

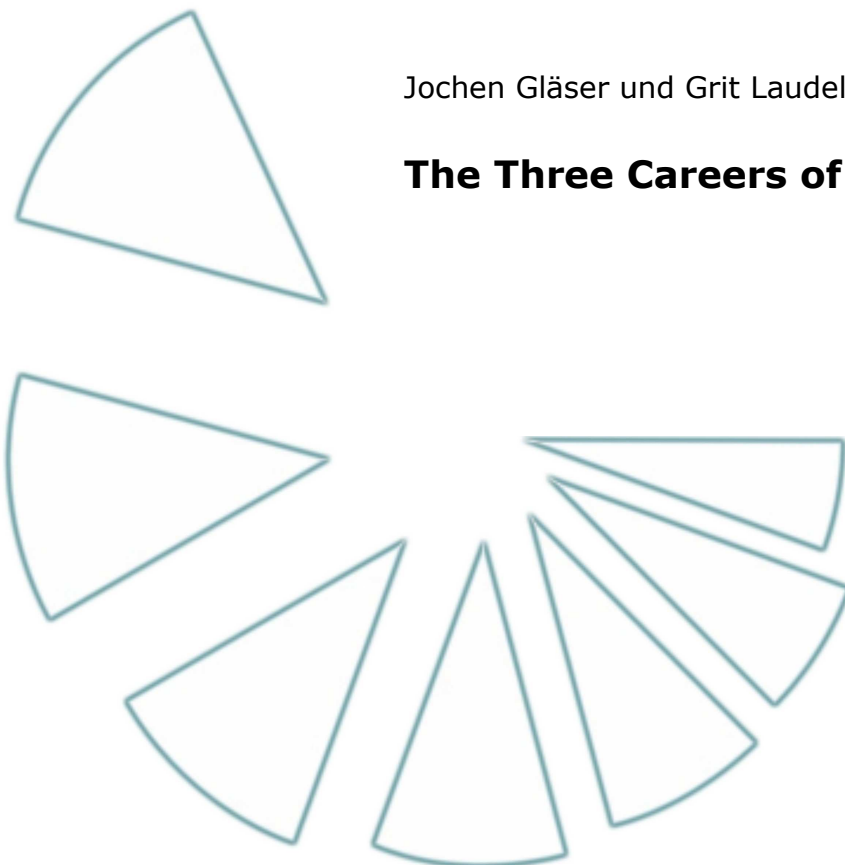
discussion paper Nr. 35/2015
09/2015

Zentrum Technik und Gesellschaft

discussion paper

Jochen Gläser und Grit Laudel

The Three Careers of an Academic



Impressum

Zentrum Technik und Gesellschaft
Sekretariat HBS 1
Hardenbergstraße 16.18
10623 Berlin
www.ztg.tu-berlin.de

Die discussion paper werden von Martina Schäfer, Leon Hempel und Dorothee Keppler herausgegeben. Sie sind als pdf-Datei abrufbar unter:

http://www.tu-berlin.de/ztg/menue/publikationen/discussion_papers/

Abstract

Academic careers differ from other careers in the role the content of work (research) plays for career dynamics and in the role of scientific communities, which are the work context and provide careers with changing work roles. These specificities surface in studies of academic careers but have not yet been systematically appraised or conceptualized. We address this problem by proposing a model that distinguishes between three interacting careers an academic goes through simultaneously, namely a cognitive career consisting of the interconnected research processes a researcher is involved with over time, a scientific community career of status positions that are associated with specific work roles, and an organizational career that consists of a sequence of organizational positions. The model "brings work back in" the understanding of academic careers, and turns the analysis of academic careers into an interdisciplinary enterprise between the sociology of science, organizational sociology, and higher education research. Two applications demonstrate that analytically separating the three careers and studying their interactions enables new research questions and answers to them.

Zusammenfassung

Akademische Karrieren unterscheiden sich von anderen Karrieren in der Rolle des Arbeitsinhaltes (Forschung) für den Karriereverlauf und in der Rolle der Fachgemeinschaften als Arbeitskontext und Quelle von Arbeitsrollen. Diese Besonderheiten scheinen in der Literatur zu akademischen Karrieren auf, ohne bislang systematisch behandelt und theoretisch gewürdigt worden zu sein. Wir schlagen zur Behebung dieses Defizits ein Modell vor, dass zwischen drei miteinander interagierenden Karrieren von WissenschaftlerInnen unterscheidet: einer kognitiven Karriere der miteinander verbundenen Forschungsprozesse, einer Karriere aus Arbeitsrollen und Statuspositionen in der wissenschaftlichen Gemeinschaft und einer Organisationskarriere als Sequenz von Beschäftigungspositionen. Das Modell „bringt die Arbeit zurück“ in die Interpretation akademischer Karrieren und verwandelt die Analyse solcher Karrieren in ein interdisziplinäres Unternehmen von Wissenschaftssoziologie, Organisationssoziologie und Hochschulforschung. Zwei Anwendungen demonstrieren, dass die analytische Unterscheidung der drei Karrieren und das Studium ihrer Interaktionen neue Forschungsfragen und Antworten möglich machen.

Table of Contents

1.	Introduction	5
2.	Similar concerns but different emphases	6
3.	Utilizing two suggestions by Stephen Barley	11
4.	Explaining the peculiarities of academic careers	13
4.1.	The content of work: Diachronic structures in research and cognitive careers	13
4.2.	The scientific community: Status-related experiences and the community career	14
4.3.	Organizations: Job-related experiences and the organizational career	16
4.4.	Interactions between the three careers	17
5.	Applications.....	19
5.1.	Becoming an independent researcher in Australia	19
5.2.	The impact of careers on opportunities for scientific innovations... ..	25
6.	Conclusions	30
	References	31

1. Introduction

Over the last four decades, higher education research, organizational sociology and science studies have paid increasing attention to academic careers. The large and fast-growing literature appears to cover most concerns of general career research including changes in career patterns caused by societal change, career success and its antecedents, work-life conflicts, gendered careers, career imprinting, and many others. Interestingly, these general questions are often operationalized in unique ways for academic careers, and some of them lead to peculiar answers. The empirical object 'academic career' appears to suggest specific research questions and to require specific approaches, both of which are not necessarily consistent with general career theory.

A consistent explanation of specific approaches to academic careers and their sometimes unusual results is still missing. Although studies of academic careers sometimes link them to general career theory, the position of academic careers in career theory remains unclear. We can be sure that academic careers constitute a somewhat specific case but still lack a systematic account of the features they share with other careers, the dimensions in which differences can best be described, and the reasons why academic careers differ from other careers in these dimensions.

With this article, we want to contribute to closing the conceptual gap between research on academic careers and career theory. Our aim is to explain the specificity of academic careers and to provide a heuristics for analysing them by drawing on two ideas (re-)introduced to career research by Barley, namely reviving conceptualizations of careers by the Chicago school (Barley 1989) and the plea for "bringing work back in" (Barley and Kunda 2001). The second suggestion leads to a new facet of career research's interdisciplinarity. "Bringing work back in" to the study of academic careers means engaging with the sociology of science and reading it as a sociology of research work.

Our argument begins with an exploration of links between research on academic careers and career theory, which leads us to the conclusion that understanding academic careers requires considering the specific content of work and its impact on the career (2). We then utilize the two suggestions by Barley (3.) to develop a model of the academic career that analytically distinguishes between the dynamics of work content, a career in scientific communities and the (inter)organizational career (4). We illustrate the potential of the model with two examples, namely Australian early career researchers' transition to independent research and the role of academic careers in the development of scientific innovations in four countries (5). Our conclusions address the possibilities of turning our heuristics into a middle-range theory and the scope of such a theory, which depends on the existence of other types of work with similar characteristics (6).

2. Similar concerns but different emphases

We begin our argument for the specificity of academic careers by exploring the links between their investigation and general career theory. For this comparison, we disregard the specific results obtained by these studies and focus on types of research questions they asked.¹

Our comparison yields three observations. First, the heuristics of general career research is applied to the investigation of academic careers. Second, exploring some questions of mainstream career research has led to quite specific answers. Third, research on academic careers highlights some features which are counter-intuitive from the perspective of general career theory.

Applying the heuristics of general career research to academic careers

The heuristics of general career research has been applied to academic careers by introducing distinctions and using perspectives from general career research in the investigation of academic careers. These include

- the distinction between objective and subjective careers (Khapova et al. 2007; for academic careers see e.g. Åkerlind 2008; Felt et al. 2013);
- relationships between work and family lives (Wolf-Wendel and Twombly 2000; Greenhaus and Foley 2007; for academic careers Ackers 2007);
- the mediation between institutions and careers by scripts, that is collectively shared frames that represent successful career paths and their requirements in a particular institutional environment (Barley 1989; Barley and Tolbert 1997; for academic careers Duberley et al. 2006; Dany et al. 2011); and
- career success (Arthur et al. 2005, for academic careers see the discussion below).

In addition, academic careers have been treated by career theorists as archetypical examples of 'boundaryless', 'protean', and other 'new' careers (Arthur and Rousseau 1996; Baruch 2004), a use that has been supported by the observation that academic careers have always had features of 'boundaryless' careers (Harley et al. 2004: 340-341; Enders and Kaulisch 2006). At the same time, the criticism of the idea of 'boundaryless' careers has been adopted in the literature on academic careers (Dany et al. 2011). Studies of academic careers suggest that a careful analysis of boundaries in and between scientific communities must supplement the perspective on organizational boundaries, and that the overemphasis on individual agency in shaping careers might better be replaced by introducing scripts as

¹ An important simplification of our analysis, which we share with most of the literature on academic careers, is its limitation to the researcher role of an academic. The simultaneous career in teaching, and the role teaching plays for academic careers, have not yet found sufficient attention.

mediating between institutional structures and individual career choices (Duberley et al. 2006; Dany et al. 2011). Changes in academic careers due to marketization and hierarchisation of universities might introduce new and reinforce existing boundaries in academic careers (Harley et al. 2004).

Specific answers to questions of general career research

Research on academic careers has produced some quite specific answers to the general concerns of career research such as the impact of earlier on later stages of a career and gender biases. In general career research, the impact of earlier on later stages of careers is discussed as "career imprinting" (Higgins 2005), by interpreting careers as "repositories of knowledge" (Bird 1994) and in studies that link mentoring, counselling and networking in earlier stages of a career to its later progress (Bozeman and Feeney 2007; Ibarra and Deshpande 2007). The 'career outcomes' of earlier stages are commonly linked to career success.

