her current teaching and research position immediately after her PhD phase.

This observation can be linked to the severe time problems that have been reported by all but two ECRs.⁵ When ECRs begin their work as lecturers, they face the high teaching and administration loads that are now common at Australian universities. Most of interviewees reported teaching loads of 10–12 contact hours per week, often accompanied by time-consuming administrative duties.

⁵ One of those two was the postdoctoral fellow, the other a geologist who reported a relatively low teaching load of 7–8 contact hours.

When I first came here there were three of us that were teaching the whole geology curriculum, or three and a half of us, whereas most other universities I've been to have probably at least half a dozen, eight, maybe ten staff teaching the whole curriculum. It was just 100% teaching. There was absolutely no time for research.

(Geologist, Lecturer)

The time problems of ECRs are aggravated by the need to prepare their courses for the first time. Seven ECRs reported that the time pressure eased after they had prepared their courses. Apart from the two exceptions mentioned, all ECRs experienced a period in which there was no time for research at all. This situation is reflected in the bibliometric analysis.

ECRs from all fields reported not having sufficient resources for research. But less than one third of our interviewees reported resource problems. This seems odd in the light of the general resource problems at Australian universities. However, all universities in our sample have responded to the problematic resource situation of ECRs by setting up specific grant schemes. ECRs were in some cases entitled to 'new staff grants'. Other grants for ECRs or general internal research grants were distributed on a competitive basis but had very high success rates. Thus, most ECRs could access small grants between 2,500 AU\$ and 15,000 AU\$ after being appointed by their current university. Although internal grants are usually not large enough to enable research projects because they are intended to function as 'seed' money that enables applications for 'big' external grants, seven of our ECRs used them as the sole means for funding their research. In the cases of two political scientists and one historian the internal grants were sufficient to finance research. While the internal grants significantly improved the research funding for ECRs, they did not help easing the time pressure because they do not finance teaching relief.

The autonomy for research granted by the organisation played a minor role for ECRs. Only four of them felt constrained in their decisions about research topics, in three of these cases this was due to expectations by their schools respectively research groups. Interestingly, our interviewees did not perceive the ubiquitous adaptive pressure generated by funding sources as a limitation of their autonomy. The ECRs were forced to respond to this pressure in the same ways as their colleagues in later career phases, namely by abandoning topics, turning to more applied research, 'downsizing' there projects (see Gläser and Laudel 2007 for discussions of these adaptation processes).

Discussion

In spite of the limitations produced by the small number of cases, the data analysis presented here points to two important sources of variance in career—individual interests and field differences. Australian academics might attempt to construct pure teaching careers by assuming a teaching and research position and ceasing (or not beginning) independent research. Depending on the emphasis put on research by their university, they might face severe organisational pressure (Gläser and Laudel 2007). A pure research career is also problematic because it requires a continuity of fixed-term contracts which is difficult to achieve. Thus, the dominant expectation institutionalised in the Australian university system is that of a teaching and research career, and the dominant expectation institutionalised in scientific communities is that of independent research. The second source of variations concerns fields. While our analysis emphasised a process that occurs in all community careers (the transition to independent research), field specific differences in

organisational careers were clearly visible. Postdoctoral research positions are much more common in the sciences than in social sciences and humanities, whereas independent research in the latter can be more easily achieved because the resources provided by the university often suffice. While these implications are important, larger samples of ECRs are necessary to establish field-specific properties of the transition to independent research.

We have categorised our ECRs on the basis of indicators for the conduct of independent research. This categorisation, of course, only applies to the career stage at the time of the interviews. While it is difficult to believe that a researcher might lose their status as an independent member of a scientific community, this can happen. For example, extended phases without time for research or funding could force academics to withdraw from their community's knowledge production altogether. It is therefore possible that some of the seven academics we identified as independent researchers will lose this status in the future. Conversely, it is likely that at least some of the ECRs who have not yet achieved independence may do so later in their career.

