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From apprentice to colleague

The metamorphosis of Early Career Researchers

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Abstract

While the studies of early career researchers have contributed politically important insights into factors hindering early career researchers, 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 emphasizes the transitional process. We demonstrate the usefulness of this framework with a pilot study of Australian early career researchers. Theoretically, we contend that each researcher simultaneously advances through three careers, namely a cognitive career, a career in her scientific community, and an organisational career. Under 'normal' conditions, the early career phase contains the transition from the apprentice to the colleague states in the community career. In order to capture the mechanisms underlying this transition, it is important to analyse the interactions of these careers as they unfold over time. Empirically, we demonstrate (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.

1 Beyond compassion: What is theoretically interesting about early career researchers?

In each social system there is a group that is most vulnerable, and suffers first when the system experiences stress. In the science system, Early Career Researchers (ECRs) are this group. The growing literature on their problems indicates that the entrance into an academic career is becoming a long, risky and often painful phase for many academics.

Most investigations of the early career phase have been focussed on either postdoctoral employment or all forms of employment in a fixed period of time after the PhD. Studies of the postdoctoral phase have become concerned about the increasing duration of employment in postdoctoral positions, which is caused by the lack of permanent academic positions. This trend is regarded as particularly problematic in the USA.¹ The postdoctoral period appears to turn into a ‘holding pattern’ of ‘normal’ employment for scientists who cannot find a permanent position. This trend undermines the major purpose of the postdoctoral phase, namely providing ECRs with “skills and experiences that will help foster their transition to independence” (NRC 2005: 4). A similar trend of worsening career prospects for postdoctoral researchers has been found for other countries, e.g. Australia (Thompson et al. 2001; Åkerlind 2005) and the UK (Roberts 2002, chap. 5). Some observers fear that the jam in career paths indicated by the extension of postdoctoral periods makes the best researchers choose careers outside academia (Roberts 2002: 143; NRC 2005: 1).

A second group of studies directly addresses the situation of ECRs, i.e. the phase following the award of the PhD, regardless of the form of employment. These studies identified limitations in the access to funding as a major problem for ECRs. Funding statistics in the US and Australia showed that the success rates of ECR are below average, a situation which funding agencies seem to have contributed to by raising their expectations on grant applications (NRC 2005: 102-103). A study on ECRs at Australian universities found that their success in getting external grants also depends on the motivation to do research, working conditions such as time constraints because of teaching and administrative loads, access to internal grant schemes, and integration into research teams (Bazeley et al. 1996; Grbich 1998; Bazeley 1999, 2003). Funding agencies responded to the difficulties for ECRs by introducing specific funding programmes and rules of assessment for ECR applications.

The major implicit concern underlying all studies on postdoctoral and early career researchers is that the worsening conditions affect a very important transition, namely

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 (COSEPUP 2000) and by the National Research Council (NRC 1998, 2005).

that from a dependent to an independent researcher. The studies show that ECRs and postdoctoral researchers are worried about their working conditions (particularly resources and time) and their career prospects, and rightly so. However, a major problem of this whole discussion is that it neglects the process dynamics of the transition. The empirical studies listed above apply a synchronous perspective that would be appropriate only if the transition from independent to dependent research were an event rather than a process with particular internal dynamics. They thereby focus on organisational conditions and external funding at the time of the investigation. While politically important information about the situation of ECRs can be obtained this way, this information is theoretically unsatisfying because it tells us little about the causal mechanisms that link conditions of work, the research conducted by ECRs, and the kind of knowledge they produce in this research. The independence of ECRs emerges in their research biographies as they unfold over time and is expressed in these research biographies rather than in opinions about conditions for research.

If we want to understand the transition process from dependent to independent research that is apparently taking place in the ECR phase we need to link the ECR phase to the previous PhD phase, and look at an ECR's research as it unfolds over time after their PhD. While successful grant applications are an important indicator for independent research in some fields, they do not work in others. More importantly, they are not a sufficient indicator of a successful transition if considered in isolation. To understand the mechanisms that are at work in the transition phase and the effects of increasing insecurity and prolonged postdoctoral phases on the transition requires a historical approach to the research biographies and organisational careers of ECRs.

The aims of our paper are (a) to position the ECR phase in a theoretical framework that enables a diachronic approach to the ECR phase, and (b) to demonstrate the usefulness of such a framework with a pilot study of Australian ECRs. In the following section we provide the framework that links knowledge production, positioning in scientific communities and organisational careers (2). From this framework we derive a strategy for investigating the ECR phase as a transition to independent research (3), which we apply in a pilot study that uses data from an ongoing study of Australian university research (4). The results show that the transition phase is stretched by misalignments of the three careers, and that the success of the transition is often decided upon prior to the first academic standard employment (5).