Studies of academic careers with similar interests mainly link the first stages of an academic career, the "early career phase", to later career stages. The early career phase includes the PhD and a postdoctoral phase. It usually spans a period of up to eight years after the PhD. Among the variables describing this phase, mentoring (van Emmerik 2004; Kirchmeyer 2005), networking (Casper and Murray 2005; Lam 2007) and training (Duberley et al. 2007; Lee et al. 2010) are most prominent, which is in accordance with the research on careers in general. An additional factor specific to the academic career is mobility in the early career phase (Zubieta 2009).

While the independent variables are very similar, the measurement of career success in academia significantly deviates from the approach of general career research. A review of general career research by Arthur et al. (2005) showed that a large majority of empirical studies focused on income, number of promotions, and organizational position (measured as managerial level or power within the organization) as success in the objective career (see also Ibarra and Deshpande 2007). Only few studies attempted to measure status (also a property of the objective career) or career satisfaction (a property of the subjective career). Other possible aspects of career success were not considered.

Research on the outcomes of academic careers often uses different dependent variables. With very few exceptions (one of which is Kirchmeyer 2005), salaries are not considered as a measure of career success. Being able to have an academic career at all is a very important measure of success for both the objective and the subjective career, which is why achieving a tenured position is an important indicator of success. In few cases, organizational prestige of positions is measured as prestige of departments or universities (Reskin 1979; Miller et al. 2005; Su 2013). The academic's status in the scientific community is a much more important

measure (Mumford et al. 2005; Youtie et al. 2013). In contrast to general career research, however, the most important indicator is research performance (Reskin 1979; Mumford et al. 2005; Zubieta 2009).

An important difference between academic and other careers concerns the way in which performance is measured. Both organizational and general career theory would suggest that job performance is measured in relation to organizational goals. However, common measures of research performance such as research productivity or research impact have little to do with the organization. These measures are based on the publications researchers address to their scientific communities, and on the impact these publications have (Miller et al. 2005; Zubieta 2009; Zhang and Glänzel 2012; Su 2013).

Changes in the content of work are another effect whose investigation appears to be specific to academic careers. This includes the widespread concern with research performance discussed above. In addition to this mainstream of research on the performance-wise success of academic careers, a few studies ask how earlier career phases affect what researchers do in their later work, i.e. what questions they ask and how they go about solving them. This question is indirectly addressed by Zhang and Glänzel (2012) as well as Jonkers and Tijssen (2008), whose bibliometric studies include the impact of earlier career phases on later collaboration. Lam (2007) asked how careers affect knowledge flows between research in universities and industry.

Research on academic careers has also returned specific answers to questions about gender discrimination (see e.g. Reskin 1993; Phillips 2005; Castilla 2008 for concerns in general career research). In addition to studies of gender discrimination in organizational decisions on academic careers and 'cooling out' effects of discriminating working conditions (e.g. Mählck 2001; Kraiss 2002), two specific observations have been made. First, gender discrimination has been ascribed to decision processes in scientific communities. For example, Wennerås and Wold (1997) found that women applying to the Swedish research council for grants had to document higher performance in order to have equal chances of receiving a grant. Second, researchers have identified a "productivity puzzle" (Cole and Zuckerman 1984): Women were found to publish less than men (Cole and Singer 1991; Xie and Shauman 1998), with the search for explanations apparently still ongoing. At the same time, the difference in productivity has been shown to be field-specific and on the decline (Abramo et al. 2009; van Arensbergen et al. 2012). The field-specificity of the productivity gap and of the representation of women across the academic ranks suggest that the social conditions discriminating against women systematically vary with the content of academic work.

Counter-intuitive features of academic careers

Three characteristics of academic careers look 'odd' from the perspective of general career research, namely

- the institution of tenure, which appears to exist in most national career systems and has attracted various functionalist explanations that tie the institution of tenure to the problem of recruiting new faculty members or to the necessity to guarantee the independence of research (Carmichael 1988; Siow 1998);
- the observation that postdocs, which belong to the most highly qualified segment of the work force, are being paid below the average wage in the US (Stephan 2013); and
- a reverse relationship between seniority and pay (Ransom 1993), which is caused by performance differences between younger and older faculty (Moore et al. 1998).

Another interesting counter-intuitive feature concerns the relationship between academic careers and organizations. There are phases in the academic careers that are largely independent of employment organizations. Salaries and the means for conducting research are granted by research councils, which are best considered intermediary organizations between the state and scientific communities (Braun 1998). Researchers receiving such grants work at universities but do not really depend on them and can often choose a university to work at. These grants fund an increasing number of postdoctoral positions (e.g. Jacob and Lefgren 2011) and positions for young leaders of research groups (e.g. Hornbostel et al. 2009). More generally, the transition from university block funding to a split system of block funding and project grant funding significantly increases the independence of successful researchers vis-à-vis their university (see already Greenberg 1966 on "grant swingers").

Thus, we observe phases of the academic career that are almost exclusively controlled by the scientific community. In addition, universities rely on peer review and thus on scientific communities in many of their decisions on the careers of their employees.

Two major lessons can be distilled from this brief review. First, the content of work plays a much more significant role in the analysis of academic careers, and therefore most likely in the careers themselves. Second, the scientific communities to which academics belong appear to play a stronger role than do the professions, occupational communities or communities of practice discussed in general career research. They do not only provide a social context in which "careers of achievement" occur but constantly interfere with the academics' movement through organizational positions. This is why treating them as "career communities ... from which people draw career support" (Parker and Arthur 2000: 105) or as an institutional context (Duberley et al. 2006: 1138) does not do them justice.

Although research on academic careers clearly points to these two specificities, they are not systematically addressed or conceptualized. Instead, there is a tendency either to treat academic careers as a separate phenomenon and not linking them to general career theory at all, or to subsume observations to the conceptual schemes of career theory. This leaves some interesting research questions unexplored. How does the content of academic work (specifically research) interact with institutional settings in shaping academic careers? How do careers mediate institutional influences on the content of research? How do the fluid trans-national scientific communities interact with national institutions in shaping academic careers? Answering these questions requires a wide understanding of careers and considerable attention to the content of work, which both have been suggested by Stephen Barley.

3. Utilizing two suggestions by Stephen Barley

In his account of the emergence of research on careers by the Chicago school of sociology, Barley (1989) observes that this research took off with a wide notion of 'career'. Commenting on Wilensky's (1960) criticism of this wide notion, Barley states:

Despite the benefits of the restrictions that Wilensky advocated (which, as we shall see, most modern career scholars adapt in practice, if not in theory), it is worth remembering that precision, by definition, requires narrowing and that narrowing entails loss. The critical question is whether the loss involves anything of value (Barley 1989: 45).

Barley demonstrates that the Chicago School sociologists did not reduce the concept 'career' to a movement through a series of jobs that leads to increasing status or rewards. Instead, the concept was understood to refer to "a series of statuses and clearly defined offices" (Hughes), "any social strand of any person's course through life" (Goffman), or "a series of related and definable stages or phases of a given sphere of activity that a group of people goes through in a progressive fashion (that is, one step leads to another) in a given direction or on the way to a more or less definite and recognizable end-point or goal or series of goals" (Roth) (ibid: 45-48, quotes from page 46). Barley shows that

... Hughes and his students composed their fugue-like renditions of career by weaving together four related themes: (a) careers fuse the objective and the subjective; (b) careers entail status passages; (c) careers are rightfully properties of collectives; and perhaps most importantly (d) careers link individuals to the social structure. (ibid: 49)

Career research has partly caught up with these ideas. The tradition has lived in research on professional careers (Dalton et al. 1977; Dalton 1989) and more generally on career-like progress in occupational communities (Zabusky and Barley 1996). By now, the definition of a career by Arthur et al. (1989: 8) as "the evolving sequence of a person's work experiences over time" has been widely adopted.² This definition does not limit the concept 'career' to a sequence of jobs. It does, however, limit it to work.

Does it also include work content? Although the definition is wide enough that it could, our brief review demonstrated that it does not. This observation leads us to a second important suggestion, namely to "bring work back in" studies of organizations (Barley and Kunda 2001). Barely and

² Unfortunately, the widespread use of this definition does seem to include an element of alibi. For example, Arthur himself introduces this definition (Arthur 2008: 166) only to define a "boundaryless career" as "a sequence of job opportunities that goes beyond the boundaries of any single employment setting" on the following page (ibid: 167). As the review of research on career success by Arthur et al. (Arthur et al. 2005) demonstrates, this research reduces the career to a sequence of jobs. Valcour et al. (2007) explicitly lean towards the narrow Wilensky definition in order to introduce their "customized careers". And so on.

Kunda criticize organizational theory for neglecting the content of work and list several possible payoffs of bringing work back in. One advantage is that "situated studies of work can potentially resolve puzzles that have stymied older, less well-grounded theories because they produce more concrete images of organizing." (ibid: 87) The authors demonstrate the dangers of confusing formal descriptions of work roles with the actual work content, and suggest that a focus on work might better support studies of the dynamics of organizing (ibid: 88).

"Bringing work back in" studies of the academic career may benefit from the fact that research has been the subject of extensive work place studies for more than three decades. The constructivist turn in the sociology of science has led to a wealth of ethnographic studies that analysed in great detail how scientific knowledge is produced, and how researchers interact in this production (e.g. Knorr-Cetina 1981; Lynch 1985; Latour and Woolgar 1986 [1979]; Collins 2004). Although ethnographic science studies have paid only limited attention to interactions between researchers and their organizations, they provide valuable information about the content of work, which has such a strong influence on academic careers.

4. Explaining the peculiarities of academic careers

Our proposal for a reconceptualization of academic careers responds to their specific features and to Barley's methodological recommendations. We follow the wider approach suggested by the Chicago School and define a career as a series of interconnected work situations an individual goes through. We thereby limit the concept to work but impose no other limitations. In particular, we do not limit the concept to organizational positions, a person's experiences or progression in the sense of increasing gains of whatever kind.

The definition makes it possible to analytically distinguish three different careers through which an academic moves simultaneously, namely

- a cognitive career consisting of the sequence of research processes an academic is involved in;
- a community career in their scientific communities, in which academics not only build (and lose) reputation among their peers but also move through a series of statuses and associated work roles; and
- an organizational career in the traditional sense, in which academics move through sequences of organizational positions.