Our pilot study enables conclusions about mechanisms that transform apprentices into colleagues. If we assume that the factors that showed up most consistently in successful status passages are the most important ones, then a successful apprenticeship and a research intensive time before entering standard academic employment need to be singled out. Successful apprenticeships seem to create an interest in extending the research intensive phase with postdoctoral positions and the opportunity to do so because a strong PhD makes it more likely to get such a position. Since our information on the PhD phases was incomplete, we cannot tell whether this pattern is created by 'good researchers' (with strong motivations and abilities) or by 'good apprenticeships' (with stimulating working environments and mentoring). Probably a combination of both factors is at work.

The research intensive phase prior to standard academic employment appears to be essential because ECRs must build up a stock of results and problems on which they can draw in the initial phase of their first teaching and research position, when continuous research seems to be almost impossible due to time constraints. This is indirectly confirmed by a study that analysed the success of a mentoring program for ECRs. The study revealed that while ECRs valued the advice from mentors, they also stated that the mentoring program did not solve their main problem, namely the lack of time for research (Gardiner 1999).

Our analysis has shown that a clear alignment of cognitive, community and organisational careers is the exception rather than the rule. This is why it is difficult to locate the status passages in any of the organisational positions. They can occur in extended PhD phases, postdoctoral positions, other forms of employment, or in the first teaching and research position. Prolonged PhD phases and a series of short-term contracts may either contain the transition period or delay it for several years.

An interesting misalignment, that might be specific to Australian universities, is the relative neglect of research by universities when 'managing' their academics. Some academics in our sample were hired without having shown any sign of a successful cognitive or community career. All 16 academics faced the 'normal' teaching loads of their department regardless of the additional effort required by first-time teaching. Nevertheless, all of them are expected to build a successful research career. While the university provides special financial assistance for ECRs, they do not compromise on what has turned out to be the other serious constraint, namely time for research.

The misalignments of the three careers we observed in our pilot study reinforce a methodological point we have made. Science studies have not yet appreciated the utility of

bibliographic interviews as a research method. We believe that although we haven't used 'true' biographic interviews ourselves, we have made a strong case for this type of interview. It can be fruitfully combined with bibliometric methods, which offer a perspective on research biographies that are independent of an academic's own perspective on their career.

Conclusions

Our pilot study on ECRs has demonstrated that in order to understand the transition to independent research we need to consider a process beginning with the PhD phase, and encompassing a cognitive career, a career in a scientific community, and an organisational career. The transition usually builds on a successful PhD, whose topic is expanded and supplemented by new topics. To begin a career as an independent researcher requires more time for research than is provided by the standard academic position. Therefore, it occurs within extended PhD phases or in research-intensive phases prior to academic standard employment. It is only in exceptional cases that this transition appears to be possible under conditions of standard teaching and research employment at universities.

The importance of a research intensive period for the transition to independent research is a consequence of the growing separation of teaching from research that is occurring at Australian universities. Mechanisms such as funding cuts, teaching buy-outs by holders of external grants, and the creation of research-only positions by universities for the sake of research competitiveness has resulted in a decrease in the number of academics who are available for teaching and increased their teaching loads. Under these conditions, research biographies need to be started and nourished under research-only conditions in order to survive the nearly inevitable interruption at the beginning of standard academic employment. Evidence from our main project suggests that universities begin to hire academics with established research records for entrance positions, thereby expecting the transition from dependent to independent research to occur between the two phases for which they are responsible (PhD and academic employment). ECRs are forced to become independent researchers in an organisational career phase consisting of one or more short, fixed-term employments in which their autonomy and access to funding may be limited.

Under these conditions, the postdoctoral research phase appears to become essential not only as a means of further education in some fields but as a transitional period to independent research in all fields. The behaviour of universities indicates a 'market failure' emerging from the evaluation-based funding of university research by the government (Gläser 2007). All universities attempt to benefit from the transition period by hiring academics at the 'colleague' stage who are able to 'earn their university money', but none of them invests in facilitating the transition period by providing appropriate positions. Instead, time for establishing an independent cognitive career that has the potential to grow is implicitly relegated to a time between PhD and academic standard employment, and it is up to the ECRs to manage this phase by combining postdoctoral positions, work as research associates or research assistants, or work in positions that are not research-related at all. This creates an enormous pressure to adapt the research to the preferences of senior colleagues and funding agencies, which in turn undermines the very independence of thought academics need to achieve in this phase.