2 Theoretical approach: the three careers of a researcher

A theoretical framework to study career transition processes must be sought within organisational sociology and the sociology of science.² A career can be defined as a sequence of jobs (Otto, Call, and Spenner 1981: 3). The building block of a career, the job, is best understood as a set of work roles “that have requirements for entry, imply a set of routines that characterise the content of the work role, and provide rewards for work-role occupancy and performance” (ibid.: 16). These definitions situate jobs and careers in work organisations where employees conduct work defined by the organisation and are rewarded accordingly, a relationship that is specified in the employment contract (Simon 1991).

As general as this standard model of work organisations that underlies career theory might look, it does not apply to the production of scientific knowledge. While today most research is conducted in organisations, these organisations are not the knowledge-producing actor constellation. Scientific knowledge is produced by scientific communities, i.e. by collectivities that are usually dispersed across many countries and organisations and whose boundaries are fuzzy and fluid. The members of these communities advance a common body of knowledge by interpreting the existing knowledge, identifying gaps in that knowledge, deriving tasks for themselves filling these gaps, 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 for conduct as well as the target of contributions, i.e. it fulfils all the main functions of the work organisation except for providing salaries in exchange for the work (Gläser 2006).

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: 22-23) we distinguish four stages of an academic’s career in her 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 her 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.

² For a detailed discussion of the concept of scientific career see Gläser (2001).

All researchers can be said to go through the stage of an apprentice, which usually includes a PhD phase and possibly a subsequent postdoctoral phase. While most researchers can be assumed to reach the ‘colleague’ stage of an independent contributor, too, fewer become masters, and only very few become members of the scientific elite.

The last three stages are characterised by additional tasks and responsibilities for an independent researcher. They can therefore be difficult to distinguish from each other. The only significant change in the way research is conducted occurs when apprentices become colleagues. The brief description of a scientific community’s mode of knowledge production indicated that the members of the community define their tasks and the ways in which they are conducted autonomously. This requires 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 that is 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.

To do all this entails intellectual capabilities, experience, and a personal knowledge base. The major tool for the assessment of knowledge is prior knowledge, and a personal stock of knowledge is applied by all researchers to the tasks listed above. This personal knowledge acquisition happens along a researcher’s 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 an extending 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 particularity 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.

Each of these cognitive careers is unique. Participating in the production of scientific knowledge means to produce new knowledge. Each research process combines the previously acquired knowledge of the participating researchers, their perception of the state of the art, and the opportunities provided by the local working environment. This

combination cannot be achieved by any other constellation of researchers, knowledge, and working environments in exactly the same way (Gläser 2006: 93).

The ability of a researcher to identify and solve research problems is a necessary but not a sufficient condition for successful research. The researcher must also be given the opportunity to do so. These opportunities are provided by organisations, which provide jobs for academics. The jobs include research roles according to one of the career stages in the scientific community. Thus, organisations might want to employ apprentices, colleagues, masters, or elite members. Since the scientific community rather than the organisation is the relevant work context, the actual research that is expected is usually described in very general terms.

Thus, each researcher has an *organisational career* that consists of the sequence of their positions in one or more organisations, which they need and utilise to conduct their research. In many countries the interorganisational mobility of researchers is high because only fixed-term positions are offered to apprentices and younger colleagues. Intraorganisational mobility is low because the position in an organisation is usually linked to a specific field of expertise (Gläser 2001).

Organisations provide resources to support their employees' research and the necessary logistics for the acquisition of external funding. 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).

Figure 1 shows the basic relationships between the community career, the cognitive career and the organisational career of a researcher. The cognitive career is influenced by the community career of a researcher because knowledge acquisition as well as opportunities to conduct research, to collaborate, and to communicate partly depend on the stage of the community career and the status assigned to it. It is also influenced by the organisational career because organisations provide access to resources, and interorganisational mobility moves academics between local working environments. The community career must provide the knowledge base and reputation that are necessary to be hired by organisations, and the organisational career must provide the opportunities to pursue the community career.