From this perspective, talking about 'the academic career' does not make much sense unless the context in which the move through interconnected situations occurs – knowledge, community, or organization – is specified. We now extend the conceptualization of each of the three careers and their interaction.

4.1. The content of work: Diachronic structures in research and cognitive careers

One of the peculiarities of research, which sets it apart from most other work, is its production of and embeddedness in diachronic knowledge structures that extend throughout an academic's research biography. By diachronic knowledge structures we mean sequences of research processes that build on each other because the knowledge produced in previous research processes informs the choices of research problems and approaches in subsequent research. Research in the sciences, social sciences and humanities differs from much other organized work because it is embedded in such diachronic structures, which it simultaneously extends.

The diachronic knowledge structure that is central to the academic career emerges and operates on the individual level.³ It evolves in the course of an individual researcher's cognitive career because each research process uses and contributes to the researcher's evolving scientific knowledge, which is used in current and future research. The problem-solving processes a

³ A scientific community's shared body of knowledge might also be considered as such a diachronic knowledge structure.

researcher is involved with are interlinked through this use of previously produced knowledge in subsequent research and form 'research trails', i.e. sequences of thematically interconnected projects in which findings from earlier projects serve as input in later projects (Chubin and Connolly 1982).

These diachronic structures are different from the accumulation of knowledge that has been described for careers in professions and skilled occupations (Dalton 1989; Bird 1994; Zabusky and Barley 1996). Learning in communities of practice makes it possible to improve one's work because problems can be solved more efficiently. It does not affect the formulation of tasks or the basic inventory of approaches to solving them. The former is set by the organization, while authority over the latter is shared between organizations and professions. In contrast, researchers formulate their own tasks. They do this by interpreting their community's body of knowledge in the light of their own previous research and the approaches available to them. Their work process unfolds over time, and does so largely independently of the organization they work in (Whitley and Gläser 2014a).

Research trails do not always take the simple linear form considered by Chubin and Connolly. Researchers may simultaneously work on several different topics, i.e. have several parallel research trails (see e.g. Zuckerman and Cole 1994: 398-399; Gläser and Laudel 2007: 143). A research trail can branch out into several new trails, which are relatively independent of each other and are followed by the researcher in parallel. Research trails may also end if the researcher loses interest or does not find funding for continuing them.

Through these diachronic structures, previous research influences the choice of new research problems, as current research will – through modifying the structures – influence future choices. The evolving bodies of knowledge constitute important conditions of action for researchers.

The diachronic structure resembles a career pattern, which is why we term it cognitive career. It is covered by our definition because it is an interconnected series of research processes and thus of work situations. The content of research unfolds over time, has – at least in the perception of researchers – distinguishable stages, and is closely linked to other career experiences. For the sake of analytical clarity, we think that introducing research trails as an academic's cognitive career justified.

4.2. The scientific community: Status-related experiences and the community career

The definition of a community career as a series of interrelated reputational statuses and accompanying work roles of members of a scientific community resonates with the work on careers in professional and occupational communities. The literature on careers of professionals has already suggested that they have a second career in their professional community (Dalton et al. 1977; Zabusky and Barley 1996). Applying this

idea to scientific communities fits their strong role in academic careers better than relegating them to the context of academics' organizational careers. We consider scientific communities as social collectives in which academics have a parallel career that proceeds somewhat independently of their career in organizations.

A major difference between community careers of academics and professional careers or 'careers of achievement' of technicians stems from the fact that scientific communities are not only communities of practice but also production communities, i.e. a configuration of actors who jointly produce scientific knowledge (Gläser 2006; 2007: 247-249; 2012). Tasks emerge, collaboration occurs, and results are used in scientific communities. Consequently, academics do not only acquire reputation and go through a series of corresponding status positions in their scientific community but also have *work roles* in this community. The work roles are linked to the influence researchers have on each other's work. Community members whose scientific contributions are used by many other members have a higher reputation and status. They influence the knowledge production of others not only through their own contributions but also through their work as reviewers and advisors. In order to include the link between work role and status in a community career, we adopt a proposal by Dalton et al. (1977: 22-23) and distinguish four stages of an academic's community career:

- *apprentices* learn to conduct research while working under the direction of others;
- *colleagues* conduct independent research and contribute its results to their community's knowledge;
- *masters are colleagues* who additionally lead groups or act as a mentors for apprentices; and
- members of the *elite* additionally shape the direction of the knowledge production of their community.

All researchers can be said to go through the stage of an apprentice which is usually associated with the PhD phase and possibly a subsequent postdoctoral phase. Most researchers can be assumed to reach the 'colleague' stage of an independent contributor, which means that they can

- assess the relevance, validity and reliability of the community's body of knowledge and of the contributions offered by fellow members in their publications;
- acquire valid and reliable knowledge that is deemed relevant for their work;
- identify gaps in that knowledge and formulate research questions concerning these gaps;
- assess their capabilities and opportunities to answer these research questions;

- conduct the work that is necessary for answering the research questions, which may include collaborating with other researchers; and
- publish the results in a way they can be adopted by their scientific community.

The master and elite stages add specific tasks and responsibilities to this status, and are not reached by all community members. In many experimental science communities, the master stage includes the direction of the work of others, which usually means that the master leads a research group and realizes a research program. The elite stage is characterized by the production of scientific contributions that orient the work of a large number of community members as well as the inclusion in informal networks in which the direction of the community's research is negotiated (see for this stage Mulkay 1976; Laudel 2005).

Although the community career is described here as a vertical move through status positions, this is by no means a necessity. Reputation can be lost as well as gained, as Collins (2004) describes for one of the main proponents in a controversy about the search for gravitational waves. Researchers in the experimental sciences who lose funding and cannot maintain a group may move from the master stage back to the colleague stage. Thus, while there is vertical movement, transitions between the last three stages appear to be reversible.

4.3. Organizations: Job-related experiences and the organizational career

For the organizational career of an academic we can maintain a very narrow conceptualization and define it as a sequence of jobs (e.g. Otto et al. 1981: 3), and the job as a set of work roles "that have requirements for entry, imply a set of routines that characterize the content of the work role, and provide rewards for work-role occupancy and performance" (ibid.: 16). We just need to consider that while going through this organizational career, researchers also go through the other two careers.

The national systems of academics' organizational careers can roughly be categorized as chair systems, tenure systems and tenure-track systems. Chair systems are characterized by late tenure and an academic's formal dependence from a chair holder in the (long) period between the PhD and becoming a professor. Germany is a typical representative of the chair system. The tenure system is characterized by a short probation period, early tenure and internal promotion. This system which for example exists in the UK and Australia, features flat hierarchies. All academics are formally independent. Tenure-track system such as the US-American are based on long and rigorous probation periods before tenure might or might not be granted.

The link between organizations and academic careers is somewhat tenuous because the organization provides positions that are tied to salaries and

access to resources but has little influence on the actual definition of an academic's research task. While individual research performance is measured and many organizations try to increase the performance of their researchers, they have little influence on what is researched, how it is researched, and with whom an academic collaborates in this research. From the perspective of scientific communities, the main purpose of organizations is to equip some community members 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 is under the community's authority. This is why the work roles defined by organizational positions are rather unspecific. They leave the content of work to be specified by community work roles, and ultimately by academics themselves as they develop their cognitive career.

4.4. Interactions between the three careers

The three careers of a researcher – the cognitive, the community and the organizational careers – can be analytically separated and must be considered in their own right (i.e. with their own endogenous dynamics) when academic careers are analysed. It is not sufficient to treat the cognitive and community careers as the context of the organizational career because the organizational career may be simply a resource for researchers that enables cognitive and community careers.

Diagram 1 shows the basic relationships between the community career, the cognitive career and the organizational 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 organizational career because organizations provide access to resources, and interorganizational mobility moves academics between local working environments. The community career must provide the knowledge base and reputation that are necessary to be hired by organizations, and the organizational career must provide the opportunities to pursue the community career.

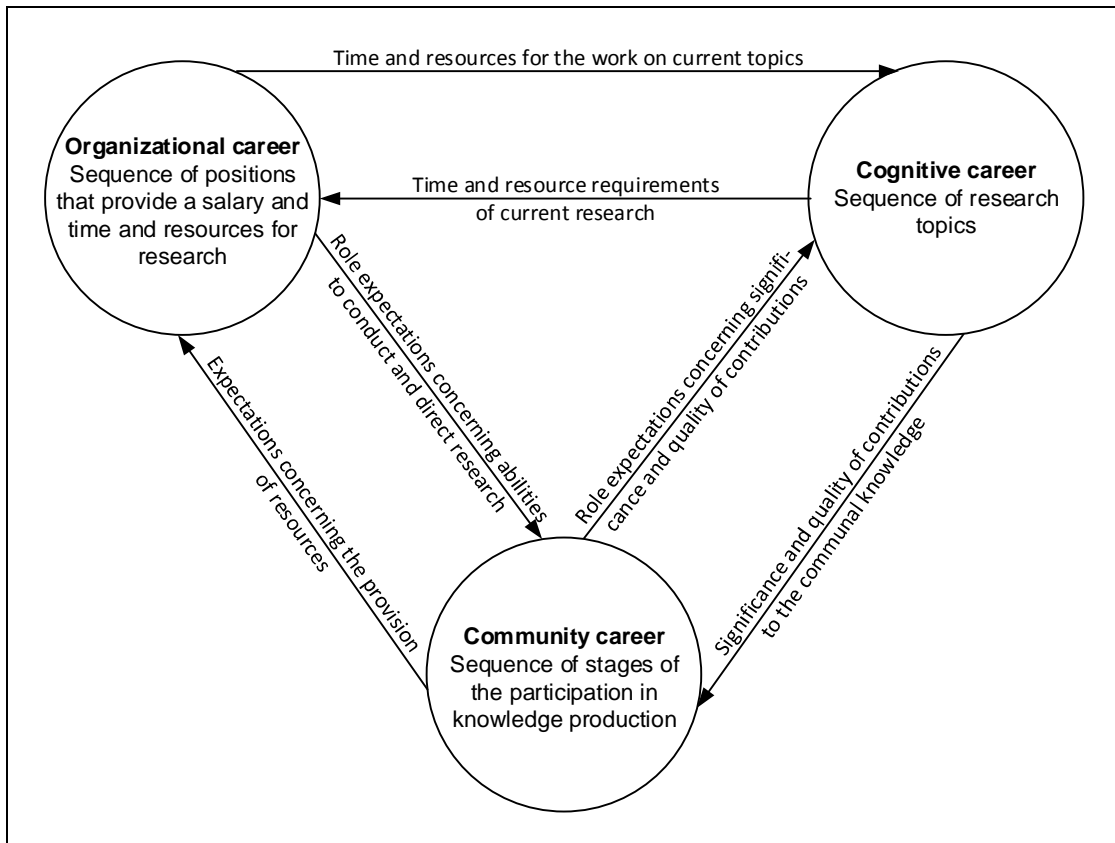


Diagram 1 A researcher's three careers and their interrelations

The three careers coincide in the decisions of researchers. Researchers constantly reflect their position in the three careers and consider the other two careers when making a decision on one of them. This link is most prominent between the cognitive and organizational careers, where the anticipation of one career's development usually affects decisions on the next step in the other.