Appendix

Table A Characterisation of ECRs according to the independence of their research

ECR	Research projects after PhD		Publications*		Reception	Competitive funding		Independent research
	Personal research program					University grants	External grants	
Phys1	Yes (long-term interests)		9 journal articles		Cited	None ?	One	Yes
Phys2	Yes (long-term interests)		29 journal articles		Well cited	Several grants	Many	Yes
Geo3	Yes (long-term interests)		6 journal articles		Well cited	None	Many	Yes
Bio2	Yes		1 journal article		-	Several grants	One	Yes
Hist3	Yes		None		-	1 grant	Two	Yes
Pol1	Yes		1 textbook, 6 journal articles		Cited	Several grants	One	Yes
Pol4	Yes (long-term interests)		2 books, 5 book chapters, 3 journal articles		Cited	Several grants	Two	Yes
Pol3	No (opportunistic selection of topics)		1 journal article		Not cited	1 grant	None	No
Pol2	No (opportunistic selection of topics)		None		-	1 grant	None	No
Geo1	No (opportunistic selection of topics)		None		-	None	None	No
Hist1	No (opportunistic selection of topics)		2 journal articles, 1 book chapter		Not cited	1 grant	None	No
Hist2	No		None		-	None	None	No
Math1	No		1 journal article		Not cited	1 grant	None	No
Geo2	No (projects suggested by colleagues)		None		-	Several grants	None	? (group)
Bio1	(Not clear)		None		-	Several grants	None	? (group)
Bio3	No (projects suggested by colleagues)		2 journal articles		Not cited	None?	None	? (group)

* Conference papers excluded

Table B Characteristics of the cognitive, community and organisational careers of dependent and independent ECRs

ECR	Independent research	Productivity and perception of PhD project	Continuation of the PhD topic	Length of PhD Phase (years)	Years since PhD finished	Job positions since PhD started	Research-intensive phase after PhD	Resource needs	Resource problems	Time problems	Problems of research autonomy
Phys1	yes	High	Yes (broadened)	3	5	3	Postdoc	Low	No	Never	No
Phys2	yes	High	Yes (broadened)	6	8	3	Postdoc	High	No	First	No
Geo3	Yes	High	Yes (broadened/ new topic)	5	7	3	Postdoc	High	No	First	Nes
Bio2	Yes	High	Yes (broadened)	8	6	3	Half-time lecturer	Medium	No	First	No
Hist3	Yes	High	Yes (broadened, new object)	7	5	3	Postdoc	High	No	Always	No
Pol1	Yes	High	Yes (broadened)	ca. 3	5	2	No	Medium	No	First	No
Pol4	Yes	High	Yes (broadened/ three new topics)	ca. 4	8	4	Postdoc	Medium	Nes	First	Yes
Pol3	No	Low	Yes (broadened/ three new topics)	7	4	5	No	Low	No	First	No
Pol2	No	Low	Yes (broadened)	6	4	2	No	Low	No	Always	No
Geo1	No	Low	No (major change)	3	5	3	No	Medium	Yes	Always	Yes
Hist1	No	Low	Yes (broadened)	8	4	3	No	Medium	No	Always	No
Math1	No	Low	No (no research)	ca. 3	4	2	No	Low	No	First	No
Hist2	No	Low	No (no research)	12	7	2	No	Low	No	Always	No
Geo2	? (group)	High	Yes (broadened)	?	4	2	No	Medium	Yes	Never	No
Bio1	? (group)	High	Yes (broadened)	6	3	3	Yes	High	Yes	Always	Yes
Bio3	? (group)	High	No (major change)	7	4	4	Yes	High	Yes	First	No

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