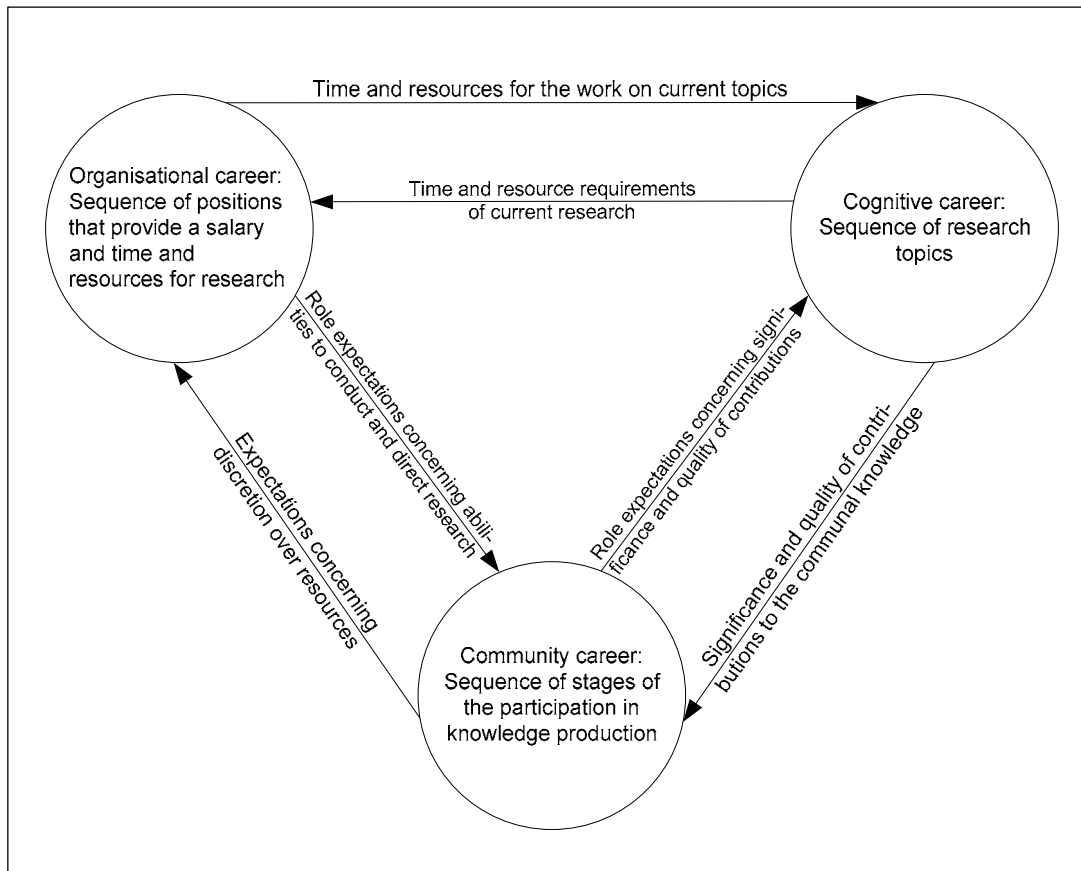


Figure 1 A researcher's three careers and their interrelations

All three careers of a researcher – the cognitive, the community and the organisational careers - must be considered when transitions between career stages are analysed. As has become clear from our discussion of the stages of the community career, the most important transition is that from the apprentice to the colleague stage. For this transition, the researcher must have acquired a knowledge base that enables the formulation of research problems and independent decisions about research, and needs the opportunities to realise them in her research.

The transition to a colleague who meets the above-described role expectations is a significant qualitative change because it implies a step into a role-set whose foremost attribute is autonomy. One of the most striking features of the scientific community is the independence of its members. As far as decisions about the content of their research are concerned, researchers are largely independent from both the organisation that employs them and their own scientific community. Colleagues are 'alone in their community' because the latter expects that they apply their own independent judgement to research problems, objects, and methods, and can conduct research under these conditions. The transition from apprentice to colleague is that from guided to autonomous research. This is an enormous challenge because at the time when this

transition is occurring the new colleague's knowledge base is still small, and they are likely to have never formulated a research question on their own. Since the transition from apprentice to colleague is difficult, the organisational career is particularly important in this phase. It usually comprises of the transition from a PhD position to an entrance position for an academic at a university.

The three careers must be synchronized in order to enable a successful transition. If they are misaligned, participation in the community's knowledge production might be delayed, or the transition might not be successful at all. The preceding theoretical considerations indicate possible reasons for such a misalignment. Firstly, the PhD phase might either not yield a knowledge base that enables independent decisions, or might not provide sufficient development of the intellectual capabilities that are required for independent research. This may lead either to an extended apprenticeship during subsequent postdoctoral employment or the beginning of the first teaching and research position at the university, or to a lengthy lonely struggle for independent research during the first post-PhD employment. Secondly, the researcher may lack either the intellectual capabilities or the motivation to conduct independent research. Thirdly, the organisational career that follows the PhD phase might not provide sufficient opportunities to conduct independent research. Finally, the researcher might already have turned from an apprentice into a colleague during an extended or a particularly successful PhD phase.