5. Applications

In this section, we present two applications of our conceptual approach. In both cases, investigating the relationship between the three careers was crucial for answering research question about the impact of institutional conditions on the content of research. We operationalized our conceptual approach by reconstructing the cognitive and organizational careers and presenting visualizations of these careers to researchers in semi-structured interviews about their careers and research conditions. The reconstruction of cognitive careers is based on a bibliometric analysis of the interviewees' oeuvres (see Gläser and Laudel 2015 for a description of the method). Diagram 3 in section 5.2 shows examples of the pictures presented to interviewees, a simplified version of which is also included in the analytical scheme in Diagram 2 in the following section.

5.1. Becoming an independent researcher in Australia

Our discussion of the community career suggests that the transition from the apprentice to the colleague stage is the most important status passage and change of work roles in the community career. It includes the move from guided to autonomous research, which is associated with becoming a full member of the community. As far as decisions about the content of their research are concerned, researchers are largely independent of 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 that they can conduct research under these conditions.

This transition poses a major challenge to all would-be colleagues. For it to be successful, researchers must have reached a stage of their cognitive career at which the acquired knowledge base and abilities enable independent decisions about research, and a stage of their organizational career that provides them with opportunities to realize these decisions. This is often problematic because a researcher's knowledge base is still limited when the transition is expected, and most researchers have never formulated a research question on their own. The organizational career is particularly important in this phase. It usually includes the transition from a PhD or postdoctoral position to an entrance position for an academic at a university.

Against this background, the increasing concern about the early career phase becomes understandable. Studies of the postdoctoral phase have discovered an increase in the duration of postdoctoral employment, which is caused by the lack of permanent academic positions (Stephan and Levin 2001), (Roberts 2002), (Åkerlind 2005), NRC (2005), (Puljak and Sharif 2009), (Müller 2014). Early Career Researchers (ECRs) have below-average success rates when applying for research grants, a situation which funding agencies seem to have contributed to by raising their expectations on grant applications (Bazeley et al. 1996; NRC 2005: 102-103).

The studies listed above have been conducted from the traditional organizational perspective and therefore missed dynamic interactions between cognitive, community and organizational careers. We therefore conducted a pilot study in order to explore how the situation of Australian ECRs would look like if the alignment of organizational, cognitive and community careers was taken into account (Laudel and Gläser 2008).

We conducted the study as a secondary analysis of interviews with ECRs that were conducted in a larger project on the impact of funding conditions on Australian university research (Gläser and Laudel 2007; Gläser et al. 2010). We selected interviews with Australian academics who completed their PhD up to eight years before the interview. A total of 16 academics from Physics (2), Mathematics (1), Biochemistry (3), Geology (3), Political Sciences (4), and History (3) met this criterion.

We reconstructed the cognitive, community and organizational careers of each researcher from the interview and bibliometric data, assessed the status of the academic, and identified factors in the three careers and in their interaction that promoted and hindered the transition to independent research. Information on the progress of the three careers was organized in chronological schematics that enabled their simultaneous assessment (Diagram 2).

The following short description of the three careers presents the results concerning the status passage in the community career and patterns in the cognitive and organizational careers that are characteristic of successful and delayed transitions to independent research.

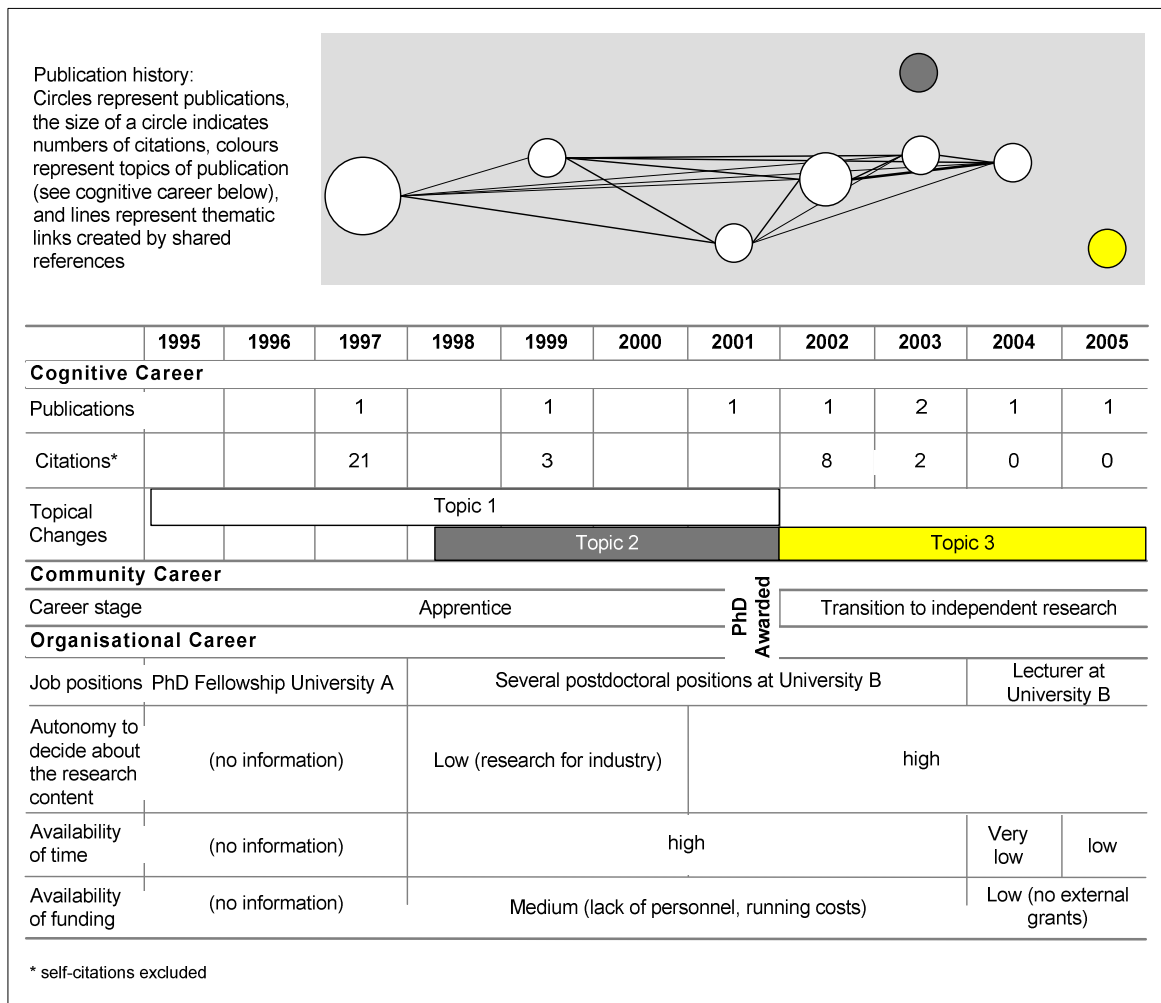


Diagram 2 Career profile of a researcher and main influencing conditions (example)

Status passage in community careers: Only seven of the 16 academics could be categorized as conducting independent research at the time of the interview (Table 1). These researchers either had made autonomous decisions about new research topics during or after their PhD-phase. They all had won external competitive grants, which means that their independently designed research projects found the approval of their scientific communities. The following example describes the emergence of research plans at the 'colleague' level:

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)

We categorized five ECRs as not (yet) conducting independent research. Two of them had not yet published the results of their PhD project or any subsequent research findings. The three others have minor publications (in local journals, as conference papers, or as co-authors of colleagues to whose research project they contributed). We concluded from the interviews 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)

<i>Category (number of cases)</i>	<i>Fields</i>	<i>Distinctive attributes</i>
Independent research (7)	Physics, Geology, Biology, History, Political Science	Long-term research interests or self-selected topics after the PhD, publication of post-PhD results, external funding
Dependent research or no research (5)	Geology, Mathematics, History, Political Science	Few or zero publications of PhD and post-PhD research, no consistent research plans, no external funding
Ambiguous cases (4)	Geology, Biology, History	Inconsistent publication record, internal grants, closely integrated in research groups

Table 1 Categorization of ECRs according to the independence of their research

The remaining four researchers could not be unambiguously categorized. The interviews did not provide enough information about their research because the interviewees did not volunteer it, and the focus of the main study prevented us from probing deeper.

We can explain our findings on the dynamics of the community career (success and failure of the transition from apprentice to colleague) by the dynamics of the other two careers and their interaction.

Cognitive careers: In the context of the cognitive career, 'success' of a PhD means that the topic of the PhD leads to new research. All ECRs who were independent at the time of the interview built 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 added new topics to that of the PhD.

The PhD topic was also continued by two academics who had not achieved colleague status for lack of any alternative research ideas. Two other ECRs who have not achieved the colleague stage largely ceased to conduct research, and the fifth experienced an externally enforced change of his topic because he had to adapt to the research profile of his department, and has not yet achieved independence after the radical change.

Organizational careers: The most important channel through which organizational careers affected the transition to independent research was the provision of time for research. Organizational careers varied significantly with regard to the sequence of positions taken for the PhD-phase. Eight of our ECRs took significantly longer than the expected four years (from six up to 13 years). In most cases, PhD students who had these extended PhD phases did not manage to complete their PhD during their scholarship, or did not have a scholarship. These ECRs had to take on positions to support themselves. Many of them worked as casual teachers or Associate Lecturers. The time constraints resulting from these tasks expanded the final phase of the PhD by several years. These extensions of the PhD phases did not in all cases prolong the apprenticeships. Some comments in the interviews suggested that an extended PhD phase can contain elements of the transition to independent research.

After completing their PhD, all but one of the independent ECRs went through a research-intensive phase – organizational positions in which research was the only work role – before taking up the standard academic employment. This observation can be linked to the severe time problems that have been reported by most ECRs on standard teaching and research positions. When Australian ECRs begin their work as lecturers, they are confronted by high teaching and administration loads, which are common at most Australian universities. Most interviewees in the main study from which our sample was drawn reported teaching loads of ten to twelve contact hours per week, often accompanied by time-consuming administrative duties. These time problems were aggravated for new lecturers who had to develop all their courses at once. As a result, the 14 ECRs who reported time problems said that at the beginning of their work in standard teaching and research positions they had virtually no time for research at all. Successful ECRs managed to continue publishing on the basis of research results accumulated in their research intensive time before the standard employment.

Contrary to the picture drawn by previous studies, only less than one third of our interviewees described resource problems. We found two possible reasons for this, which are difficult to differentiate. First, universities tended to invest in the research base of their ECRs. Most ECRs could access small grants after being appointed by their current university. Instead of funding

whole research projects, these grants were intended as 'start-up' grants that support bids for 'big' external grants. Nevertheless, seven of the ECRs that were categorized as not independent or as ambiguous cases used them as sole means for funding their research. This indicates a possible second reason for the lack of complaints about the research base. ECRs might have adopted their research aspirations to their funding opportunities by doing 'small research' with 'small grants'.

Interactions between careers: Two conditions are of particular importance for the transition from apprentice to colleague. The condition produced by the *cognitive career* is a PhD topic that can serve as the beginning of a research trail (by generating new research problems and being expandable). This appears to be the most important (albeit not a necessary) condition for a successful transition. In the *organizational career*, a research-intensive time in which a sufficient stock of knowledge can be built up seems to be crucial because at the beginning of the first academic standard position there is almost no time for research at all.

Our analysis shows that a clear alignment of cognitive, community and organizational careers is the exception rather than the rule. The variety of precarious positions that need to be taken in order to 'cover' the final stage of the apprenticeship and the transition period produces a major misalignment of community and organizational careers. The colleague state to which ECRs are expected to move requires time horizons and resources for independent research, which simply didn't exist for several interviewees. Another misalignment of community and organizational careers is due to the universities' disregard for the requirements of the transition period. Several academics in our sample were recruited without having shown any sign of a successful cognitive or community career. Furthermore, universities provide special financial assistance for their ECRs but do not compromise on what has turned out to be the most serious constraint, namely time for research.

These misalignments demonstrate that the phase that is usually referred to as ECR phase in the literature may comprise four quite different stages of the community career, namely

- the independent research of an apprentice-turned colleague;
- the transition from apprentice to colleague;
- the last phase of an apprenticeship and a subsequent transition; or
- continued dependent research.

Without taking into account the three careers of a researcher and their possible misalignments, studies of ECR are bound to analyse a mixture of these stages, which makes findings difficult to interpret.

It has also become clear that the three careers of an academic relate to the transition to independent research in entirely different ways. The cognitive career consists of an accumulation of knowledge and abilities that will at

some point enable independent research regardless of an academic's organizational position and status in the community. The community mostly 'looks from afar' by judging contributions regardless of the support an academic had in producing them. However, when academics appear at conferences or are drawn into new collaboration, their status will soon be revealed, and interactions with them adjusted accordingly. Finally the organizational career as it is currently designed does not systematically take into account the transition phase. If it would, the transition phase would be supported by guaranteeing research time at the beginning of the standard employment. As it currently stands, the organizational career sends apprentices out and takes colleagues in without providing favourable conditions for the status passage from one into the other.

5.2. The impact of careers on opportunities for scientific innovations

The second example is part of an internationally comparative analysis of the impact of changing authority relations on conditions for scientific innovations. We asked how the changing structures and processes of governance modified the relative authority of actors over the choice of research problems and thus the opportunities for researchers to develop innovations in their field. The project compared these conditions in four countries for one innovation each from the physical sciences, life sciences, social sciences, and humanities.⁴ The results of the project are described in several chapters in Whitley and Gläser (2014b).

Our example is taken from the analysis of an innovation in physics, namely the experimental realization of Bose-Einstein Condensation in cold atom gases (see Laudel et al. 2014b for a full account of the study). Bose-Einstein Condensation (BEC) is a state of matter that occurs when gases of atoms or subatomic particles are cooled to near absolute zero. This state had been theoretically predicted by Bose and Einstein in 1924. In 1995, two US groups produced the first BECs. It took more than two years before other research groups were able to replicate the experiments. When they succeeded, it soon turned out that BEC can be used for a wide range of fundamental research in several subfields of physics, and BEC research grew rapidly. However, until the early 2000s, researchers who wanted to produce a BEC faced significant technical and strategic uncertainties and needed considerable resources for the experiment to succeed.

⁴ For methodological reasons, our study did not concentrate on the actual innovation but rather included the early diffusion of the innovation in different national science systems. Innovations are likely to emerge in just one country, which is why an internationally comparative study of the emergence of innovations would have required finding similar innovations emerging in the countries under investigation at approximately the same time. This is close to impossible. Since the early development of an innovation poses similar problems as the actual invention in terms of contradicting the community's majority opinion, access to resources, and reputational risks, the early stages of diffusion were used and enabled comparisons of national science systems for the same innovation.

In the following, we discuss the impact of authority relations on cognitive careers by comparing two researchers who wanted to begin research on BEC. One of them could immediately realize this intention, while the other's move to BEC research was considerably delayed.

The interviews began by presenting a printout of the picture representing the interviewees' cognitive and organizational careers (Diagram 3).⁵ In the first part of the interview, physicist 1 described the development of his research, beginning with his PhD research (cluster I). During his postdoc, he learned a new method which still belonged to the field of his PhD. He then moved on to another field (cluster II) but abandoned this work because he saw no future in it. At the same time, physicist 1 (as many other later BEC researchers) had followed the international development and learned new techniques of laser cooling, which are important for producing BECs (cluster III).

A: That's why it is finished here (*pointing at cluster II*). I saw no future in that field. And similar things happened [elsewhere] there is not much continuing. It is more or less a completed field.

Q: Is it just saturated?

A: Yes it is just saturated. And that's what you have to do, you stop. ... And I started to do laser cooling. And you can see that slowly the laser cooling field took over. And then I stopped this (*pointing at cluster II*) and I continued further on that (*pointing at cluster III*).

Inspired by the promising results and the eventual first experimental success of US groups, the researcher intended to move his research in this new direction. Cluster III contains both the use of laser cooling methods that was not yet directed at BEC and the subsequent work on BEC. Clusters III and IV (publication 5 and 4) are thematically connected, one being the production of a BEC (III), the other the use of a BEC in other research (IV).

⁵ Interviews were conducted in English. Omissions and changes that are necessary for privacy protection are marked by [brackets], other cuts by "...". For reasons of privacy protection we disguised the names of topics and publication titles as well as positions and locations.

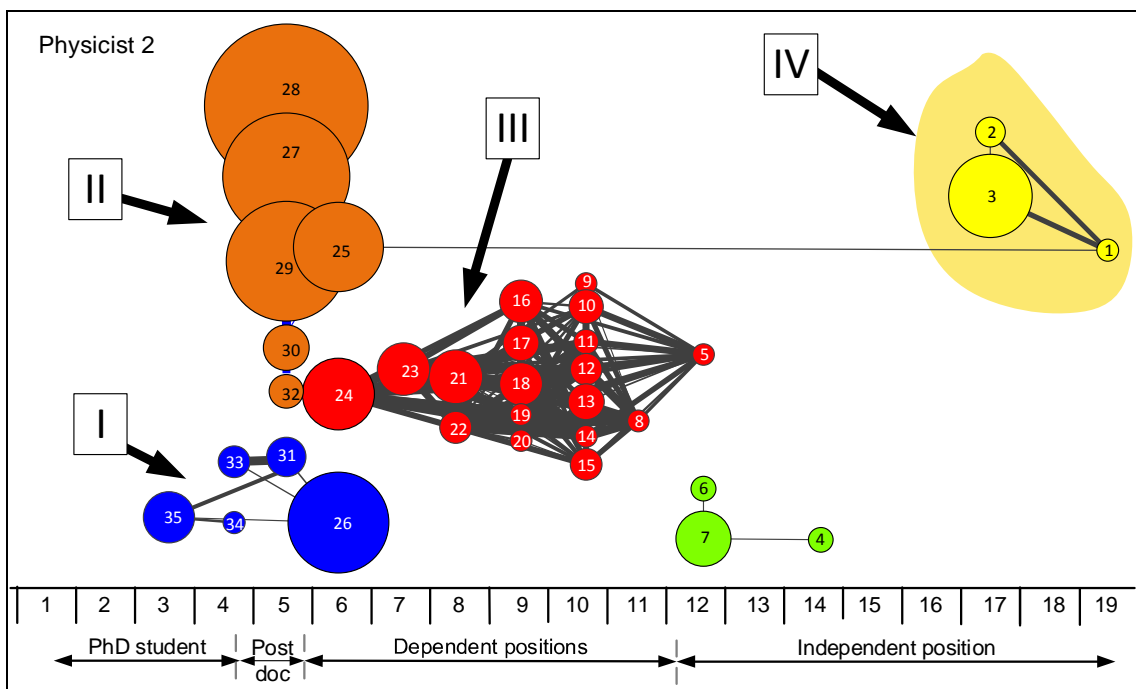
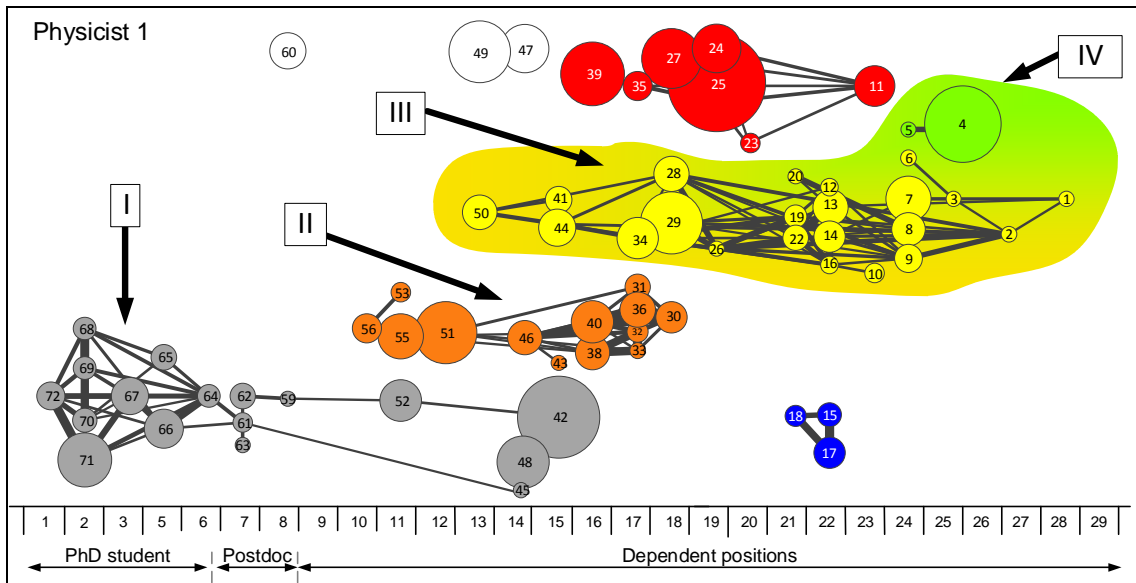