Thus, the phase that is usually referred to as ECR phase in the literature may comprise the independent research of an apprentice-turned colleague, the transition from apprentice to colleague, the last phase of apprenticeship and a subsequent transition, or continued dependent research. Keeping these possibilities in mind, we will consider the ECR phase as the one in which the transition from the apprentice stage of guided research to the colleague stage of an independent researcher is most likely to occur. From our theoretical considerations follows that in order to understand the mechanisms at work in the transition period, we need to look at the ECR's past cognitive career, at the expectations of her scientific community concerning the colleague stage and at the expectations and opportunities provided by the current organisation as well as the wider science system.

3 How to investigate the transition period? A pilot study

In the remainder of this paper we describe a pilot study in which we tested our theoretical approach and its methodological implications. The pilot study uses data collected in an ongoing investigation of the impact of evaluation based funding on Australian university research (Gläser and Laudel 2006). The aim of the pilot study is to

identify the major factors that affect the transition to independent research and, mediated through this transition, the content of research of ECRs.

Variables

From the theoretical framework outlined in the previous section follows that we need to analyse the interaction of all three careers of the ECR (figure 2). 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, albeit with support from a mentor, with her PhD. After her PhD, an ECR is expected to produce contributions of the same type on her own, thereby developing her individual research trail that is characterised by a varying degree of continuity and breadth as well as collaborations. Because of 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 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 conditions for research. From the theoretical considerations and from the literature it follows that 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. These variables describe the conditions under which an ECR conducts research when going through various positions in one or more organisations. 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 included 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, researchers acting as *mentors* might play an important role for the transition.

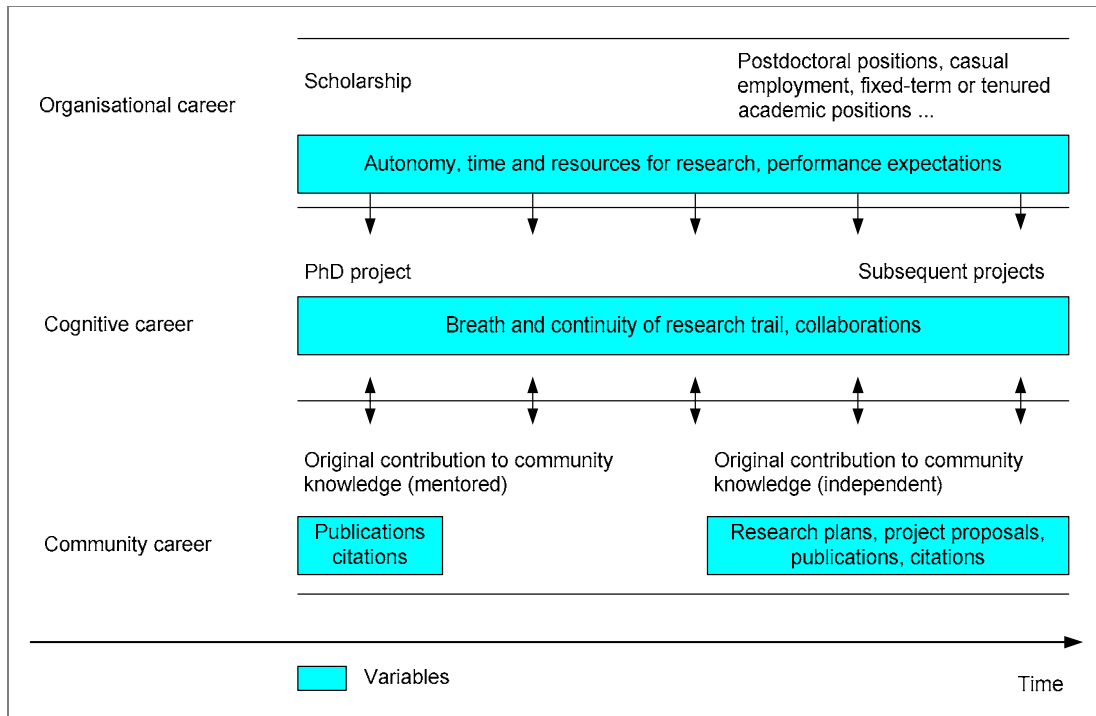


Figure 2 Variables describing the transition phase in the three careers

Case selection

In order to identify causal mechanisms, variations of causes and effects need to be observed. This requires a comparative approach. This means that in our investigation 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.

From the theoretical discussion it follows that in order to identify researchers who recently completed or are in the transition phase, we need to already know a lot about them. The transition phase from apprentice to colleague cannot be linked to a specific position in an organisation. For example, postdoctoral researchers are often assumed to be dependent because they work in a research group, where they receive ‘training’ by senior researchers. In Germany most of the young academics at universities are formally subordinated to a professor and are expected to conduct research on topics assigned to them by this professor (Enders 2001: 11). However, in neither case is it possible to draw conclusions about the actual independence of the researcher from the formal status. The mentors of postdoctoral researchers respectively the supervising professors may (and often do) grant ‘their’ younger academics full autonomy. This is particularly the case where the postdoctoral position functions as a ‘waiting position’, which might be independently funded by fellowships rather than grants awarded to others. ‘Older’ postdocs who have held several of these positions are particularly likely to have reached the ‘colleague’ stage. Thus, the difference between the limited auton-

omy formally assigned to certain positions and the actual autonomy granted to an academic in such a position makes the type of position a very imprecise indicator of the stage in the community career.