Diagram 3: Cognitive and organizational careers of two researchers who moved to the innovation BEC immediately (Physicist 1) and with a delay of nine years (Physicist 2).⁶

Overall, the cognitive career of physicist 1 was shaped by opportunities to follow his interests when beginning and abandoning research trails after the PhD. This looks surprising given his organizational career, which consisted of dependent positions that did not grant him the right to decide autonomously

⁶ The sizes of circles indicate numbers of citations, colours indicate thematically different clusters. The widths of lines indicate the strengths of thematic connections. Numbers in circles link publications to a publication list.

on research topics. However, the second part of the interview revealed that although physicist 1 was formally dependent on his professor, this professor tolerated the plan to begin BEC research and granted the interviewee the use of infrastructure. The interviewee could mobilize the necessary additional funding for specific equipment and personnel first by 'bootlegging' money from other projects and later through grants specifically awarded for BEC research.

The second BEC researcher described a cognitive career that was markedly different. Physicist 2 moved from his PhD topic (cluster I), which was different from BEC research, to research that was directly relevant for BEC and could have developed into his own BEC research trail (cluster II). However, he abandoned this research and worked on a different topic (cluster III). He felt unable to compete with groups abroad, not least because he could not secure the considerable resources he would have needed:

A: If I would have had the opportunity to start a fully independent research group with the clear understanding that I would be completely on the same scale with these groups, things might have been different. ... The investment necessary to do something close to identical to what was present at [the successful BEC groups in the US] would have required more than €500,000, perhaps closer to €1 million, several junior people and several years of investment. This is not a scale where a junior person can start. I did not have the scientific muscle to bring about such a major effort.

He continued his career with dependent positions in research groups whose leaders had other interests than BEC research and whose infrastructure he could not utilize for his interest in BEC. Only when he could secure an independent position and obtained external research grants, he could begin the long-planned BEC work.

A: At that time I was really at the point where this [...] idea could take shape, start my own line of research, students that I guided from the start. So I started with one university-funded PhD student. I applied for funding for a second one. This was granted. Then one could really speak of a team and the setup was built. And this is the effort that is depicted here in yellow (*pointing at cluster IV*).

Thus, this interviewee's BEC research started with an unintended delay of several years. It then took him several years to produce a BEC, apply it to answer an interesting question and to publish the results. This led to a gap of two years in which he didn't publish. The university supported the move towards BEC by tolerating the lack of publication output for several years.

Taken together, interviews with BEC researchers enabled the identification of authoritative agencies with veto powers concerning the necessary conditions for changes of the cognitive career. Researchers who wanted to develop the innovation BEC needed to simultaneously control the infrastructure of a laboratory at the university, acquire external grants,

have access to PhD students and work in an environment that tolerated publication delays of several years. Only if all these conditions were met, the work with the scientific innovation was likely to be successful.

This example demonstrates an impact of organizational careers on the content of research. Other case studies in the same project included organizational careers that prevented changes of research topic or enabled changes but prevented the success of new research trails (Laudel et al. 2014a; Laudel et al. 2014b). The example presented here also demonstrates that sometimes looking at organizational careers is not enough because the formal position does not provide enough information about the work-related interactions in the organization.

6. Conclusions

Academic careers differ from other careers in the role the content of work (research) plays for the career dynamics and in the role of communities, which are the work context and provide careers with changing work roles. These specificities surface in studies of academic careers but have not yet been systematically appraised or conceptualized. We addressed this problem by proposing a model that distinguishes between three interacting careers an academic goes through simultaneously, namely a cognitive career consisting of the interconnected research processes a researcher is involved with over time, a community career of status positions that are associated with specific work roles, and an organizational career that consists of a sequence of organizational positions. The model “brings work back in” the understanding of academic careers, and turns the analysis of academic careers into an interdisciplinary enterprise between the sociology of science, organizational sociology, and higher education research.

Two applications demonstrated that analytically separating the three careers and studying their interactions enables new research questions and answers to them. In particular, careers turn out to be an important phenomenon that mediates between the institutional conditions of research and the diachronic structures that emerge in the production of scientific knowledge. Studying academic careers is therefore an indispensable part of investigations of institutional influences on the content of research.

How can the proposed model of three interacting careers be turned into a middle-range theory? A theory could be developed by linking specific conditions for careers to specific career patterns, and through them to career outcomes in form of specific scientific knowledge. Constellations of conditions, career patterns, and outcomes can be expected to vary between both scientific fields and national career systems. Further research would also need to include teaching as a second major work role of academics at universities. The teaching role positions academics in different communities, and appears to be linked to universities more strongly than the research role. Thus, there is a superposition of forces at work here, and looking at the academic career only within the context of research roles is an analytical simplification that needs to be overcome by future research.

Finally, it will be interesting to see which other careers belong to the class we claimed for academic careers, namely the class of careers built around diachronic structures of work, in which previous work has a stronger influence on current work than the current organization. The so-called creative industries, and the arts more generally, might be a good place to start looking.

References

- Abramo, Giovanni, CiriacoAndrea D'Angelo and Alessandro Caprasecca (2009). Gender differences in research productivity: A bibliometric analysis of the Italian academic system. *Scientometrics* 79(3): 517-539.
- Ackers, Louise (2007). Legislating for Equality? Working Hours and Progression in Science Careers *European Law Journal* 13(2): 169-185.
- Åkerlind, Gerlese S. (2005). Postdoctoral Researchers: Roles, Functions and Career Prospects, and Development. *Higher Education Research & Development* 24(1): 21-40.
- Åkerlind, Gerlese S. (2008). Growing and developing as a university researcher. *Higher Education* 55(2): 241-254.
- Arthur, Michael B. (2008). Examining contemporary careers: A call for interdisciplinary inquiry. *Human Relations* 61(2): 163-186.
- Arthur, Michael B., Douglas T. Hall and Barbara S. Lawrence (1989). Generating new Directions in Career Theory: the Case for a Transdisciplinary Approach. In Michael B. Arthur, Douglas T. Hall and Barbara S. Lawrence (eds.), *Handbook of career-theory*, Cambridge: Cambridge University Press, 7-24.
- Arthur, Michael B., Svetlana N. Khapova and Celeste P. M. Wilderom (2005). Career success in a boundaryless career world. *Journal of Organizational Behavior* 26(2): 177-202.
- Arthur, Michael B. and D.M. Rousseau (1996). Introduction: The Boundaryless Career as a new Employment Principle. In Michael B. Arthur and D.M. Rousseau (eds.), *The Boundaryless Career: A new Employment Principle for New Organizational Era*, New York: Oxford University Press, 3-17.
- Barley, Stephen R. (1989). Careers, identities, and institutions: The legacy of the Chicago School of Sociology. In Michael B. Arthur, Douglas T. Hall and Barbara S. Lawrence (eds.), *Handbook of Career Theory*, New York: Cambridge University Press, 41-66.
- Barley, Stephen R. and Gideon Kunda (2001). Bringing Work Back In. *Organization Science* 12(1): 76-95.
- Barley, Stephen R. and Pamela S. Tolbert (1997). Institutionalization and Structuration: Studying the Links between Action and Institution. *Organization Studies* 18(1): 93-117.
- Baruch, Yehuda (2004). Transforming careers: from linear to multidirectional career paths: Organizational and individual perspectives. *Career Development International* 9(1): 58 - 73.

- Baruch, Yehuda (2013). Careers in academe: the academic labour market as an eco-system. *Career Development International* 18(2): 196-210.
- Bazeley, Pat, Lynn Kemp, Kate Stevens, Christine Asmar, Carol Grbich, Herb Marsh and Ragbir Bhathal (1996). *Waiting in the Wings: A Study of Early Career Academic Researchers in Australia*, Australian Research Council.
- Bird, Allan (1994). Careers as repositories of knowledge: A new perspective on boundaryless careers. *Journal of Organizational Behavior* 15(4): 325-344.
- Bozeman, Barry and Mary K. Feeney (2007). Toward a Useful Theory of Mentoring: A Conceptual Analysis and Critique. *Administration & Society* 39(6): 719-739.
- Braun, Dietmar (1998). The role of funding agencies in the cognitive development of science. *Research Policy* 27(8): 807-821.
- Carmichael, Lorne H. (1988). Incentives in Academics: Why is There Tenure? *Journal of Political Economy* 96(3): 453-472.
- Casper, Steven and Fiona Murray (2005). Careers and clusters: analyzing the career network dynamic of biotechnology clusters. *Journal of Engineering and Technology Management* 22: 51-74.
- Castilla, Emilio J. (2008). Gender, Race, and Meritocracy in Organizational Careers. *American Journal of Sociology* 113 (6): 1479-1526.
- Chubin, Daryl E. and Terence Connolly (1982). Research Trails and Science Policies. In Norbert Elias, Herminio Martins and Richard Whitley (eds.), *Scientific Establishments and Hierarchies*, Dordrecht: Reidel, 293-311.
- Cole, Jonathan R. and Burton Singer (1991). A Theory of Limited Differences: Explaining the Productivity Puzzle in Science. In Harriet A. Zuckerman, Jonathan R. Cole and John T. Bruer (eds.), *The Outer Circle*, New York: W W Norton & Company, 277-340.
- Cole, Jonathan R. and Harriet A. Zuckerman (1984). The Productivity Puzzle: Persistence and Change in Patterns of Publication of Men and Women Scientists. *Advances in Motivation and Achievement* 2: 217-258.
- Collins, Harry M. (ed.) (2004). *Gravity's Shadow - The Search for Gravitational Waves*. London, The University of Chicago Press.
- Dalton, Gene (1989). Developmental views of careers in organizations. In Michael Arthur, Douglas Hall and Barbara Lawrence (eds.), *Handbook of career-theory*, Cambridge: Cambridge University Press, 89-109.
- Dalton, Gene W., Paul H. Thompson and Raymond L. Price (1977). The four stages of professional careers - a new look at performance by professionals. *Organizational Dynamics* 6(1): 19-42.