An empirical identification of ECRs is bound to use such imprecise indicators as a starting point in order to identify academics who are at least likely to be ECRs. The first academic positions in a limited time-span after the PhD are a good starting point for the search for ECRs in their transition phases. Thus, we selected from our material all interviews with academics who had finished their PhD within the previous eight years. A total of 16 interviews with so-defined ECRs from six Australian universities and six fields in the sciences, social sciences and humanities could be included (table 1).

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

Table 1 Distribution of the 16 ECRs across fields

Data collection

Most of the studies on postdoctoral and early career researchers apply quantitative approaches based on representative samples and questionnaires (Zumeta 1985; Bazeley et al. 1996; NRC 1998; Nerad and Cerny 1999; Thompson et al. 2001). This approach seems logical because studies that are aimed at assessing aspects of a national science system or targeted policies must enable conclusions concerning *all* postdoctoral or early career researchers. However, quantifying approaches can (at best) reveal causal *relationships*, while being principally unable to find causal *mechanisms* (Mayntz 2004: 237-239; Hedström 2005: 11-33). The social mechanisms that are responsible for the dynamics of academic careers in general and of the transition from dependent to independent research in particular can only be identified with a qualitative approach.

Qualitative approaches have been applied mainly for gathering expert opinions in either dedicated workshops with postdoctoral and early career researchers, and research managers (COSEPUP 2000; NRC 2005); or by qualitative interviews that supplemented quantitative studies (Bazeley et al. 1996; Nerad and Cerny 1999; Thompson et al. 2001). Only very few studies are solely based on in-depth interviews (Grbich 1998; Gardiner 1999). These approaches provided anecdotal evidence rather than systematic information on causal mechanisms.

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 pilot 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 (especially on earlier career stages) 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 sections of the interviews that are relevant for the study of ECRs are:

- research topics conducted since the interviewee joined the university and their epistemic characteristics, reasons for selecting and abandoning certain topics, collaborations;
- funding needs and funding obtained for the more recent project(s); and
- other 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 Science Citation Index, Social Science Citation Index, and Arts and Humanities Citation Index of Thomson Scientific's Institute of Scientific Information (ISI). 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 (figure 3). 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 databases were searched for citations to the publications except for political scientists and historians because the ISI databases are unsuitable for such an analysis. In these two fields we put more emphasis on the publication types (journal articles, books, and book chapters versus conference papers and unpublished reports). Additionally we searched for national and international book reviews of the PhD publication.

Data analysis

The interviews were tape-recorded, fully transcribed and analysed using a method of qualitative content analysis (Gläser and Laudel 2004). 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 3 shows an example of the career profile and the condition profile. By arranging all these information on one time-scale, interrelations between the three careers and the conditions of action could be revealed. For example, the academic whose career is depicted in figure 3 shows ‘warped’ community and organisational careers. The ‘post-doctoral phase’ began three years before the PhD was awarded. (see section 4 for a discussion of this case).

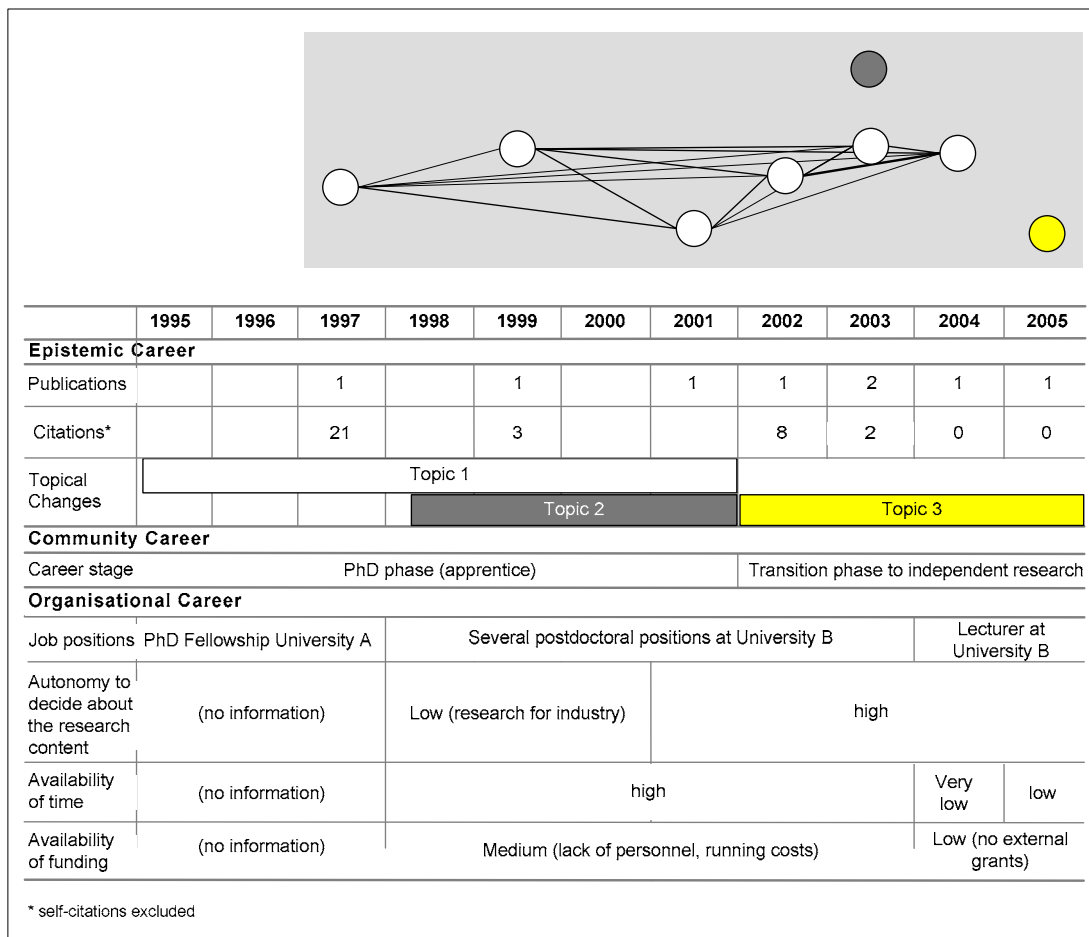


Figure 3 Career profile of a researcher and main influencing conditions (example)

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 and is usually avoided by the studies on ECRs. 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 five years for grants of the Australian Research Council (ARC 2005), six years for the US Sloan Research fellowships (Alfred P. Sloan Foundation 2006) and seven 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 five 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 five 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 the colleague stage is defined by a specific way of contributing to the community's knowledge, characteristics of the cognitive career must be used to identify the completion of the ECR's transition to independent research. Such an approach has been applied by the NRC study on early careers in the life sciences. According to this study, an independent investigator is 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).

To decide whether somebody has achieved the state of an independent researcher, we used the following indicators:

- Selection of research topics: How did the research questions after the PhD emerge? Does the ECR pursue long-term research interests or has she no clear research interests at all? Is the topic self-selected or was it suggested by colleagues/ collaborators?
- Publishing of the research following the PhD: Is it published at all? Where is 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 had been obtained in the context of the larger study in interviews with approximately 20 academics from each field and managers from the six universities.

4 Results

4.1 Cognitive and community careers

The tables in the appendix contain a summary of key information about our 16 cases. According to our criteria, 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 DNA work I'd already started with different collaborators in [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 in [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 [application contexts].

(Biologist, Lecturer)

Except for one, they had all published results of their research after the PhD. The exception is an historian, who had not yet completed publications because of the longer duration of research and publication processes in her field (she was writing a book). The publications on post-PhD research of some ECRs were already cited by the national or international community.

We categorised five ECRs as not (yet) conducting independent research. Two of them had neither published the results of their PhD project nor anything from subsequent research. Three of them had publications from post-PhD research in the form of conference papers or as co-authors of colleagues to whose research project they contributed. Furthermore, from the interviews could be concluded that two of the five had little interest in research.

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)

The other three expressed an interest in research but provided eclectic lists of topics without a common denominator.

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)

None of the five academics had external competitive funding, and only one of them had won a competitive faculty grant.

The remaining four researchers could not be unambiguously categorised because of insufficient information about their research.³ None of them had published anything on topics following the PhD project. They had no external grants but had secured internal competitive funds. Three of them (a geologist and two biologists) were members of a research group. One biologist worked on a topic suggested by his colleagues; the two other academics might have experienced similar influences by their research groups on their choice of topics. The fourth academic (a historian) was still about to publish his PhD work. He had several publications on a new topic, whose reception by the community could not yet be assessed.

Based on this positioning of our ECRs in their community career we can now look at the career dynamics. Since the transition to independent research follows the apprenticeship (PhD phase), we first look at the success of this phase. Two different kinds of success can be distinguished. In the context of the community career the PhD project should have led to a contribution to the community's knowledge at the colleague level, which is recognised as such by the community. This happened in ten of the 16 cases. Ten ECRs published the results of their PhD project in the way that is typical for their field and received recognition for their contribution. In two other cases, the results of the PhD were published but went largely unnoticed. Four ECRs had not yet published results of their PhD after a time span from four to seven years after the PhD was awarded.