- Dany, Françoise, Severine Louvel and Annick Valette (2011). Academic careers: The limits of the 'boundaryless approach' and the power of promotion scripts. *Human Relations* 64(7): 971-996.
- Duberley, Joanne , Laurie Cohen and Elspeth Leeson (2007). Entrepreneurial Academics: Developing Scientific Careers in Changing University Settings. *Higher Education Quarterly* 61(4): 479-497.
- Duberley, Joanne, Laurie Cohen and Mary Mallon (2006). Constructing Scientific Careers: Change, Continuity and Context. *Organization Studies* 27(8): 1131-1151.
- Enders, Jürgen and Marc Kaulisch (2006). The binding and unbinding of academic careers. In Ulrich Teichler (ed.) *The Formative Years of Scholars*, London: Portland Press, 85-96.
- Felt, Ulrike, Judith Igelsböck, Andrea Schikowitz and Thomas Völker (2013). Growing Into What? The (Un-)disciplined Socialisation of Early Stage Researchers in Transdisciplinary Research. *Higher Education* 65(4): 511-524.
- Gläser, Jochen (2006). *Wissenschaftliche Produktionsgemeinschaften. Die soziale Ordnung der Forschung*. Frankfurt a. M.: Campus.
- Gläser, Jochen (2007). The social orders of research evaluation systems. In Richard Whitley and Jochen Gläser (eds.), *The Changing Governance of the Sciences: The Advent of Research Evaluation Systems*, Dordrecht: Springer, 245-266.
- Gläser, Jochen (2012). How does Governance change research content? On the possibility of a sociological middle-range theory linking science policy studies to the sociology of scientific knowledge. *The Technical University Technology Studies Working Papers, TUTS-WP-1-2012*, Berlin, Technical University Berlin.
- Gläser, Jochen, Stefan Lange, Grit Laudel and Uwe Schimank (2010). The Limits of Universality: How field-specific epistemic conditions affect Authority Relations and their Consequences. In Richard Whitley, Jochen Gläser and Lars Engwall (eds.), *Reconfiguring Knowledge Production: Changing authority relationships in the sciences and their consequences for intellectual innovation*, Oxford: Oxford University Press, 291-324.
- Gläser, Jochen and Grit Laudel (2007). Evaluation without Evaluators: The impact of funding formulae on Australian University Research. In Richard Whitley and Jochen Gläser (eds.), *The Changing Governance of the Sciences: The Advent of Research Evaluation Systems*, Dordrecht: Springer, 127-151.
- Gläser, Jochen and Grit Laudel (2015). A Bibliometric Reconstruction of Research Trails for Qualitative Investigations of Scientific Innovations. *Historical Social Research - Historische Sozialforschung* 40(3): 299-330.

- Greenberg, D. S. (1966). Grant Swinger: Reflections on Six Years of Progress. *Science* 154(3755): 1424-1425.
- Greenhaus, Jeffrey H. and Sharon Foley (2007). The intersection of work and family lives. In Hugh Gunz and Maury A. Peiperl (eds.), *Handbook of career studies*, Thousand Oaks: Sage, 131-152.
- Harley, Sandra, Michael Muller-Camen and Andrey Collin (2004). From Academic Communities to Managed Organisations: The Implications for Academic Careers in UK and German Universities *Journal of Vocational Behavior*: 329-345.
- Higgins, Monica (2005). *Career imprints: Creating leaders across an industry*. San Francisco: Jossey-Bass.
- Hornbostel, Stefan, Susan Böhmer, Bernd Klingsporn, Jörg Neufeld and Markus von Ins (2009). Funding of young scientist and scientific excellence. *Scientometrics* 79: 171-190.
- Ibarra, Herminia and Prashant H. Deshpande (2007). Networks and identities. Reciprocal influences on career processes and outcomes. In Hugh Gunz and Maury A. Peiperl (eds.), *Handbook of career studies*, Thousand Oaks: Sage, 268-282.
- Jacob, Brian and Lars Lefgren (2011). The impact of NIH postdoctoral training grants on scientific productivity. *Research Policy* 40(6): 864-874.
- Jonkers, Koen and Robert J. W. Tijssen (2008). Chinese researchers returning home: Impacts of international mobility on research collaboration and scientific productivity. *Scientometrics* 77(2): 309-333.
- Khapova, Svetlana N., Michael B. Arthur and Celeste P. M. Wilderom (2007). The subjective career in the knowledge economy. In Hugh Gunz and Maury A. Peiperl (eds.), *Handbook of career studies*, Thousand Oaks: Sage, 114-130.
- Kirchmeyer, Catherine (2005). The effects of mentoring on academic careers over time: Testing performance and political perspectives. *Human Relations* 58(5): 637-660.
- Knorr-Cetina, Karin (1981). *The Manufacture of Knowledge: An Essay on the Constructivist and Contextual Nature of Science*. Oxford: Pergamon Press.
- Krais, Beate (2002). Academia as a Profession and the Hierarchy of the Sexes: Paths out of Research in German Universities. *Higher Education Quarterly* 56(4): 407-418.
- Lam, Alice (2007). Knowledge networks and careers: Academic scientists in industry-university links. *Journal of Management Studies* 44(6): 993-1016.

- Latour, Bruno and Steve Woolgar (1986 [1979]). *Laboratory Life: The Construction of Scientific Facts*. Princeton: Princeton University Press.
- Laudel, Grit (2005). Migration Currents among the scientific elite. *Minerva* 43: 377-395.
- Laudel, Grit, Martin Benninghoff, Eric Lettkemann and Elias Håkansson (2014a). Highly Adaptable but not Invulnerable: Necessary and Facilitating Conditions for Research in Evolutionary Developmental Biology. In Richard Whitley and Jochen Gläser (eds.), *Organizational Transformation And Scientific Change: The Impact Of Institutional Restructuring On Universities And Intellectual Innovation*, Bingley, UK: Emerald Group Publishing Limited, 235-265.
- Laudel, Grit and Jochen Gläser (2008). From apprentice to colleague: the metamorphosis of Early Career Researchers. *Higher Education* 55: 387-406.
- Laudel, Grit, Eric Lettkemann, Raphaël Ramuz, Linda Wedlin and Richard Woolley (2014b). Cold Atoms – Hot Research: High Risks, High Rewards in Five Different Authority Structures. In Richard Whitley and Jochen Gläser (eds.), *Organizational Transformation And Scientific Change: The Impact Of Institutional Restructuring On Universities And Intellectual Innovation*, Bingley, UK: Emerald Group Publishing Limited, 203-234.
- Lee, Hsing-fen, Marcela Miozzo and Philippe Laredo (2010). Career patterns and competences of PhDs in science and engineering in the knowledge economy: the case of graduates from a UK research-based university. *Research Policy* 39(7): 869-881.
- Lynch, Michael (1985). *Art and Artifact in Laboratory Science: A Study of Shop Work and Shop Talk in a Research Laboratory*. London: Routledge & Kegan Paul.
- Mählck, Paula (2001). Mapping Gender Differences in Scientific Careers in Social and Bibliometric Space. *Science, Technology, & Human Values* 26(2): 167-190.
- Miller, C. Chet, William H. Glick and Laura B. Cardinal (2005). The allocation of prestigious positions in organizational science: accumulative advantage, sponsored mobility, and contest mobility. *Journal of Organizational Behaviour* 26: 489-516.
- Moore, William J., Robert J. Newman and Geoffrey K. Turnbull (1998). Do Academic Salaries Decline with Seniority? *Journal of Labor Economics* 16(2): 352-366.
- Mulkay, Michael (1976). The Mediating Role of the Scientific Elite. *Social Studies of Science* 6(3-4): 445-470.

- Müller, Ruth (2014). Postdoctoral Life Scientists and Supervision Work in the Contemporary University: A Case Study of Changes in the Cultural Norms of Science. *Minerva* 52(3): 329-349.
- Mumford, Michael D., Mary Shane Connelly, Ginamarie Scott, Jazmine Espejo, Laura M. Sohl, Samuel T. Hunter and Katrina E. Bedell (2005). Career Experiences and Scientific Performance: A Study of Social, Physical, Life, and Health Sciences. *Creativity Research Journal* 17(2-3): 105-129.
- NRC (National Research Council) (2005). *Bridges to Independence: Fostering the Independence of New Investigators in Biomedical Research*. Washington: The National Academies Press.
- Otto, Luther B., R.A. Call Vaughn and Kenneth I. Spenner (1981). *Design for a study of entry into careers*. Lexington, Mass.: Lexington Books.
- Phillips, Damon J. (2005). Organizational Genealogies and the Persistence of Gender Inequality: The Case of Silicon Valley Law Firms. *Administrative Science Quarterly* 50(3): 440-472.
- Puljak, Livia and Wallace D. Sharif (2009). Postdocs' perceptions of work environment and career prospects at a US academic institution. *Research Evaluation* 18(5): 411-415.
- Ransom, Michael R. (1993). Seniority and Monopsony in the Academic Labor Market. *The American Economic Review* 83(1): 221-233.
- Reskin, Barbara (1993). Sex Segregation in the Workplace. *Annual Review of Sociology* 19: 241-270.
- Reskin, Barbara F. (1979). Academic sponsorship and scientists' careers. *Sociology of Education* 52: 129-140.
- Roberts, Sir Gareth (2002). *Set for Success: The Supply of People with Science, Technology, Engineering and Mathematics Skills*. London, HM Treasury.
- Siow, Aloysius (1998). Tenure and Other Unusual Practices in Academia. *The Journal of Law, Economics & Organization* 14(1): 152-173.
- Stephan, Paula (2013). How to exploit postdocs. *BioScience* 63(4): 245-246.
- Stephan, Paula E. and Sharon G. Levin (2001). Career stage, benchmarking and collective research. *International Journal of Technology Management* 22(7-8): 676-687.
- Su, Xuhong (2013). The Impacts of Postdoctoral Training on Scientists' Academic Employment. *Journal of Higher Education* 84(2): 239-265.
- Valcour, Monique, Lotte Bailyn and Maria Alejandra Quijada (2007). Customized careers. In Hugh Gunz and Maury A. Peiperl (eds.), *Handbook of career studies*, Thousand Oaks: Sage, 188-210.