In the context of the cognitive career, 'success' means that the topic of the PhD kicks off a research program by enabling new projects to emerge 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

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 categorization would have been possible.

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 topics to that of the PhD (see for example the biologist quoted above). Two political scientists supplemented the PhD line of research by new topics (three each) which were 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 so it’s like a different one because before that I was just a research student, PhD student, 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)

Four of the ECRs changed their research significantly after their PhD. Among those are the two ECRs (a mathematician and a historian) who in spite of their universities’ expectations ceased to conduct any research. The two others (a geologist and a biochemist) were forced to leave the area in which they had accumulated expertise during their PhD phase and to enter a new field. The geologist had to adapt to the research direction of his department. He did not (yet) achieve independence. The biochemist’s careers are depicted earlier in figure 3. 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. As a result of his integration into a research group, the ‘colleague’ state could not be unambiguously assigned. A comparison of these aspects of the cognitive and community careers of the 16 ECRs

shows that a successful apprenticeship and continuity of the research topic seem to be strong predictors of the success of the transition phase.

4.2 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 previously held positions varied. Five of the ECRs in our sample held two positions, eight had three, two had four and one ECR had five positions since starting their PhD work.

This summary hides a significant part of the variation between careers and thus part of the difficulties of the early career phase. The PhD phases themselves often deviated from a standard pattern of three or four years. Eight of our ECRs took significantly longer than four years (from six up to 13 years). 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)

One historian and one political scientist had to take positions that were entirely unrelated to research. But 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. These extensions of the PhD phases cannot in all cases be equated to extended apprenticeships. In some cases the new positions taken in academic environments apparently supported the transition because the ECRs went beyond the apprentice stage by developing new lines of research before the PhD was granted. Among the ECRs we categorised as independent researchers, one historian and two biologists had extended PhD phases.

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.

Six of our interviewees held postdoctoral positions between the PhD and the standard academic positions at the time of the interviews. This was to be expected given the increasing importance of postdoctoral positions after the PhD. Five of the eight ECR in the sciences did so, while in the non-science fields only one historian had a postdoctoral position after the PhD.

The observation that all ECRs who had taken postdoctoral positions prior to their current positions were independent researchers at the time of the interview made us look more closely at the time between the PhD phase and the current appointment. It turned out that except for one political scientist all independent ECRs went through such a phase. In addition to the five ECRs with postdoctoral phases we found one ECR in the biosciences who began as a half-time lecturer after the PhD and thus had enough time for research. Only one of the independent ECRs, a political scientist, took her current teaching and research position immediately after her 'normal', i.e. short 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 ten to twelve contact hours per week, often accompanied by time-consuming administrative duties.

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, and 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. However, with 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.

As could be expected from the studies quoted in the introduction, many ECRs faced not only time problems but also lacked resources for their research. Insufficient resources were reported by ECRs from all fields. Thus, resource problems that hinder research occur not only in the capital-intensive sciences but in the social sciences and humanities as well. One of the seven independent researchers (a political scientist) complained about a lack of resources regardless of her grants, the others had little

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.

problems with resources. Among the nine other academics four reported a lack of resources and five had no complaints.

In total, less than one third of our interviewees had resource problems. This seems odd given the general resource problems at Australian universities. However, all universities in our sample have responded to the problematic resource situation of early career researchers by setting up specific grant schemes. Early career researchers were in some cases entitled to 'new staff grants'. Other grants for early career researchers 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. These grants were often not large enough to enable research projects. They are intended to function as 'startup' grants by supporting applications for 'big' external grants. Seven of our ECRs used them as sole means for funding their research, nevertheless. For 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 internal grants do not support teaching buy-outs.

Only four of the ECRs reported insufficient autonomy in their decisions about research topics. In three cases the autonomy was restrained by the university. One biologist had to adapt his research to his new research group, a political scientist experienced general difficulties in getting a position with her PhD topic and therefore changed her research, and a geologist had to adapt his research to the programme of his school. The major adaptive pressure was exerted by funding sources.⁶ Like their colleagues in later career phases, ECRs were forced to abandon topics, to accommodate research councils and industry partners by turning to more applied topics, and to 'downsize' their projects, i.e. to conduct 'cheap' research (see Gläser and Laudel 2006; and Laudel 2006 for discussions of these adaptation processes).

5 Discussion

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

⁶ Interestingly, this pressure was not perceived by interviewees as a limitation of their autonomy.

achieved independence may do so in their later career. In spite of the preliminary character of our categorisation, the analysis enables conclusions about mechanisms that transform apprentices into colleagues.

If we assume that the factors that showed up most consistently in successful transitions 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 these positions. Since our information on the PhD phases was incomplete, we cannot tell whether this sequence is due to ‘good researchers’ (with strong motivations and abilities) or to ‘good apprenticeships’ (with stimulating working environments and mentoring). Probably a combination of both factors is at work. The research intensive phase prior to the academic standard employment appears to be essential because ECRs must build up substance from which they can live 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. It 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. Two major misalignments occurred. Firstly, the comparison of organisational careers has made clear that it is difficult to locate the transition period in any of the positions undertaken. The transition can occur in extended PhD phases, postdoctoral positions, other forms of employment, or in the first teaching and research position. Prolonged PhD phases and series of short-term contracts may either contain the transition period or delay it for several years. Secondly, at least until recently the hiring and employment practices of universities concerning ECRs appear to be focused entirely on teaching. Some academics in our sample were hired without having shown any sign of a successful cognitive or community career. All 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.

6 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 competitiveness let the number of academics who are available for teaching decrease and their teaching loads increase. 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 academic standard employment. Evidence from our main project suggests that universities begin to hire only 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. 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.

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Appendix

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

ECR	independent research	Selection after PhD topic	Publication of work after PhD	Publication types of after PhD topic	Publishing without PhD supervisor / First author	Citations of work after PhD	Competitive funding	
							Internal grants	External grants
Phys1	+	long-term interests	9	journal articles	yes	cited	none ?	ARC APD 2002-2004
Phys2	+	long-term interests	29	journal articles	yes	well cited	university grants	4 ARC, 3 US
Geo3	+	long-term interests	6	journal articles	yes, always first author	well cited	none	many ARC grants
Bio2	+	self-selected	1	journal articles	-	-	some grant money	1 ARC
Hist3	+	self-selected	0	-	-	-	Near Miss grant	1 American, 1 ARC Disc
Pol1	+	self-selected	7	1 textbook, articles in medium journals	yes	1 national	faculty grants	1 ARC Discovery
Pol4	+	self-selected (only partly interest)	10	2 books, book chapters, j. articles	yes	2 nat. + 2 international	some faculty grants	parliament fellowship
Pol3	-	no clear interests	0	0	-	-	New researcher grant	none
Pol2	-	no clear interests	0	-	-	-	faculty grant	none
Geo1	-	no clear interests	0	-	-	-	none	none
Math1	-	--	0	journal article	-	-	2 years ago small grant Divisional fund	none
Hist2	-	--	0	-	-	-	none	none
Geo2	? (group)	questions by collaborators	0	-	-	-	some grant money	none
Bio1	? (group)	(not clear)	0	-	-	-	divisional grants	none
Bio3	? (group)	project suggested by colleagues	2	journal articles	2 (never first author)	(not cited – pub too recent)	none?	none
Hist1	?	no new topic	3	articles in journals of medium reputation	yes	-	start-up grant	none

Table B Comparison of characteristics of the cognitive and community careers with the independence status

ECR	Independent research	Productivity and perception of PhD project	Continuation of the PhD topic	Years since PhD finished	Job positions since PhD started		research-only phase after PhD	Resource needs	Resource problems	Time problems	Problems of research autonomy
					total	not research related					
Phys1	yes	+	Yes (broadened)	5	3	0	yes	low	no	never	no
Phys2	yes	+	Yes (broadened)	8	3	0	yes	high	no	first	no
Geo3	yes	+	Yes (broadened/ new topic)	7	3	0	yes	high	no	first	yes
Bio2	yes	+	Yes (broadened)	6	3	0	yes	medium	no	first	no
Hist3	yes	+	Yes (broadened, new object)	5	3	0	yes	high	no	always	no
Pol1	yes	+	Yes (broadened)	5	2	0	no	medium	no	first	no
Pol4	yes	+	Yes (broadened/ 3 new topics)	8	4	0	yes	medium	yes	first	yes
Pol3	no	-	Yes (broadened/ 3 new topics)	4	5	1	no	low	no	first	no
Pol2	no	-	Yes (broadened)	4	2	0	no	low	no	always	no
Geo1	no	-	No (major change)	5	3	0	no	medium	yes	always	yes
Math1	no	-	No (no research)	4	2	0	no	low	no	first	no
Hist2	no	-	No (no research)	7	2	0	no	low	no	always	no
Geo2	? (group)	+	Yes (broadened)	4	2	0	no	medium	yes	never	no
Bio1	? (group)	+	Yes (broadened)	3	3	0	yes	high	yes	always	yes
Bio3	? (group)	+	No (major change)	4	4	0	yes	high	yes	first	no
Hist1	?	-	Yes (broadened)	4	3	1	no	medium	no	always	no