- van Arensbergen, Pleun, Inge van der Weijden and Peter van den Besselaar (2012). Gender differences in scientific productivity: a persisting phenomenon? *Scientometrics* 93(3): 857-868.
- van Emmerik, I.J. Hetty (2004). The more you can get the better - Mentoring constellations and intrinsic career success. *Career Development International* 9(6): 578-594.
- Wennerås, C. and A. Wold (1997). Nepotism and Sexism in Peer-review. *Nature* 387(6631): 341-343.
- Whitley, Richard and Jochen Gläser (2014a). The Impact of Institutional Reforms on the Nature of Universities as Organisations. In Richard Whitley and Jochen Gläser (eds.), *Organizational Transformation and Scientific Change: The Impact of Institutional Restructuring on Universities and Intellectual Innovation*, Bingley, UK: Emerald Group, 19-49.
- Whitley, Richard and Jochen Gläser (eds.). (2014b). *Organizational Transformation and Scientific Change: The Impact of Institutional Restructuring on Universities and Intellectual Innovation*. Research in the Sociology of Organizations. Bingley, UK, Emerald Group
- Wolf-Wendel, Lisa E. and Susan Twombly (2000). Dual-Career Couples: Keeping Them Together. *The Journal of Higher Education* 71 (3): 291-321.
- Xie, Yu and Kimberlee A. Shauman (1998). Sex differences in research productivity: New evidence about an old puzzle. *American Sociological Review* 63(6): 847-870.
- Youtie, Jan, Juan Rogers, Thomas Heinze, Philip Shapira and Li Tang (2013). Career-based influences on scientific recognition in the United States and Europe: Longitudinal evidence from curriculum vitae data. *Research Policy* 42(8): 1341-1355.
- Zabusky, Stacia and Stephen R. Barley (1996). Redefining success: Ethnographic observations on the careers of technicians. In Paul Osterman (ed.) *Broken Ladders: White-Collar Careers in Transition*, Cambridge: Cambridge University Press, 185-214.
- Zhang, Lin and Wolfgang Glänzel (2012). Where demographics meets scientometrics: towards a dynamic career analysis. *Scientometrics* 91(2): 617-630.
- Zubieta, Ana F. (2009). Recognition and weak ties: is there a positive effect of postdoctoral position on academic performance and career development? *Research Evaluation* 18(2): 105-115.
- Zuckerman, Harriet and Jonathan R. Cole (1994). Research Strategies in Science: A Preliminary Inquiry. *Creativity Research Journal* 7(3-4): 391-405.

Bisher veröffentlichte discussion paper des ZTG

- Nr. 01/02 Susanne Schön, Dorothee Keppler, Brigitte Geißel: Gender und Nachhaltigkeit. Sondierung eines unübersichtlichen Forschungsfeldes.
- Nr. 02/02 Alexander Peine, Rainer Haase, Hans-Liudger Dienel: Prozessevaluation – Evaluation der interdisziplinären Zusammenarbeit im Rahmen der Forschergruppe Sentha.
- Nr. 03/02 Martina Schäfer: Kundenvielfalt erfordert Marktvielfalt – Eine Untersuchung der Potenziale von vier verschiedenen Bioeinkaufsformen.
- Nr. 04/02 Heike Walk: Global Governance – Hoffnung und Ernüchterung in der internationalen Klimapolitik.
- Nr. 05/03 Susanne Schön: Co-operation Management as a Part of Engineering Education.
- Nr. 06/03 Leon Hempel, Eric Töpfer: On the Threshold to Urban Panopticon? Objectives and Results of the "Urbaneye" Project on the employment of CCTV in Europe.
- Nr. 07/03 Dörte Ohlhorst: Der Weg ist das Ziel... Radfernwanderwege als nachhaltige Verknüpfung kontrastreicher Regionen.
- Nr. 08/03 M. Schophaus, H. L. Dienel, C. F. von Braun: Von Brücken und Einbahnstraßen. Aufgaben für das Kooperationsmanagement interdisziplinärer Forschung.
- Nr. 09/03 Leon Hempel, Hans-Liudger Dienel: Tele City Vision –Perceptions of ICT and its Impacts on City Competition.
- Nr. 10/03 Martina Schäfer, Benjamin Nölting, Lydia Illge: Zukunftsfähiger Wohlstand. Analyserahmen zur Evaluation nachhaltiger Wohlstandseffekte einer regionalen Branche.
- Nr. 11/04 Gabriele Wendorf, Doris Felbinger, Bettina Graf, Sabine Gruner, Helga Jonuschat, Olaf Saphöster: Von den Qualitäten des Wohnumfeldes zur Lebensqualität? Das Konzept des „Atmosphärischen“ als Ausgangspunkt einer integrierten Theorie.
- Nr. 12/04 Susanne Schön, Benjamin Nölting, Martin Meister: Konstellationsanalyse. Ein interdisziplinäres Brückenkonzept für die Technik-, Nachhaltigkeits- und Innovationsforschung.
- Nr. 13/04 Jörg Potthast, Hans-Liudger Dienel: „Die Zeiten des natürlichen Fortschritts sind vorbei.“ Verkehrssicherheit als Gegenstand von Forschung und Politik. Vertiefung der SMARTBENCH-Teilstudie Frankreich.
- Nr. 14/04 Achim Brunnengräber, Kristina Dietz, Bernd Hirschl, Heike Walk: Interdisziplinarität in der Governance-Forschung.
- Nr. 15/05 Elke Baranek, Corinna Fischer, Heike Walk: Partizipation und Nachhaltigkeit. Reflektionen über Zusammenhänge und Vereinbarkeiten.

- Nr. 16/05 Dorothee Keppler: Nachhaltigkeitskompetenzen. Zur Bedeutung geschlechtsspezifischer Kompetenzunterschiede für eine nachhaltige Technikentwicklung.
- Nr. 17/05 Tina Boeckmann, Pamela Dorsch, Frauke Hoffmann, Dörte Ohlhorst, Ulrike Schumacher, Julia Wulff: Zwischen Theorie und Praxis. Anregungen zur Gestaltung von Wissenschafts-Praxis-Kooperationen in der Nachhaltigkeitsforschung.
- Nr. 18/05 Benjamin Nölting, Tina Boeckmann: Struktur der Land- und Ernährungswirtschaft in Brandenburg und Berlin – Anknüpfungspunkte für eine nachhaltige Regionalentwicklung.
- Nr. 19/05 Hans-Liudger Dienel: Grupy nieprofesjonalnych planistów i opinie mieszkańców. Nowa metoda uczestnictwa mieszkańców na przykładzie opracowania projektu dla jednej dzielnicy Berlina (Übersetzung Bürgergutachen „Zukunft Sparrplatz“ der Senatsverwaltung für Stadtentwicklung Berlin 2001).
- Nr. 20/05 Adina Herde: Kriterien für eine nachhaltige Ernährung auf Konsumentenebene.
- Nr. 21/05 Christin Wemheurer, Jens Eitmann: Coaching in der ökologischen Landwirtschaft.
- Nr. 22/05 Dorothee Keppler: Zur Evaluierung integrativer Arbeitsmarktkonzepte für Menschen mit Benachteiligungen.
- Nr. 23/06 Benjamin Nölting: Die Politik der Europäischen Union für den ländlichen Raum. Die ELER-Verordnung, nachhaltige ländliche Entwicklung und die ökologische Land- und Ernährungswirtschaft.
- Nr. 24/06 Dorothee Keppler, Eric Töpfer: Die Akzeptanz und Nutzung erneuerbarer Energien in der "Energierregion" Lausitz.
- Nr. 25/07 Benjamin Nölting, Dorothee Keppler, Birgit Böhm: Ostdeutschlandforschung trifft Nachhaltigkeitsforschung - fruchtbare Spannungsfelder für die Entwicklung neuer Perspektiven in Ostdeutschland.
- Nr. 26/08 Dorothee Keppler: "Das persönliche Engagement derer, die hier sind, das ist doch das eigentlich Wertvolle". Die Bürgerausstellung als Forum für die Stimmen von BürgerInnen zur Zukunft der Energierregion Lausitz.
- Nr. 27/08 Benjamin Nölting: Social-ecological research for sustainable agriculture and nutrition.
- Nr. 28/08 Christine Dissmann, Nina Gribat, Benjamin Nölting: Bilder des Wandels – Wandel der Bilder. Analysen zu Ostdeutschland.
- Nr. 29/09 Leon Hempel, Michael Carius & Carla Ilten: Exchange of information and data between law enforcement agencies within the European Union.
- Nr. 30/09 Benjamin Nölting, Silke Reimann, Carola Strassner: Bio-Schulverpflegung in Deutschland. Ein erster Überblick.

- Nr. 31/11 Jochen Gläser, Grit Laudel: Life with and without coding. Two methods of early-stage data analysis in theory-guided qualitative research.
- Nr. 32/12 Safaa Mohajeri, Daphne Reim, Martin Schönberg: Umgang mit den Herausforderungen der Existenzgründung.
- Nr. 33/12 Benjamin Nölting, Martina Schäfer, Carsten Mann, Eva Koch: Positionsbestimmungen zur Nachhaltigkeitsforschung am Zentrum Technik und Gesellschaft.
- Nr. 34/13 Martina Schäfer, Dorothee Keppler: Modelle der technikorientierten Akzeptanzforschung. Überblick und Reflexion am Beispiel eines Forschungsprojekts zur Implementierung innovativer technischer Energieeffizienz-Maßnahmen.